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BENZENE AND OTHER VOCs RESEARCH IN FOUNDARIES WITH LOST FOAM TECHNOLOGY

FINAL REPORT 2019

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1. PREAMBLE

In the first half of 2017, different complaints were received in the Basque Government (Spain) regarding "bad smells" in the municipality of Durango (Spain). The Vice-Ministry of Environment of the Basque Government carried out a campaign to measure and control the air quality of Durango with a GC-MS mobile unit. One of the work areas was to carry out several Volatile Organic Compounds (VOC) characterization campaigns through a mobile unit provided with a GC-MS chromatography equipment between October 2017 and December 2018, given that the VOC analysis showed values of Benzene that were higher than those ranges measured in other areas of the Basque Autonomous Community (Spain), and very close to the limit values in air quality.

Throughout the study of characterization of the pollutants that possibly generated the discomfort of smell, abnormal values of benzene, toluene, styrene and xylene (BTSX) were detected. Subsequently, after conducting a research, the sources of origin of the BTSX were found in two foundries in the area; both foundries used a lost foam process for the elaboration of their pieces. Thanks to an analysis on the quality of the air and on the emissions (chimney) of these foundries, it was concluded that in both cases, the lost foam process was the cause for the high BTSX rates in the area.

Finally, not so much because of the smell problem, but because of the parallel discovery of high BTSX emissions, the study lasted for a year. This report summarizes the data and conclusions obtained and, along with its annexes, it provides a review of the environmental impact of lost foam technology.

2. AREA OF THE RESEARCH

The research has been located in the area of Durango (Spain), which is a town located in the north of Spain, in the Basque Autonomous Community. Durango occupies an open space on the left bank of the Ibaizabal River. To the Southside, it is a small compressed and faulted anticline with almost vertical layers. This has given rise to a ridge that continues towards the East across the mountains, situated in a limestone massif with several karst formations.

Durango experienced a steady demographic growth from 1940 onwards, when numerous industrial enterprises were set up in the surrounding area. However, business expansion tailed off during the 1980s' recession. The population increased mainly because of the arrival of immigrants from the rural areas of what is called Durangaldea (Durango and the surroundings), from the coastal regions of Bizkaia, and particularly from other regions. This explains the youthfulness of Durango's age pyramid. The population of Durango is around 28.229 inhabitants.

Image 1. Durango town (Basque Autonomous Community in Spain).

Durango is a large services town, strategically located in the middle of the geography of the Basque Autonomous Community. It has a large industrial sector engaged mainly in foundry and tool manufacture. Concretely, in the area of Durango there are 20 metal companies that are regulated and controlled by local and regional governments.

3. AIR QUALITY CONTROL NETWORK OF THE BASQUE GOVERNMENT

The Air Quality Control Network of the Basque Government is an instrument to control and monitor pollution levels in the Basque Autonomous Community (Spain) that complies with the obligation of the Autonomous Communities to assess the quality of air in their territory. This Network has analyzers and sensors that measure the pollutants established by the air quality regulations, mainly sulfur dioxide (SO2), nitrogen oxides (NO and NO2), tropospheric ozone, carbon monoxide (CO), benzene and suspended particles (PM10 and PM2.5). In addition, meteorological parameters such as wind speed and direction, temperature, relative humidity, pressure, radiation and precipitation are measured.

The Air Quality Control Network consists of stations that are arranged throughout the Basque territory (Spain), there are currently 53 stations, of which 14 belong to industrial activities. These stations allow the measurement of background contamination in natural conditions, air quality in urban areas and also industrial environments. In general they are classified according to the area where they are: rural, urban or suburban, and according to the origin of the pollution that has been detected: traffic, industry or fund (when it is a mixture of various sources).

In addition to fixed stations in the Network, mobile equipment is also available to carry out indicative campaigns in different parts of the territory. There are currently 3 mobile vans and a mobile trailer with automatic analyzers and 3 mobile laboratories that measure pollutants of another nature.

This mobile equipment enables the discovery and monitoring of the air quality in a specific place and time in order to design an action plan if necessary. In addition to traditional pollutants, it can measure volatile organic compounds or heavy metals, among others.

Besides automatic measurements that take place in real time, in the Network, there are also manual measurement points for some contaminants whose analysis is performed in the Public Health Laboratory. These measurements are conducted through manual PM10 sensors whose samples (filters) are transferred to the laboratory where they are analyzed according to the corresponding reference methods. Samples last 24 hours, so data is obtained daily. The pollutants that are measured in this way and regulated according to the current air quality legislation are As, Cd, Ni, Hg, Pb and Benzo(a)pyrene.

More information here: http://www.euskadi.eus/informacion/la-red-de-control-de-calidad-del-aire/web01-a2ingair/es/#64

4. RESEARCH WORKING GROUP.

In order to carry out the present study, this Vice-Ministry of the Environment has created a specialised Working Group formed by the Air, Inspection and IPPC Services and the Public Health Laboratory of the Basque Government.

The Public Health Laboratory of the Department of Public Health of the Basque Government has also been integrated into this group. Apart from being a reference laboratory for the Network, it provides assistance for its technical competence in measuring pollutants of different nature (VOCs, PAH, metals, etc.). It has the ENAC accreditation that guarantees the technical competence for tests in the area of environmental chemistry, among others. It is the job of this Laboratory to develop and maintain a high level of scientific and technological innovation in the analysis of the environmental field, also by collaborating in different studies and research projects.

Moreover, the Chemical Technologies for Environmental Sustainability Group (TQSA), from the Department of Chemical Engineering of the Faculty of Science and Technology (ZTF-FCT) of the Public University of the Basque Country (UPV) has also collaborated with the group by offering expert chemical and environmental advice.

5. CAMPAIGNS TO CONTROL VOLATILE ORGANIC COMPOUNDS AND BSTX IN DURANGO.

In the first half of 2017, different complaints were received in the Basque Government regarding “bad smells” in the municipality of Durango. The Vice-Ministry of Environment of the Basque Government created a Working Group and carried out some campaigns along the area of study to measure and control the air quality. In order to clarify the organic contamination in the area of Durango town, the Working Group decided to study, measure and analyze with a GC-MS mobile two area of the town affected by two metal foundry industries. Along this study and in order to maintain the confidentiality of the companies, they will be named INDUSTRY 1 and INDUSTRY 2.

It should be noted that these foundry companies do not have benzene-toluene-styrene in their raw materials, nor do they manipulate them in secondary processes, but after the analysis carried out by the Working Group on the lost foam process that they use, it is concluded that **the expanded polystyrene (used as a model for parts in some foundries) decomposes thermally when the melt is cast into the mould, and this process generates benzene-toluene-styrene emissions into the atmosphere.**

Therefore, the study has focused on the INDUSTRY 1 and INDUSTRY 2 companies, which use this lost foam technology process for the elaboration of their product. The actions carried out during the period 2017-2018 have been focused on identifying and understanding the processes causing the emission of benzene, characterising the levels of immission in the environment and finally assessing the corrective measures to be applied. These actions were as follows:

- VOC measurement campaigns during winter and seasonal periods with the GC-MS mobile unit. The location points were in: *Pagasarri kalea* (close to INDUSTRY 1) and *Tabira Kalea* (close to INDUSTRY 2).

- Simultaneous measurement of VOCs to delimit its source and dispersion. During the melting and casting processes, VOC sampling and measurement were performed.

    - In the chimneys, the emission levels in the flues were measured with an ECA accredited by ENAC for sampling and analysis.
    - Inside each building, the staff of the Public Health Laboratory measured immission levels with portable equipment for VOC sampling.
    - In the immediate area of the facilities, the levels of VOCs in immission were measured with the GC-MS mobile units.

5.1. PERIODs, METHODs AND LOCATION.

The Working Group of the Vice-Ministry of Environment has launched a series of air quality control campaigns between October 2017 and December 2018. A total of 4 campaigns were carried out **between** the following time periods:

- Campaign I: Between October 2017 and March 2018.
- Campaign II: Between Aril 2018 and July 2018.
- Campaign III: Between August 2018 and November 2018.
- Campaign IV: Between November 2018 and December 2018.

As an analysis **methodology** for the campaigns, a Mobile Unit of the ACBC Air Quality Control Network was installed, specifically the so-called Mobile Unit, equipped with a CDS ACEM 9305 Thermal Desorption equipment coupled to a gas chromatograph and mass spectrometer (GC/MSD 5975T onwards) with the use of a tube and trap with focused desorption, whose operation can be controlled by software. The final desorption is done through a transfer line to the GC/MSD 5975T. Subsequently, with the use of ChemStation Software and Deconvolution Software (DRS) used by the IARTLIB.MSL library (Indoor Air Toxic Library), the observed organic compounds are identified and quantified. In the case of compounds whose pattern is not known, the SemiQuant method is used to estimate the content of the sample. In addition, TargetView Software is used for more detailed identification in cases of uncertainty.

All this equipment has made it possible to quantify different families of organic compounds in the surroundings of Durango, such as: aromatic hydrocarbons, aliphatic hydrocarbons, cycloalkanes, alcohols, esters, halocarbons, glycols, aldehydes, ketones and terpenes, among others. The method developed in this Movile Unit makes it possible to determine 172 reference compounds estimated by the WHO and the EPA.

In relation to the location of the points of the municipality of Durango for the campaigns, the study has been **located** in two areas:

1. Pagasarri Kalea (Campaigns I and III), close to INDUSTRY 1.
2. Tabira Kalea (Campaigns II and IV), close to INDUSTRY 2.

As mentioned above, for the determination of these points of study and analysis, the results obtained from the measurements carried out by Movile Unit in Campaign I in Pagarsarri Kalea (Durango) were taken into account. It showed concentrations of some aromatic hydrocarbons, among other VOCs, higher than those of other urban areas in the Basque Autonomous Community, and with concentration peaks at certain times of the day, mainly at night. Considering the topological characteristics of Durango, the meteorological characteristics (in particular the direction and intensity of the wind), the type of compounds detected, and the possible sources of emissions that could justify these levels of concentration, the campaigns and study were focused on the surrounding areas of two companies in the municipality. The following orthophoto details the exact location of both points where the campaigns have been carried out.

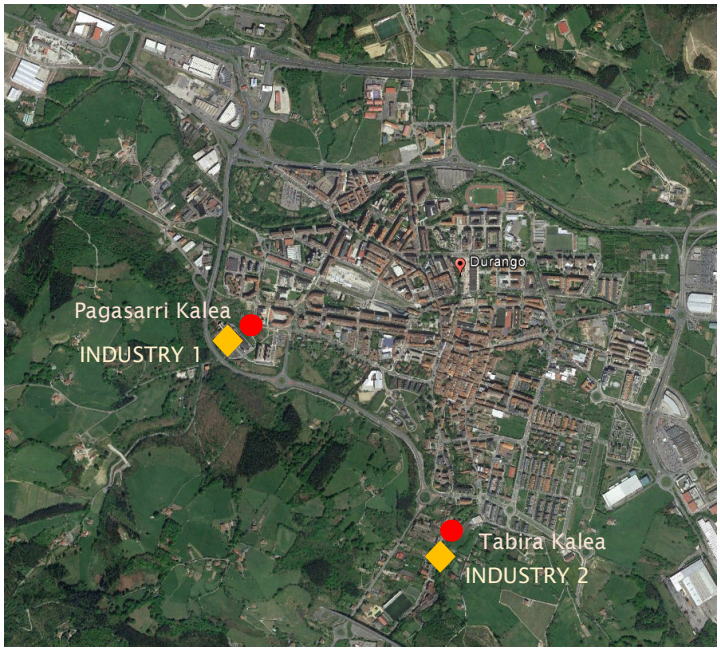


Image 2: Orthophoto of the municipality of Durango and two locations of the Mobile Unit.

6. RESULTS.

The results refer to the three measuring points selected for simultaneous analysis.

i. Immediate area of the installations or outdoor area by means of the Mobile Unit.
ii. Atmospheric emission sources channelling emissions from melting or casting.
iii. Inside the buildings of both foundries (INDUSTRI 1 and INDUSTRI 2).

All the results of these controls are annexed and in the following reports:

i. The data corresponding to the air quality campaigns are collected in four annexed reports dated 22 January 2019 and called:
   - Report on air quality in the environment: Volatile organic compounds. Municipality of Durango: Pagasarri Kalea (Campaign I)
   - Report on air quality in the environment: Volatile organic compounds. Municipality of Durango: Pagasarri Kalea (Campaign III)
   - Report on air quality in the environment: Volatile organic compounds. Municipality of Durango: Tabira Kalea (Campaign II)
   - Report on air quality in the environment: Volatile organic compounds. Municipality of Durango: Tabira Kalea (Campaign IV)
   - Report on air quality in the environment: Volatile organic compounds. INDUSTRY 2 company (outdoors). This report collects data on volatile organic compounds at two other points adjacent to the company.

If it would be required all the daily data of the results saved in Excel format, please ask for in the following mails: h-bilbao@euskadi.eus or inesa-banos@euskadi.eus

ii. The data corresponding to the controls in the emission sources can be found in two ECA reports issued by TECNALABAQUA:
   - Report number TEC-18.90-003 of 3 December 2018 for INDUSTRY 1 emission sources.
   - Report number TEC-18.90-002 of 11 December 2018 for INDUSTRY 2 sources of emission to the atmosphere.

iii. The data corresponding to the taking of samples of immission in the interior of each plant are detailed in the:
   - Report on air quality of the environment: Volatile organic compounds. INDUSTRY 1 Company.
   - Report on air quality of the environment: Volatile organic compounds. INDUSTRY 2 Company.

After conducting a detailed analysis: the data collected; the reports mentioned; the operations in both smelting facilities; the VOC emissions that occur as a consequence of the casting-moulding operations; the concentrations in immission inside the plants; the wind regime and the impact of the emissions on immission concentrations in the municipality of Durango, in the vicinity of both plants, the following can be concluded:

Based on the profile of observed organic compounds, it is estimated that the reference compounds found in the two environments analysed by Mobile Unit are mostly **benzene, toluene, styrene**, 2-Propanol, dimethyl sulphide, pentane, ethyl acetate and naphthalene. The results provided indicated the presence, in concentrations that were higher than expected, of benzene, toluene, styrene, and 2-propanol. The concentrations of the first three compounds also evolve in parallel, which points to a common origin.

In relation to the VOCs generated in both plants, it has been possible to determine that in both cases three main organic compounds (benzene-toluene-styrene) are emitted, and they are generated mainly during **cast-moulding operations**. These emissions are generated in the casting process, when it comes into contact with polystyrene moulds expanded at high temperature, and it decomposes the polymer through thermal pyrolysis. Although these compounds are produced in low quantities during the decomposition of the polymer, given that the polystyrene models used are large in volume, the result shows that the emission is significant.

In both cases, the emissions analysis performed during the melting and casting-moulding operations indicates the presence of the three components of interest, in a proportion that is not kept constant, particularly in the case of styrene, and it seems to depend on the day. This may be due to the variability of the pieces manufactured, which affects the decomposition temperature.

Although **INDUSTRY 1** and **INDUSTRY 2** facilities carry out a similar process, they are in a quite different situation in relation to pipelines, plant layout and emissions.

In the case of INDUSTRY 1, the emissions from the fusion and part of the cast moulding are channelled through the **extraction** system. Therefore, it is simple to determine which emissions are produced in each stage, and it is clearly observed that the emissions of the compounds of interest are produced in the cast-moulding stage. However, the company should be study and implement a method to improve the captures and extractions of emissions related to the indicated processes.

With respect to INDUSTRY 2, it should be pointed out that its building has vents and overhead lifts, and there are diffuse emissions released outdoors without any aspiration or conduit with an outlet to the outside. Concentrations in the emission of these components have been detected both in fusion and in cast moulding. This has been attributed to the fact that, during fusion, part of the gases from the plant, where these compounds are present, is sucked up. In any case, the conclusion drawn in the case of

INDUSTRY 2 is that a significant proportion of the emissions from the cast-moulding stage is of a diffuse type and it is released to the outside without any aspiration or conduit.

The **importance of the winds** in the impact of both plants on the concentrations in immission has been confirmed. In the case of INDUSTRY 1, due to its location, the impact increases in Durango when southwesterly winds blow; indeed, these winds would carry the released compounds towards the municipality. It has been observed that the concentrations of these components in immission during the diurnal period are very low, mostly below the detection limit, but they are high in some night periods, especially in "adverse" wind conditions. The fact that they occur during the night period also mitigates their impact on the general population, since there is less exposure at those times.

In the case of INDUSTRY 2, no high peaks of concentration of the compounds of interest in immission have been observed in the surroundings, which is attributed to the fact that the emissions are mostly diffuse and more dispersed in the environment. From the results obtained, it seems that the most significant impact is produced in the location of the Mobile Unit, which corresponds precisely to the location in which the municipality is located. From the concentrations in immission measured by the Mobile Unit, it has been proven that they oscillate in a relatively narrow range of values, except during the weekend, when they descend significantly to values that are mostly below the detection limit. However, the average concentrations detected in immission at the location of the Mobile Unit are high. Moreover, In this case, these concentrations are maintained both during the day and night periods. Fortunately, the plant is relatively far from the population, so the impact on the urban area is expected to be lower but still significant.

In the INDUSTRY 2 plant, due to the absence of an **extraction system** for cast-mould emissions, relatively high concentration values of various volatile organic compounds have been measured inside the building. INDUSTRY 2´s plant requires substantial improvements for the encapsulation of the building, as well as for the efficient extraction and purification of cast-mould emissions. Unlike INDUSTRY 1, one of the initial tasks that the company should address is the enclosure of the building and the extraction of diffuse emissions that result from cast moulding.

In both cases, the correct and effective aspiration of the cast-mould emissions is considered, as well as their **purification** by means of an absorption system or a similar one. In this way, emissions of volatile organic compounds, especially benzene, toluene and styrene, into the atmospheric environment of Durango would be minimised.

6.1. STATUS OF COMPLIANCE WITH AIR QUALITY STANDARDS.

Benzene is a volatile compound that can have different origins, such as traffic or certain industrial activities. This compound is regulated by Spanish Royal Decree 102/2011, of 28 January, related to the improvement of air quality and to the annual limit value referred to the annual averages in Annex I. It also establishes the data quality objective for calculating the average in Annex V and the reference method for its measurement in Annex VII (modified by point DOCE of Royal Decree 39/2017, of 27 January, amending Royal Decree 102/2011, of 28 January, related to the improvement of air quality).

Limit value	Period of the average	Limit value
	Civil year.	5 µg/m^3

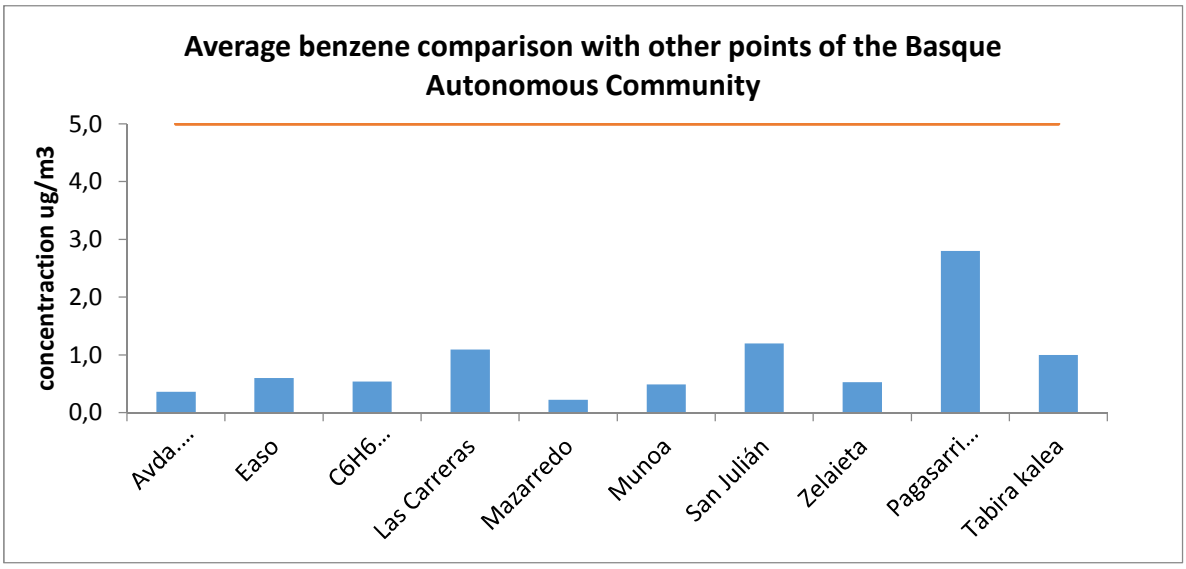
Table 1. Royal Decree 102/2011, annex I, section F. Limit value of benzene for health protection. The limit value shall be expressed in µg/m3. The volume must be referred to a temperature of 293 K and a pressure of 101,3 kPa.

Below are the averages for each campaign and the temporary coverage for each case:

CAMPAIGNS	Pagasarri kalea Area		Tabira kalea Area	
	Campaign average	Temporary coverage	Campaign average	Temporary coverage
Campaign I 27/09/2017-22/04/2018	3.12 µg/m^3	209 days	--	--
Campaign II 20/06/2018-25/07/2018	--	--	0.09 µg/m3	35 days
Campaign III 25/07/2018-16/11/2018	2.55 µg/m^3	114 days	--	--
Campaign IV 16-11-2018-26/02/2019	--	--	1.926 µg/m^3	102 days
Campaigns' Average	2.8 µg/m3	--	1.008 µg/m^3	--

Table 2. Average per campaign

If we compare the averages for each campaign at each point with the annual averages collected during 2017 at different points in the Basque Autonomous Community, we can see that the results are higher tan those measured in other urban environments, although it complies with the annual limit value for benzene set by air quality regulations:



Graph 1: Average benzene comparison with other measured points in the Basque Autonomous Community.

Given this situation, in 2018 the Vice-Ministry of the Environment acquired and installed an automatic BTX analyser (Benzene, Toluene and Xylene) in the measuring station of Durango (San Roque Street). At this moment, the analyser is installed and extracting data in probationary period, until the adequacy of its readings and results is verified.

7. RELATION BETWEEN POLYSTYRENE IN FOUNDRIES AND VOLATILE ORGANIC COMPOUNDS.

Throughout the Durango air quality study, the Working Group of the Vice-Ministry of Environment has detected that the concentrations of the benzene-styrene organic group, measured at both points of the study, are directly related to the manufacture of castings through Lost-foam processing with expanded polystyrene models. In the municipality of Durango there are two industrial facilities that use this technology as the basis for their processes: INDUSTRY 1 and INDUSTRY 2 foundry facilities. That is why the study has focused mostly on the surroundings of both facilities.

The report prepared by the TQSA working group of the UPV-EHU on June 7, 2018, named *Report on Emissions in the Manufacture of Foundry Parts through Lost-Foam Processing with Expanded Polystyrene Models*" and annexed to this report, details the specific relationship of emissions from both facilities with the results obtained about the air quality in Durango.

To summarize, it should be noted that lost-foam is a manufacturing process of pieces casted by mould, in which the mould of the pieces is made of expanded polystyrene. In the process of casting the polystyrene moulds (covered with sand and refractory material) a pyrolysis of the polystyrene is produced under reducing conditions at high temperature and atmospheric pressure. In other words, the polystyrene decomposes and transforms into gases without leaving solid residues; this leaves a gap for the casting to cool down and take the shape of the desired piece without removing the mould, which is for single use. Since the polystyrene polymer contains aromatic rings, thermal decomposition at high temperature produces the emission of benzene, toluene and styrene into the air.

This thermal decomposition of the polystyrene produced during the casting process in both foundries is of a diffuse nature. In other words, there are no localised extractions and, therefore, it is released through the emission flues in the case of INDUSTRY 1 and, in the case of INDUSTRY 2, through all the vents located in the plant and, to a lesser extent, through the emission sources.

8. CONCLUSIONS

In October 2017, the Vice-Ministry of Environment began an air quality campaign in Durango in which the presence of some volatile organic compounds such as benzene-toluene-styrene was detected. Although they were below the values of air quality regulations, they were still significant and superior to those found in other industrial areas in the Basque Autonomous Community. This led to the identification of the origin and delimitation of the problem in order to address a solution. With this aim in mind, various actions have been carried out, the results of which have been included in this Durango Air Quality Study.

In order to carry out the present study, this Vice-Ministry of the Environment has created a specialised Working Group formed by the Air, Inspection and IPPC Services and the Public Health Laboratory of the Basque Government. It also had the collaboration of the Department of Chemical Engineering of the University of the Basque Country (EHU-UPV). This report includes all the data, conclusions and actions addressed in the study as well as a proposal for an action plan.

To this end, and taking into account the characteristics of the surrounding industrial activities and the predominant wind directions in the area, the four campaigns carried out at two points in the municipality have detected two main sources of benzene-toluene-styrene emission. These are the foundries INDUSTRY 1 and INDUSTRY 2 in the municipality of Durango. None of these facilities use these compounds as raw materials for their activity, but their processes give rise to it. This fact was not known either in the regulations, in European references or in the associated BREF documents. Therefore, none of these facilities have controls for benzene-toluene-styrene contaminants in their environmental authorizations. Both sources of benzene-toluene-styrene release have been confirmed by measuring the emissions in their flues and inside their plants by means of an accredited Environmental Control Entity, certified, registered and contracted by the Vice-Ministry and with the support of the reference laboratory of the Basque Government.

The process that causes these benzene-toluene-styrene emissions is the thermal decomposition of the expanded polystyrene moulds used to make their pieces or products. This process takes place in the cast moulding of the foundries and high values of these compounds have been obtained.

In both studied companies, these emissions are not extracted and purified prior to being released into the atmosphere. Therefore, corrective measures are being taken in both installations. The measures include the installation of effective extractions and purification (by adsorption of active carbon) of benzene-toluene-styrene emissions. After studied the case of INDUSTRY 2, it may also be necessary to carry out an enclosure/encapsulation of the plant, in order to ensure that the diffuse emissions of these compounds are not emitted into the atmosphere in an uncontrolled way.

To end up, the Vice-Ministry of the Environment of the Basque Government of Spain advises that it is really necessary to take into account this discover into the modification of the BREF Smitheries and Foundries Industry that now is in process. We believe that, as happened with Dioxins and Furans, it is easy to minimize the amount of benzene and other related organic compounds in the emission of foundries that use the lost foam technology in their processes. In the case of INDUSTRY 1 and INDUSTRY 2 of Durango (Spain) this depuration mechanisms are being installed this year. The reference emission value of benzene for the construction of the depuration system has been 1,5 g/h ó 0,5 mg/m^3. Both industries are installing systems with carbon active addition in the end of the tube before the filter. As in dioxins and furans, the constructor guarantees the reference emission value provided.

ANNEXES TO THE RESEARCH: BENZENE AND OTHER VOCs IN FOUNDARIES WITH LOST FOAM TECHNOLOGY (FINAL REPORT 2019)

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ANNEX I:

Informe sobre calidad del aire ambiente: Compuestos orgánicos volátiles.

Término municipal de Durango: Pagasarri Kalea (Campaña I).

Made by Basque Government Laboratory..

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Término municipal de Durango: Pagasarri Kalea (Campaña I)

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Los ensayos se han realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software. La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos. glicoles, aldehídos, cetonas y terpenos. entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane, Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane

1. Pagasarri Kalea: Campaña I (27/09/2017-22/04/2018)
4097 muestras

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(1)	*Dichlorodifluoromethane*	µg/m³	2,07	9,71	<LD	3,63	1,25	83,33
	Trichlorofluoromethane	µg/m³	0,53	2,46	<LD	1,66	0,61	44,79
	Dichloromethane	µg/m³	0,09	56,92	<LD	0,05	1,21	0,44
	Chloroform	µg/m³	0,13	1,82	<LD	0,41	0,13	38,56
	Tetrachloromethane	µg/m³	0,29	15,93	<LD	0,40	0,32	92,48
	Tetrachloroethene	µg/m³	0,23	6,08	<LD	1,55	0,44	43,32
(2)	*n-Hexanal*	µg/m³	0,05	0,59	<LD	0,05	0,02	1,07
(3)	*Ethanethiol*	µg/m³	0,05	1,63	<LD	0,05	0,03	0,27
	Dimethyl sulphide	µg/m³	0,33	12,40	<LD	3,02	0,87	22,85
	Carbon disulphide	µg/m³	0,06	2,60	<LD	0,24	0,12	2,22
	Dimethyldisulphide	µg/m³	0,17	5,11	<LD	1,39	0,38	23,60
(4)	*2-Propanol*	µg/m³	8,96	400,81	<LD	59,08	21,12	73,32
	1-Butanol	µg/m³	0,06	0,75	<LD	0,18	0,04	4,74
	2-Butoxyethanol	µg/m³	0,05	0,91	<LD	0,05	0,02	1,07
(5)	*Acetone*	µg/m³	2,19	60,22	<LD	15,75	4,37	43,69
	2-Butanone	µg/m³	0,55	13,62	<LD	3,53	1,03	28,75
	4-Methyl-2-pentanone	µg/m³	0,11	14,00	<LD	0,54	0,42	23,99
	Acetophenone	µg/m³	1,37	5,06	<LD	3,87	1,07	78,37
(6)	*2-Methylpentane*	µg/m³	0,31	8,13	<LD	2,12	0,61	26,92
	3-Methylpentane	µg/m³	0,15	3,50	<LD	0,91	0,26	20,19
	n-Hexane	µg/m³	0,06	3,69	<LD	0,15	0,07	5,00
	Methylcyclopentane	µg/m³	0,08	1,54	<LD	0,35	0,08	19,43
	2-Methylhexane	µg/m³	0,05	1,34	<LD	0,05	0,03	0,71
	Cyclohexane	µg/m³	0,07	2,07	<LD	0,33	0,10	9,89
	3-Methylhexane	µg/m³	0,21	9,95	<LD	1,32	0,36	38,47
	2,2,4-Trimethylpentane	µg/m³	0,05	1,83	<LD	0,05	0,05	0,98
	n-Heptane	µg/m³	0,18	7,14	<LD	1,08	0,29	38,61
	Methylcyclohexane	µg/m³	0,07	1,61	<LD	0,27	0,07	18,60
	n-Octane	µg/m³	0,09	1,10	<LD	0,38	0,09	20,19
	n-Nonane	µg/m³	0,07	0,55	<LD	0,25	0,05	17,31
	n-Decane	µg/m³	0,13	5,05	<LD	0,50	0,16	40,59
	n-Undecane	µg/m³	0,20	2,31	<LD	1,25	0,33	22,46
	n-Dodecane	µg/m³	0,06	0,35	<LD	0,15	0,02	5,88
	n-Tridecane	µg/m³	0,06	0,93	<LD	0,32	0,06	3,64
	Butane, 2-methyl-	µg/m³	0,40	5,34	<LD	1,60	0,40	85,92
	Pentane	µg/m³	2,69	66,97	<LD	16,23	4,76	38,39
(7)	*Acetic acid*	µg/m³	0,46	14,76	<LD	4,21	1,09	32,56
(8)	*Ethyl acetate*	µg/m³	0,77	12,34	<LD	4,98	1,26	47,55
	Methyl methacrylate	µg/m³	0,05	0,54	<LD	0,16	0,03	4,00
	n-Butyl acetate	µg/m³	0,34	38,38	<LD	2,22	1,40	35,05

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos, (10)Ciclos y (11)Nitrogenados.

1. Pagasarri Kalea: Campaña I (27/09/2017-22/04/2018)
4097 muestras (Continuación)

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(9)	*Benzene*	µg/m³	3,12	96,32	<LD	24,12	6,77	57,53
	Toluene	µg/m³	6,55	141,34	<LD	46,17	11,75	98,24
	Ethylbenzene	µg/m³	0.40	7,51	<LD	2,39	0,61	73,52
	m-Xylene	µg/m³	0,43	4,13	<LD	1,89	0,48	77,62
	p-Xylene	µg/m³	0,06	1,85	<LD	0,26	0,07	4,52
	Ethynylbenzene	µg/m³	0,19	8,46	<LD	1,91	0,56	12,08
	Styrene	µg/m³	3,23	129,35	<LD	39,40	10,67	70,15
	o-Xylene	µg/m³	0,08	1,84	<LD	0,32	0,09	21,09
	Isopropylbenzene	µg/m³	0,05	0.50	<LD	0,05	0,01	0,59
	Phenol	µg/m³	0,08	0,98	<LD	0,21	0,06	27,87
	n-Propylbenzene	µg/m³	0,05	0,50	<LD	0,05	0,01	0,27
	m-Ethyltoluene	µg/m³	0,17	2,27	<LD	0,76	0,20	46,81
	1,3,5-Trimethylbenzene	µg/m³	0,19	2,85	<LD	0,87	0,23	49,40
	alpha-Methylstyrene	µg/m³	0,07	2,19	<LD	0,37	0,11	5,32
	1,2,4-Trimethylbenzene	µg/m³	0,05	0,85	<LD	0,05	0,02	0,12
	p-Isopropyltoluene	µg/m³	0,05	2,67	<LD	0,05	0,05	1,27
	1,2,3-Trimethylbenzene	µg/m³	0,05	0,56	<LD	0,05	0,02	0,59
	Indene	µg/m³	0,13	9,76	<LD	1,28	0,45	8,62
	Naphthalene	µg/m³	0,25	15,26	<LD	2,25	0,67	40,44
(10)	*alpha-Pinene*	µg/m³	1,06	60,09	<LD	8,51	3,10	58,99
	Camphene	µg/m³	0,14	5,26	<LD	0,88	0,25	28,46
	beta-Pinene	µg/m³	0,53	16,24	<LD	4,96	1,29	36,81
	Limonene	µg/m³	0,12	3,13	<LD	0,70	0,19	27,02
(11)	*Acrylonitrile*	µg/m³	0,05	2,36	<LD	0,05	0,07	0,15

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos, (10)Ciclos y (11)Nitrogenados.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen once familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos, ciclos y compuestos nitrogenados. En ningún caso aparecen éteres. Los compuestos que presentan mayor prevalencia, se citan a continuación:

1. Diclorodifluorometano (Halogenado)
2. n-Hexanal (Aldehído)
3. Dimetil sulfuro y Dimetil disulfuro (Azufrados)
4. 2-propanol (Alcoholes)
5. Acetona (Cetonas)
6. Pentano (Alcanos/Alquenos)
7. Ácido acético (Ácidos)
8. Etil acetato (Ésteres)
9. Benceno y Tolueno (Hidrocarburos aromáticos)
10. Alfa-pineno (Ciclos)
11. Acrilonitrilo (Nitrogenados)

En base al perfil de compuestos orgánicos observados, se estima que los compuestos de referencia del entorno son: 2-Propanol, dimetilsulfuro, dimetildisulfuro, pentano, benceno, tolueno, estireno, etil acetato y naftaleno.

Respecto a los umbrales de olores.

Los compuestos dimetilsulfuro y dimetildisulfuro superan los umbrales de olor establecidos bibliográficamente.

Bases de datos utilizadas
INHST: Instituto Nacional de Higiene y Seguridad en el Trabajo
EPA: Agencia de Protección Ambiental de Estados Unidos
JOURNAL OF APPLIED TOXICOLOGY, VOL. 3, NO. 6,1983.
"Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals -in Air and Water Dilution"

Derio, a 22 de Enero de 2018

VºBº
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Responsable Unidad
Química Ambiental

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ANNEX II:

Informe sobre calidad del aire ambiente: Compuestos orgánicos volátiles.

Término municipal de Durango: Pagasarri Kalea (Campaña III).

Made by Basque Government Laboratory.

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Término municipal de Durango: Pagasarri Kalea (Campaña II)

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Los ensayos se han realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software. La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol, Acrylonitrile, Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane, Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol, n-Hexane; 2-Butanone (MEK), 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran, 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol, Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene), alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane; Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane.

1. Pagasarri Kalea: Campaña II (25/07/2018-16/11/2018)
2345 muestras

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(1)	*Dichlorodifluoromethane*	µg/m³	1,88	3,29	<LD	3,18	1,12	81,45
	Trichlorofluoromethane	µg/m³	0,32	1,45	<LD	1,34	0,45	31,22
	Dichloromethane	µg/m³	0,06	6,10	<LD	0,05	0,16	0,17
	Chloroform	µg/m³	0,06	0,19	<LD	0,15	0,02	8,02
	Tetrachloromethane	µg/m³	0,21	0,39	<LD	0,32	0,09	80,09
	Tetrachloroethene	µg/m³	0,14	5,45	<LD	0,89	0,31	30,87
(2)	*Acetaldehyde*	µg/m³	0,06	1,67	<LD	0,32	0,08	4,09
(3)	*Dimethyl sulphide*	µg/m³	0,29	21,05	<LD	2,51	0,88	19,49
	Carbon disulphide	µg/m³	0,05	0,96	<LD	0,05	0,03	1,36
	Dimethyldisulphide	µg/m³	0,07	2,83	<LD	0,35	0,11	11,34
(4)	*2-Propanol*	µg/m³	9,59	1167,94	<LD	98,11	45,24	51,09
(5)	*Acetone*	µg/m³	4,48	186,32	<LD	23,07	8,19	52,07
	2-Butanone	µg/m³	0,77	12,28	<LD	2,83	0,95	51,47
	4-Methyl-2-pentanone	µg/m³	0,08	6,05	<LD	0,35	0,19	19,40
	Acetophenone	µg/m³	1,31	4,54	<LD	3,76	0,93	89,38
(6)	*2-Methylpentane*	µg/m³	0,15	4,44	<LD	1,34	0,36	12,49
	3-Methylpentane	µg/m³	0,09	3,85	<LD	0,58	0,17	10,49
	n-Hexane	µg/m³	0,05	0,33	<LD	0,12	0,02	3,28
	Methylcyclopentane	µg/m³	0,07	0,99	<LD	0,25	0,06	13,69
	Cyclohexane	µg/m³	0,06	0,72	<LD	0,27	0,06	7,97
	3-Methylhexane	µg/m³	0,10	2,38	<LD	0,61	0,15	16,12
	2,2,4-Trimethylpentane	µg/m³	0,05	1,02	<LD	0,11	0,03	2,17
	n-Heptane	µg/m³	0,11	1,95	<LD	0,50	0,13	28,32
	Methylcyclohexane	µg/m³	0,06	0,99	<LD	0,20	0,05	10,92
	n-Octane	µg/m³	0,07	1,13	<LD	0,30	0,07	7,80
	n-Nonane	µg/m³	0,08	1,24	<LD	0,30	0,07	21,11
	n-Decane	µg/m³	0,12	1,58	<LD	0,46	0,11	41,83
	n-Undecane	µg/m³	0,18	2,71	<LD	0,98	0,27	24,95
	Butane, 2-methyl-	µg/m³	0,27	7,43	<LD	0,98	0,28	78,81
	Pentane	µg/m³	1,16	186,53	<LD	12,39	5,22	12,37
(7)	*Acetic acid*	µg/m³	1,11	83,19	<LD	9,12	3,10	31,64
(8)	*Ethyl acetate*	µg/m³	1,20	77,78	<LD	5,91	2,35	60,60
	Methyl methacrylate	µg/m³	0,05	0,47	<LD	0,05	0,02	1,32
	n-Butyl acetate	µg/m³	0,11	18,17	<LD	0,79	0,56	6,74

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos y (10)Ciclos.

1. Pagasarri Kalea: Campaña II (25/07/2018-16/11/2018)
2345 muestras (Continuación)

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(9)	*Benzene*	µg/m³	2,55	55,06	<LD	26,70	6,60	29,21
	Toluene	µg/m³	8,32	134,87	<LD	62,07	15,60	95,31
	Ethylbenzene	µg/m³	0,48	15,98	<LD	3,21	0,97	71,04
	m-Xylene	µg/m³	0,41	25,18	<LD	1,84	0,96	70,06
	p-Xylene	µg/m³	0,06	2,00	<LD	0,22	0,07	4,09
	Ethynylbenzene	µg/m³	0,17	10,80	<LD	1,94	0,59	8,74
	Styrene	µg/m³	2,13	189,68	<LD	38,05	11,83	44,31
	o-Xylene	µg/m³	0,07	0,39	<LD	0,24	0,05	16,93
	Phenol	µg/m³	0,05	0,25	<LD	0,14	0,02	4,18
	n-Propylbenzene	µg/m³	0,05	0,49	<LD	0,05	0,02	0,43
	m-Ethyltoluene	µg/m³	0,12	1,14	<LD	0,46	0,11	42,47
	1,3,5-Trimethylbenzene	µg/m³	0,17	2,22	<LD	0,68	0,18	49,47
	p-Isopropyltoluene	µg/m³	0,06	1,61	<LD	0,05	0,06	2,00
	Indene	µg/m³	0,14	10,01	<LD	1,26	0,48	8,53
	Naphthalene	µg/m³	0,15	10,17	<LD	0,73	0,53	27,68
(10)	*alpha-Pinene*	µg/m³	0,05	0,46	<LD	0,13	0,02	2,99
	Camphene	µg/m³	0,12	4,44	<LD	0,72	0,21	27,42
	beta-Pinene	µg/m³	0,26	18,46	<LD	2,04	0,78	23,80
	Limonene	µg/m³	0,09	1,53	<LD	0,47	0,12	17,70

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos y (10)Ciclos.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen diez familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos y ciclos. En ningún caso aparecen éteres ni compuestos nitrogenados. Los compuestos que presentan mayor prevalencia, se citan a continuación:

1. Diclorodifluorometano (Halogenado)
2. Acetaldehido (Aldehído)
3. Dimetil sulfuro y Dimetil disulfuro (Azufrados)
4. 2-propanol (Alcoholes)
5. Acetona (Cetonas)
6. Pentano (Alcanos/Alquenos)
7. Ácido acético (Ácidos)
8. Etil acetato (Ésteres)
9. Benceno y Tolueno (Hidrocarburos aromáticos)
10. Alfa-pineno (Ciclos)

En base al perfil de compuestos orgánicos observados, se estima que los compuestos de referencia del entorno son: 2-Propanol, dimetilsulfuro, dimetildisulfuro, pentano, benceno, tolueno, estireno, etil acetato y naftaleno.

Respecto a los umbrales de olores.

Los compuestos dimetilsulfuro, dimetildisulfuro, acido acético y estireno superan los umbrales de olor establecidos bibliográficamente.

Bases de datos utilizadas
INHST: Instituto Nacional de Higiene y Seguridad en el Trabajo
EPA: Agencia de Protección Ambiental de Estados Unidos
JOURNAL OF APPLIED TOXICOLOGY, VOL. 3, NO. 6,1983.
"Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals -in Air and Water Dilution"

Derio, a 22 de Enero de 2018

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ANNEX III:

Informe sobre calidad del aire ambiente: Compuestos orgánicos volátiles.
Término municipal de Durango: Tabira Kalea (Campaña II).
Made by Basque Government Laboratory.

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Término municipal de Durango: Tabira Kalea (Campaña I)

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Los ensayos se han realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software. La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal, 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene, Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane; Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene, n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane.

1. Tabira Kalea: Campaña I (20/06/2018-25/07/2018)
645 muestras

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(1)	*Dichlorodifluoromethane*	µg/m³	0,89	1,91	<LD	1,82	0,64	71,32
	Trichlorofluoromethane	µg/m³	0,13	0,87	<LD	0,81	0,20	16,12
	Dichloromethane	µg/m³	0,05	0,78	<LD	0,05	0,03	0,16
	Chloroform	µg/m³	0,05	0,30	<LD	0,05	0,01	0,31
	Tetrachloromethane	µg/m³	0,11	0,20	<LD	0,18	0,03	83,72
	Tetrachloroethene	µg/m³	0,11	1,95	<LD	0,60	0,18	26,20
(2)	*Acetaldehyde*	µg/m³	0,05	0,22	<LD	0,05	0,01	0,47
(3)	*Dimethyl sulphide*	µg/m³	0,11	2,24	<LD	0,90	0,21	13,02
	Dimethyldisulphide	µg/m³	0,05	0,50	<LD	0,11	0,03	2,48
(4)	*2-Propanol*	µg/m³	0,90	55,13	<LD	5,39	2,97	28,37
(5)	*Acetone*	µg/m³	3,01	15,18	<LD	9,73	2,92	62,64
	2-Butanone	µg/m³	0,60	2,79	<LD	1,87	0,56	58,91
	4-Methyl-2-pentanone	µg/m³	0,06	0,87	<LD	0,13	0,04	5,89
	Acetophenone	µg/m³	1,84	5,52	<LD	3,97	1,12	90,70
(6)	*2-Methylpentane*	µg/m³	0,11	3,05	<LD	0,87	0,24	10,23
	3-Methylpentane	µg/m³	0,08	1,09	<LD	0,58	0,13	7,75
	n-Hexane	µg/m³	0,05	0,29	<LD	0,11	0,02	2,64
	Methylcyclopentane	µg/m³	0,06	0,32	<LD	0,16	0,03	6,05
	Cyclohexane	µg/m³	0,06	0,57	<LD	0,22	0,05	8,99
	3-Methylhexane	µg/m³	0,07	1,19	<LD	0,30	0,09	8,99
	2,2,4-Trimethylpentane	µg/m³	0,05	1,49	<LD	0,05	0,06	0,16
	n-Heptane	µg/m³	0,09	0,89	<LD	0,33	0,08	28,37
	n-Decane	µg/m³	0,08	0,89	<LD	0,40	0,09	17,83
	n-Undecane	µg/m³	0,19	5,56	<LD	1,75	0,46	25,27
	n-Dodecane	µg/m³	0,05	0,40	<LD	0,05	0,01	0,31
	n-Tridecane	µg/m³	0,06	0,84	<LD	0,25	0,05	3,57
	Butane, 2-methyl-	µg/m³	0,15	1,91	<LD	0,46	0,14	64,96
	Pentane	µg/m³	0,50	11,14	<LD	6,23	1,54	9,61
(7)	*Acetic acid*	µg/m³	1,09	14,12	<LD	6,49	1,86	41,40

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos y (10)Ciclos.

1. Tabira Kalea: Campaña I (20/06/2018-25/07/2018)
645 muestras (Continuación)

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(3)	*Ethyl acetate*	µg/m³	0,14	4,71	<LD	0,83	0,29	17,98
	n-Butyl acetate	µg/m³	0,07	0,88	<LD	0,27	0,07	10,23
(9)	*Benzene*	µg/m³	0,09	4,48	<LD	0,57	0,31	4,50
	Toluene	µg/m³	1,32	21,90	<LD	7,02	1,78	94,88
	Ethylbenzene	µg/m³	0,09	0,65	<LD	0,29	0,07	38,91
	m-Xylene	µg/m³	0,13	2,02	<LD	0,40	0,13	48,99
	p-Xylene	µg/m³	0,06	0,38	<LD	0,18	0,04	6,20
	Ethynylbenzene	µg/m³	0,06	0,74	<LD	0,15	0,04	3,26
	Styrene	µg/m³	0,28	10,06	<LD	2,01	0,75	41,09
	o-Xylene	µg/m³	0,07	0,27	<LD	0,21	0,04	18,60
	Phenol	µg/m³	0,07	0,30	<LD	0,20	0,04	12,87
	m-Ethyltoluene	µg/m³	0,07	0,59	<LD	0,21	0,05	20,62
	1,3,5-Trimethylbenzene	µg/m³	0,09	0,68	<LD	0,28	0,07	37,83
	p-Isopropyltoluene	µg/m³	0,05	0,39	<LD	0,05	0,02	0,93
	Indene	µg/m³	0,05	0,38	<LD	0,05	0,01	0,31
	Naphthalene	µg/m³	0,06	0,74	<LD	0,20	0,05	9,15
(10)	*alpha-Pinene*	µg/m³	0,05	0,35	<LD	0,15	0,03	3,41
	Camphene	µg/m³	0,10	0,94	<LD	0,45	0,11	25,58
	beta-Pinene	µg/m³	0,30	3,95	<LD	1,56	0,43	41,40
	Limonene	µg/m³	0,06	0,51	<LD	0,19	0,04	11,16

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Alcanos/Alquenos, (7)Ácidos, (8)Esteres, (9)Aromáticos y (10)Ciclos.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen diez familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos y ciclos. En ningún caso aparecen éteres ni compuestos nitrogenados.. Los compuestos que presentan mayor prevalencia, se citan a continuación:

1. Diclorodifluorometano (Halogenado)
2. Acetaldehido (Aldehído)
3. Dimetil sulfuro y Dimetil disulfuro (Azufrados)
4. 2-propanol (Alcoholes)
5. Acetona (Cetonas)
6. Pentano (Alcanos/Alquenos)
7. Ácido acético (Ácidos)
8. Etil acetato (Ésteres)
9. Benceno y Tolueno (Hidrocarburos aromáticos)
10. Beta-pineno (Ciclos)

En base al perfil de compuestos orgánicos observados, se estima que los compuestos de referencia del entorno son: 2-Propanol, dimetilsulfuro, dimetildisulfuro, pentano, benceno, tolueno, estireno, etil acetato y naftaleno.

Respecto a los umbrales de olores.

El compuesto dimetildisulfuro superan los umbrales de olor establecidos bibliográficamente.

Bases de datos utilizadas
INHST: Instituto Nacional de Higiene y Seguridad en el Trabajo
EPA: Agencia de Protección Ambiental de Estados Unidos
JOURNAL OF APPLIED TOXICOLOGY, VOL 3, NO. 6,1983.
"Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals -in Air and Water Dilution"

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Química Ambiental

J.I. Álvarez Uriarte

ANNEX IV:

Informe sobre calidad del aire ambiente: Compuestos orgánicos volátiles.

Término municipal de Durango: Tabira Kalea (Campaña IV).

Made by Basque Government Laboratory.

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Término municipal de Durango: Tabira Kalea (Campaña II)

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Los ensayos se han realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software. La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone, Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane, Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene, m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene, 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane, n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane.

1. Tabira Kalea: Campaña II (16/11/2018-01/01/2019)
942 muestras

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(1)	*Dichlorodifluoromethane*	µg/m³	2,53	3,87	<LD	3,82	1,36	82,70
	Trichlorofluoromethane	µg/m³	0,51	1,72	<LD	1,66	0,62	40,98
	Chloroform	µg/m³	0,07	0,23	<LD	0,17	0,04	16,35
	Tetrachloromethane	µg/m³	0,33	0,41	<LD	0,39	0,06	97,24
	Tetrachloroethene	µg/m³	0,21	5,76	<LD	1,38	0,46	44,37
	Chlorobenzene	µg/m³	0,06	0,50	<LD	0,36	0,06	4,78
	Bromobenzene	µg/m³	0,06	0,19	<LD	0,15	0,02	7,32
(2)	*Dimethyl sulphide*	µg/m³	0,34	29,00	<LD	2,94	1,64	16,88
	Dimethyldisulphide	µg/m³	0,07	1,05	<LD	0,29	0,08	7,54
(3)	*2-Propanol*	µg/m³	4,01	149,90	<LD	25,53	9,31	57,75
(4)	*Acetone*	µg/m³	0,61	28,39	<LD	9,02	2,46	7,75
	2-Butanone	µg/m³	0,24	16,23	<LD	1,94	0,83	10,62
	4-Methyl-2-pentanone	µg/m³	0,05	0,48	<LD	0,05	0,02	1,17
	Acetophenone	µg/m³	1,07	4,71	<LD	4,01	1,18	63,48
(5)	*Tetrahydrofuran*	µg/m³	0,05	0,80	<LD	0,05	0,03	0,21
(6)	*2-Methylpentane*	µg/m³	0,48	13,13	<LD	2,19	0,74	64,65
	3-Methylpentane	µg/m³	0,39	14,42	<LD	2,14	0,73	44,37
	n-Hexane	µg/m³	0,06	1,65	<LD	0,24	0,07	11,15
	Methylcyclopentane	µg/m³	0,13	6,05	<LD	0,64	0,24	37,90
	3-Methylhexane	µg/m³	0,24	9,93	<LD	1,69	0,61	30,36
	2,2,4-Trimethylpentane	µg/m³	0,24	7,31	<LD	1,99	0,55	21,13
	n-Heptane	µg/m³	0,23	7,40	<LD	1,48	0,46	39,17
	Methylcyclohexane	µg/m³	0,09	1,93	<LD	0,31	0,09	27,81
	n-Nonane	µg/m³	0,05	0,22	<LD	0,11	0,02	3,40
	n-Decane	µg/m³	0,15	1,64	<LD	0,68	0,16	50,42
	n-Undecane	µg/m³	0,49	7,08	<LD	3,15	0,79	54,35
	n-Dodecane	µg/m³	0,06	0,57	<LD	0,20	0,05	7,43
	Butane, 2-methyl-	µg/m³	0,08	2,75	<LD	0,45	0,14	8,17
	Pentane	µg/m³	2,81	27,83	<LD	14,78	4,19	40,23
(7)	*Ethyl acetate*	µg/m³	0,38	30,84	<LD	2,26	1,42	22,40
	Methyl methacrylate	µg/m³	0,06	1,89	<LD	0,19	0,08	5,31
	n-Butyl acetate	µg/m³	0,05	1,52	<LD	0,05	0,05	0,11

Clasificación de los COVS en Familias: (1)Halogenados, (2) Azufrados, (3) Alcoholes (4) Cetonas, (5)Eteres, (6)Alcanos/Alquenos, (7) Esteres, (8) Aromáticos y (9)Ciclos.

1. Tabira Kalea: Campaña II (16/11/2018-01/01/2019)
942 muestras (Continuación)

Familia	Compuesto		Media	Máx	Mín	Percentil 98	SD	>LD (%)
(8)	*Benzene*	µg/m³	2,38	36,07	<LD	13,35	3,75	62,53
	Toluene	µg/m³	7,12	71,01	<LD	31,31	8,31	99,36
	Ethylbenzene	µg/m³	0,38	8,11	<LD	1,58	0,44	87,69
	m-Xylene	µg/m³	0,54	13,55	<LD	2,28	0,68	88,00
	p-Xylene	µg/m³	0,05	1,29	<LD	0,12	0,05	2,12
	Styrene	µg/m³	1,12	31,30	<LD	8,96	2,67	78,34
	o-Xylene	µg/m³	0,10	2,43	<LD	0,40	0,13	27,07
	Phenol	µg/m³	0,07	0,63	<LD	0,18	0,04	16,77
	n-Propylbenzene	µg/m³	0,05	0,25	<LD	0,11	0,02	2,55
	m-Ethyltoluene	µg/m³	0,05	0,30	<LD	0,10	0,01	2,44
	1,3,5-Trimethylbenzene	µg/m³	0,21	3,11	<LD	0,77	0,24	67,30
	tert-Butylbenzene	µg/m³	0,06	0,23	<LD	0,18	0,03	4,03
	1,2,4-Trimethylbenzene	µg/m³	0,05	0,74	<LD	0,05	0,03	0,74
	Indene	µg/m³	0,05	0,39	<LD	0,05	0,01	0,32
	Naphthalene	µg/m³	0,16	1,79	<LD	0,80	0,20	50,32
(9)	*alpha-Pinene*	µg/m³	1,29	90,19	<LD	10,27	5,40	76,86
	Camphene	µg/m³	0,06	0,86	<LD	0,05	0,05	1,80
	beta-Pinene	µg/m³	0,07	1,88	<LD	0,30	0,09	12,95
	Limonene	µg/m³	0,07	1,71	<LD	0,26	0,11	6,37

Clasificación de los COVS en Familias: (1)Halogenados, (2) Azufrados, (3) Alcoholes (4) Cetonas, (5)Eteres, (6)Alcanos/Alquenos, (7) Esteres, (8) Aromáticos y (9)Ciclos.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen nueve familias de compuestos: halogenados, azufrados, alcoholes, cetonas, éteres, alcanos/alquenos, ésteres, hidrocarburos aromáticos y ciclos. En ningún caso aparecen aldehídos, ácidos ni compuestos nitrogenados. Los compuestos que presentan mayor prevalencia, se citan a continuación:

1. Diclorodifluorometano (Halogenado)
2. Dimetil sulfuro y Dimetil disulfuro (Azufrados)
3. 2-propanol (Alcoholes)
4. Acetona (Cetonas)
5. Tetrahidrofurano (Éteres)
6. Pentano (Alcanos/Alquenos)
7. Etil acetato (Ésteres)
8. Benceno y Tolueno (Hidrocarburos aromáticos)
9. Alfa-pineno (Ciclos)

En base al perfil de compuestos orgánicos observados, se estima que los compuestos de referencia del entorno son: 2-Propanol, dimetilsulfuro, dimetildisulfuro, pentano, benceno, tolueno, estireno, etil acetato y naftaleno.

Respecto a los umbrales de olores.

Los compuestos dimetilsulfuro y dimetildisulfuro superan los umbrales de olor establecidos bibliográficamente.

Bases de datos utilizadas
INHST: Instituto Nacional de Higiene y Seguridad en el Trabajo
EPA: Agencia de Protección Ambiental de Estados Unidos
JOURNAL OF APPLIED TOXICOLOGY, VOL. 3, NO. 6,1983.
"Odor as an Aid to Chemical Safety. Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals -in Air and Water Dilution"

Derio, a 22 de Enero de 2018

V°B°
Jefe de Laboratorio

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EUSKO JAURLARITZA
GOBIERNO VASCO
OSASUN SAILA
DEPARTAMENTO DE SALUD
Dirección de Salud Pública y Adicciones
Laboratorio de Salud Pública

Responsable Unidad
Química Ambiental

J.I. Álvarez Uriarte

ANNEX V:

Informe sobre calidad del aire ambiente interior: Compuestos orgánicos volátiles. Empresa INDUSTRY 2. Made by Basque Government Laboratory.

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Empresa Funsan (Interior y chimenea) Tabira Kalea, 39, 48200 Durango, Bizkaia.

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Se procede a la toma de muestras en espacio interior y chimenea de la Empresa Funsan-Durango, al objeto de determinar la concentración de contaminantes orgánicos volátiles (VOCs). La toma de muestra de compuestos orgánicos volátiles (VOCs) se ha realizado en tubos combinados (60:80 mesh Tenax-TA/Carboxen 1000/Carbosieve S11 de 4-1/2" x 4mm ID), durante un periodo de 15 minutos a un caudal de 0,33 L/min, lo que conlleva 5 litros de muestra. La cuantificación se ha realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software.La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane; Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane.

1. Muestreo: 29/11/2018 (Interior y chimenea)
12 muestras

Familia	Compuesto		MUESTRA_01 29/11/2018 06:57 a 07:12 1ª Colada (junto molde)	MUESTRA_02 29/11/2018 07:17 a 07:32 1ª Colada (pasillo central-moldes al fondo)	MUESTRA_03 29/11/2018 07:44 a 08:01 Enfriamiento (pasillo central)	MUESTRA_04 29/11/2018 11:00 a 11:15 Enfriamiento (pasillo central)
(1)	Chloromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloromethane	µg/m³	0,41	<LD	<LD	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	<LD	<LD
	1,3-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
	1,2-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
(2)	Acetaldehyde	µg/m³	<LD	<LD	<LD	<LD
	n-Hexanal	µg/m³	<LD	<LD	<LD	0,92
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	<LD	<LD	<LD	<LD
	n-Decanal	µg/m³	<LD	<LD	<LD	<LD
(3)	Carbon disulphide	µg/m³	2,48	<LD	<LD	<LD
(4)	2-Propanol	µg/m³	3064,93	272,29	142,60	91,24
	tert-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Methoxy-2-propanol	µg/m³	<LD	<LD	<LD	<LD
(5)	Acetone	µg/m³	<LD	<LD	<LD	<LD
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	3-Methyl-2-butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	0,18	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	<LD	<LD	<LD
	Acetophenone	µg/m³	6,18	0,74	0,61	0,90
(6)	1,4-Dioxane	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	274,30	8,66	4,85	0,84
	3-Methylpentane	µg/m³	258,23	8,01	4,81	0,80
	n-Hexane	µg/m³	2,78	<LD	<LD	<LD
	Methylcyclopentane	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexane	µg/m³	<LD	<LD	<LD	<LD
	Methylcyclohexane	µg/m³	<LD	<LD	<LD	<LD
	n-Decane	µg/m³	<LD	<LD	<LD	<LD
	Butane, 2-methyl-	µg/m³	<LD	<LD	<LD	<LD
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	<LD	<LD	<LD	<LD
	Butyric acid	µg/m³	<LD	<LD	<LD	<LD
(9)	Ethyl acetate	µg/m³	90,44	1,12	0,78	<LD
	Isopropyl acetate	µg/m³	<LD	<LD	<LD	<LD
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	0,96	<LD	0,10	<LD
	n-Butyl acetate	µg/m³	<LD	2,60	0,83	<LD
(10)	Benzene	µg/m³	248,28	15,98	12,52	7,98
	Toluene	µg/m³	77,00	19,92	25,88	21,28
	Ethylbenzene	µg/m³	4,40	0,31	0,70	0,66
	m-Xylene	µg/m³	5,01	0,27	0,34	<LD

Ethynylbenzene	µg/m³	<LD	<LD	<LD	<LD
Styrene	µg/m³	19,43	1,19	3,71	6,11
o-Xylene	µg/m³	<LD	<LD	<LD	<LD
Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD
Phenol	µg/m³	8,66	0,59	0,27	0,38
n-Propylbenzene	µg/m³	<LD	<LD	<LD	<LD
m-Ethyltoluene	µg/m³	<LD	<LD	<LD	<LD
1,3,5-Trimethylbenzene	µg/m³	<LD	<LD	<LD	<LD
alpha-Methylstyrene	µg/m³	0,14	<LD	<LD	<LD
p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
Indene	µg/m³	1,41	<LD	<LD	<LD
Naphthalene	µg/m³	7,27	0,25	<LD	0,53
[11] alpha-Pinene	µg/m³	<LD	<LD	<LD	<LD
beta-Pinene	µg/m³	<LD	<LD	<LD	<LD
Limonene	µg/m³	<LD	<LD	<LD	<LD

Clasificación de los COVS en Familias: [1]Halogenados, [2]Aldehidos, [3]Azufrados, [4]Alcoholes, [5]Cetonas, [6] Éteres, [7]Alcanos/Alquenos, [8]Ácidos, [9]Esteres, [10]Aromáticos y [11]Ciclos.

(a)

(b)

(c)

Fotografías de los puntos de muestreo de COVs con bomba Xitech
(a) Muestra _01
(b) Muestra_02
(c) Muestra _03 y Muestra_04.

Familia	Compuesto		MUESTRA_05 29/11/2018 11:57 a 12:12 2ª Colada (pasillo central-molde del fondo)	MUESTRA_06 29/11/2018 12:13 a 12:28 2ª Colada (mitad pasillo-junto molde)	MUESTRA_07 29/11/2018 12:35 a 12:50 Enfriamiento (pasillo central-junto molde)	MUESTRA_08 29/11/2018 12:55 a 13:10 Enfriamiento (pasillo central-junto molde)
(1)	Chloromethane	µg/m³	<LD	1,81	<LD	<LD
	Chloroform	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloromethane	µg/m³	<LD	0,32	0,41	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	0,29	<LD
	1,3-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
	1,2-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
(2)	Acetaldehyde	µg/m³	<LD	<LD	8,66	<LD
	n-Hexanal	µg/m³	0,44	<LD	<LD	<LD
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	<LD	<LD	<LD	<LD
	n-Decanal	µg/m³	<LD	<LD	<LD	<LD
(3)	Carbon disulphide	µg/m³	<LD	6,93	5,17	<LD
(4)	2-Propanol	µg/m³	180,01	3832,04	3444,96	24,67
	tert-Butanol	µg/m³	1,10	<LD	<LD	<LD
	1-Butanol	µg/m³	0,24	2,66	2,66	<LD
	1-Methoxy-2-propanol	µg/m³	5,00	<LD	<LD	<LD
(5)	Acetone	µg/m³	<LD	<LD	<LD	<LD
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	3-Methyl-2-butanone	µg/m³	<LD	0,84	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	<LD	<LD	<LD
	Acetophenone	µg/m³	0,85	7,27	8,01	0,70
(6)	1,4-Dioxane	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	10,35	348,45	249,96	1,15
	3-Methylpentane	µg/m³	9,00	329,94	228,14	0,92
	n-Hexane	µg/m³	<LD	3,75	2,84	<LD
	Methylcyclopentane	µg/m³	<LD	<LD	0,46	<LD
	Cyclohexane	µg/m³	0,21	2,34	1,93	<LD
	Methylcyclohexane	µg/m³	<LD	<LD	<LD	<LD
	n-Decane	µg/m³	<LD	<LD	<LD	<LD
	Butane, 2-methyl-	µg/m³	<LD	<LD	<LD	<LD
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	<LD	<LD	<LD	<LD
	Butyric acid	µg/m³	<LD	<LD	<LD	<LD
(9)	Ethyl acetate	µg/m³	1,12	35,15	28,46	<LD
	Isopropyl acetate	µg/m³	<LD	<LD	<LD	<LD
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	1,82	2,40	<LD
	n-Butyl acetate	µg/m³	0,25	16,31	13,56	<LD
(10)	Benzene	µg/m³	13,95	246,64	239,15	2,33
	Toluene	µg/m³	35,95	266,99	247,61	5,06
	Ethylbenzene	µg/m³	0,99	21,43	25,05	0,12
	m-Xylene	µg/m³	0,72	15,06	16,62	<LD
	Ethynylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Styrene	µg/m³	8,34	165,22	181,81	0,82
	o-Xylene	µg/m³	<LD	<LD	<LD	<LD
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD

	Phenol	µg/m³	0,29	17,69	18,50	<LD
	n-Propylbenzene	µg/m³	<LD	<LD	<LD	<LD
	m-Ethyltoluene	µg/m³	<LD	<LD	1,07	<LD
	1,3,5-Trimethylbenzene	µg/m³	<LD	<LD	0,97	<LD
	alpha-Methylstyrene	µg/m³	<LD	0,74	0,94	<LD
	p-Isopropyltoluene	µg/m³	<LD	<LD	0,15	<LD
	Indene	µg/m³	<LD	<LD	4,89	<LD
	Naphthalene	µg/m³	<LD	16,26	18,36	0,11
(11)	alpha-Pinene	µg/m³	<LD	<LD	<LD	<LD
	beta-Pinene	µg/m³	<LD	0,63	<LD	<LD
	Limonene	µg/m³	<LD	0,16	0,14	<LD

Clasificación de los COVS en Familias: [1]Halogenados, [2]Aldehidos, [3]Azufrados, [4]Alcoholes, [5]Cetonas, [6] Éteres, [7]Alcanos/Alquenos, [8]Ácidos, [9]Esteres, [10]Aromáticos y [11]Ciclos.

(a)

(b)

(c)

Fotografías de los puntos de muestreo de COVs con bomba Xitech
(a) Muestra _05
(b) Muestra_06
(c) Muestra _07 y Muestra_08.

Familia	Compuesto		MUESTRA_09 29/11/2018 07:02 a 07:08 1ª Colada (chimenea hornos)	MUESTRA_10 29/11/2018 07:16 a 07:22 1ª Colada (chimenea hornos)	MUESTRA_11 29/11/2018 12:00 a 12:06 2ª Colada (chimenea hornos)	MUESTRA_12 29/11/2018 12:15 a 12:21 2ª Colada (chimenea hornos)
(1)	Chloromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	9,14	16,57	<LD	<LD
	Tetrachloromethane	µg/m³	0,56	0,61	0,52	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	<LD	<LD
	1,3-Dichlorobenzene	µg/m³	<LD	<LD	<LD	1,83
	1,2-Dichlorobenzene	µg/m³	<LD	<LD	2,09	<LD
(2)	Acetaldehyde	µg/m³	<LD	<LD	<LD	<LD
	n-Hexanal	µg/m³	1,57	<LD	<LD	<LD
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	0,43	0,72	0,36	0,48
	n-Decanal	µg/m³	0,25	0,57	0,29	0,29
(3)	Carbon disulphide	µg/m³	28,93	62,17	<LD	67,44
(4)	2-Propanol	µg/m³	392,07	880,02	650,55	975,75
	tert-Butanol	µg/m³	8,02	13,27	<LD	7,50
	1-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Methoxy-2-propanol	µg/m³	<LD	<LD	391,19	<LD
(5)	Acetone	µg/m³	230,64	598,82	459,48	775,17
	2-Butanone	µg/m³	<LD	<LD	32,16	<LD
	3-Methyl-2-butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	2,67	<LD	<LD
	Acetophenone	µg/m³	11,28	10,28	18,89	22,61
(6)	1,4-Dioxane	µg/m³	<LD	<LD	2,10	2,52
(7)	2-Methylpentane	µg/m³	48,31	117,84	79,08	133,42
	3-Methylpentane	µg/m³	12,71	15,81	15,82	41,25
	n-Hexane	µg/m³	<LD	<LD	<LD	<LD
	Methylcyclopentane	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexane	µg/m³	0,43	0,54	1,21	<LD
	Methylcyclohexane	µg/m³	0,59	1,17	<LD	<LD
	n-Decane	µg/m³	0,55	0,98	<LD	<LD
	Butane, 2-methyl-	µg/m³	29,93	116,45	80,87	72,86
	Pentane	µg/m³	<LD	<LD	463,70	<LD
(8)	Acetic acid	µg/m³	<LD	105,24	75,16	143,39
	Butyric acid	µg/m³	<LD	<LD	<LD	1,74
(9)	Ethyl acetate	µg/m³	14,54	24,30	13,06	21,90
	Isopropyl acetate	µg/m³	<LD	<LD	4,54	8,24
	Ethyl acrylate	µg/m³	<LD	<LD	5,64	7,84
	Methyl methacrylate	µg/m³	<LD	3,95	4,82	8,47
	n-Butyl acetate	µg/m³	3,74	4,85	2,95	4,59
(10)	Benzene	µg/m³	391,74	1436,46	1651,15	1638,49
	Toluene	µg/m³	507,87	937,22	994,67	1237,94
	Ethylbenzene	µg/m³	9,76	22,76	32,28	47,88
	m-Xylene	µg/m³	6,33	13,44	15,28	28,64
	Ethynylbenzene	µg/m³	<LD	<LD	39,06	54,68
	Styrene	µg/m³	17,66	83,02	417,16	270,69
	o-Xylene	µg/m³	1,98	<LD	<LD	<LD
	Isopropylbenzene	µg/m³	<LD	<LD	3,67	<LD
	Phenol	µg/m³	1,16	1,76	2,89	4,73
	n-Propylbenzene	µg/m³	<LD	0,90	0,83	1,13

	m-Ethyltoluene	µg/m³	<LD	<LD	<LD	<LD
	1,3,5-Trimethylbenzene	µg/m³	0,54	<LD	<LD	1,14
	alpha-Methylstyrene	µg/m³	<LD	0,33	2,93	1,27
	p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
	Indene	µg/m³	<LD	3,73	12,53	7,54
	Naphthalene	µg/m³	4,02	6,31	20,27	23,96
(11)	alpha-Pinene	µg/m³	0,82	1,59	<LD	<LD
	beta-Pinene	µg/m³	<LD	<LD	<LD	<LD
	Limonene	µg/m³	<LD	<LD	<LD	<LD

Clasificación de los COVS en Familias: [1]Halogenados, [2]Aldehidos, [3]Azufrados, [4]Alcoholes, [5]Cetonas, [6] Éteres, [7]Alcanos/Alquenos, [8]Ácidos, [9]Esteres,[10]Aromáticos y [11]Ciclos.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen once familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, éteres, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos y ciclos. En ningún caso aparecen compuestos nitrogenados

Derio, a 23 de Enero de 2018

V°B°
Jefe de Laboratorio

I. García Robles

EUSKO JAURLARITZA
GOBIERNO VASCO
OSASUN SAILA
Osasun Publikoko Laborategia
DEPARTAMENTO DE SALUD
Laboratorio de Salud Pública

Responsable Unidad
Química Ambiental

J.I. Álvarez Uriarte

ANNEX VI:

Informe sobre calidad del aire ambiente interior: Compuestos orgánicos volátiles.

Empresa INDUSTRY 1.

Made by Basque Government Laboratory

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Empresa Fumbarri. San Roke Kalea, 22, 48200 Durango, Bizkaia.

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Se procede a la toma de muestra en el interior y en la chimenea de la Empresa Fumbarri-Durango, al objeto de determinar la concentración de contaminantes orgánicos volátiles (VOCs). La toma de muestra de compuestos orgánicos volátiles (VOCs) se realiza en tubos combinados (60:80 mesh Tenax-TA/Carboxen 1000/Carbosieve S11 de 4-1/2" x 4mm ID), durante un periodo de 15 minutos a un caudal de 0,33 L/min, lo que conlleva 5 litros de muestra. La cuantificación se lleva a cabo en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software.La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane; Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene, 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane. Butane,2-methyl- y Pentane.

1. Muestreo: 24/09/2018 a 25/09/2018
12 muestras

Familia	Compuesto		MUESTRA_01 24/09/2018 10:30 a 10:45 1ºColada (junto horno)	MUESTRA_02 24/09/2018 10:30 a 10:45 1ºColada (junto cabina)	MUESTRA_03 24/09/2018 10:47 a 11:02 1ºColada (junto horno)	MUESTRA_04 24/09/2018 10:47 a 11:02 1ºColada (junto cabina)
(1)	Dichlorodifluoromethane	µg/m³	0,46	<LD	<LD	<LD
	Chloroform	µg/m³	0,68	<LD	<LD	<LD
	Tetrachloromethane	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	<LD	<LD
(2)	n-Hexanal	µg/m³	0,16	<LD	0,86	0,38
	n-Octanal	µg/m³	0,15	<LD	<LD	0,30
	n-Nonanal	µg/m³	0,39	<LD	<LD	0,63
	n-Decanal	µg/m³	0,21	0,74	0,15	0,44
(3)	Dimethyl sulphide	µg/m³	<LD	<LD	0,23	<LD
	Carbon disulphide	µg/m³	0,75	<LD	5,83	<LD
	Dimethyldisulphide	µg/m³	<LD	<LD	<LD	<LD
(4)	2-Propanol	µg/m³	47,04	<LD	141,26	<LD
	tert-Butanol	µg/m³	0,66	<LD	15,67	<LD
	1-Butanol	µg/m³	0,24	<LD	<LD	<LD
	2-Ethyl-1-hexanol	µg/m³	<LD	<LD	1,13	<LD
(5)	Acetone	µg/m³	<LD	<LD	<LD	7,07
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	1,68	<LD
	Cyclohexanone	µg/m³	0,74	<LD	30,76	<LD
	Acetophenone	µg/m³	1,03	<LD	2,89	0,94
(6)	Tetrahydrofuran	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	<LD	1,26	19,33	2,09
	3-Methylpentane	µg/m³	<LD	<LD	3,37	<LD
	n-Hexane	µg/m³	<LD	<LD	0,49	<LD
	n-Heptane	µg/m³	<LD	<LD	<LD	<LD
	n-Octane	µg/m³	<LD	1,25	0,66	<LD
	3-Methyloctane	µg/m³	<LD	1,68	<LD	<LD
	n-Nonane	µg/m³	0,17	13,61	0,50	<LD
	n-Decane	µg/m³	0,42	41,61	1,82	<LD
	n-Undecane	µg/m³	<LD	44,83	5,40	<LD
	n-Dodecane	µg/m³	<LD	0,98	0,19	<LD
	Butane, 2-methyl-	µg/m³	<LD	<LD	<LD	<LD
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	4,58	<LD	<LD	2,09
(9)	Ethyl acetate	µg/m³	0,41	1,66	<LD	<LD
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	<LD	<LD	<LD
	n-Butyl acetate	µg/m³	<LD	<LD	<LD	<LD
(10)	Benzene	µg/m³	0,48	0,46	0,97	0,29
	Toluene	µg/m³	0,60	1,58	13,72	0,15
	Ethylbenzene	µg/m³	0,47	0,94	1,46	<LD
	m-Xylene	µg/m³	0,75	1,83	2,11	<LD
	Ethynylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Styrene	µg/m³	<LD	0,66	1,87	<LD
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Phenol	µg/m³	0,10	<LD	<LD	0,11
	n-Propylbenzene	µg/m³	<LD	<LD	<LD	<LD

	m-Ethyltoluene	µg/m³	0,17	13,85	0,67	<LD
	1,3,5-Trimethylbenzene	µg/m³	0,26	21,67	<LD	<LD
	alpha-Methylstyrene	µg/m³	<LD	<LD	<LD	<LD
	o-Ethyltoluene	µg/m³	<LD	10,67	<LD	<LD
	1,2,4-Trimethylbenzene	µg/m³	<LD	21,62	<LD	<LD
	p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
	1,2,3-Trimethylbenzene	µg/m³	<LD	<LD	0,36	<LD
	Indene	µg/m³	<LD	<LD	<LD	<LD
	Naphthalene	µg/m³	<LD	<LD	0,13	<LD
(11)	alpha-Pinene	µg/m³	0,37	<LD	2,51	<LD
	beta-Pinene	µg/m³	0,17	<LD	1,12	<LD
	Limonene	µg/m³	<LD	<LD	0,19	<LD
(12)	N,N-Dimethylformamide	µg/m³	<LD	<LD	<LD	<LD

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Éteres,(7)Alcanos/Alquenos, (8)Ácidos, (9)Esteres,(10)Aromáticos,(11)Ciclos y (12)Nitrogenados.

(a)

(b)

Fotografías de los puntos de muestreo de COVs con bomba Xitech
(a) Muestra _01 y Muestra_03
(b) Muestra _02 y Muestra_04.

Familia	Compuesto		MUESTRA_05 25/09/2018 02:17 a 02:32 2ºColada (junto cabina)	MUESTRA_06 25/09/2018 02:17 a 02:32 2ºColada (junto molde fondo)	MUESTRA_07 25/09/2018 02:39 a 02:54 2ºColada (junto molde entrada)	MUESTRA_08 25/09/2018 02:59 a 03:14 2ºColada (junto cabina)
(1)	Dichlorodifluoromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	<LD	0,33	<LD	<LD
	Tetrachloromethane	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	<LD	<LD
(2)	n-Hexanal	µg/m³	<LD	<LD	0,72	<LD
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	<LD	<LD	<LD	<LD
	n-Decanal	µg/m³	<LD	<LD	0,11	<LD
(3)	Dimethyl sulphide	µg/m³	<LD	<LD	<LD	1,97
	Carbon disulphide	µg/m³	<LD	<LD	9,66	<LD
	Dimethyldisulphide	µg/m³	<LD	<LD	<LD	0.12
(4)	2-Propanol	µg/m³	<LD	29,82	<LD	<LD
	tert-Butanol	µg/m³	<LD	<LD	38,21	<LD
	1-Butanol	µg/m³	<LD	<LD	1,60	<LD
	2-Ethyl-1-hexanol	µg/m³	<LD	<LD	1,98	<LD
(5)	Acetone	µg/m³	<LD	<LD	<LD	20,34
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	18,14	<LD
	Cyclohexanone	µg/m³	<LD	<LD	38,88	<LD
	Acetophenone	µg/m³	1,27	0,76	3,73	2,19
(6)	Tetrahydrofuran	µg/m³	<LD	<LD	1,25	<LD
(7)	2-Methylpentane	µg/m³	<LD	0,99	26,01	0,65
	3-Methylpentane	µg/m³	<LD	<LD	5,44	<LD
	n-Hexane	µg/m³	<LD	<LD	0,70	<LD
	n-Heptane	µg/m³	<LD	<LD	0,39	<LD
	n-Octane	µg/m³	<LD	<LD	1,00	<LD
	3-Methyloctane	µg/m³	<LD	<LD	<LD	<LD
	n-Nonane	µg/m³	<LD	<LD	<LD	0,22
	n-Decane	µg/m³	<LD	0,27	0,41	1,09
	n-Undecane	µg/m³	<LD	0,61	<LD	3,05
	n-Dodecane	µg/m³	<LD	<LD	0,18	0,17
	Butane, 2-methyl-	µg/m³	<LD	<LD	3,80	<LD
	Pentane	µg/m³	<LD	<LD	21,75	<LD
(8)	Acetic acid	µg/m³	<LD	<LD	22,66	<LD
(9)	Ethyl acetate	µg/m³	<LD	0,47	2,28	3,34
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	<LD	<LD	<LD
	n-Butyl acetate	µg/m³	<LD	<LD	<LD	<LD
(10)	Benzene	µg/m³	0,28	1,84	5,68	12,29
	Toluene	µg/m³	0,41	3,74	42,38	78,11
	Ethylbenzene	µg/m³	<LD	0,16	2,51	1,38
	m-Xylene	µg/m³	<LD	0,25	4,36	3,56
	Ethynylbenzene	µg/m³	<LD	<LD	2,54	1,35
	Styrene	µg/m³	<LD	0,93	30,74	7,02
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Phenol	µg/m³	<LD	<LD	<LD	<LD
	n-Propylbenzene	µg/m³	<LD	<LD	0,23	<LD
	m-Ethyltoluene	µg/m³	<LD	0,11	0,53	0,62
	1,3,5-Trimethylbenzene	µg/m³	<LD	<LD	0,65	<LD

	alpha-Methylstyrene	µg/m³	<LD	<LD	<LD	<LD
	o-Ethyltoluene	µg/m³	<LD	0,10	<LD	<LD
	1,2,4-Trimethylbenzene	µg/m³	<LD	<LD	<LD	<LD
	p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
	1,2,3-Trimethylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Indene	µg/m³	<LD	<LD	1,50	2,46
	Naphthalene	µg/m³	<LD	<LD	1,63	2,03
(11)	alpha-Pinene	µg/m³	<LD	1,76	2,05	<LD
	beta-Pinene	µg/m³	<LD	0,80	0,84	3,54
	Limonene	µg/m³	<LD	<LD	0,40	0,15
(12)	N,N-Dimethylformamide	µg/m³	<LD	<LD	2.29	<LD

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6)Éteres,(7)Alcanos/Alquenos, (8)Ácidos, (9)Esteres,(10)Aromáticos,(11)Ciclos y (12)Nitrogenados.

(a)

(b)

(c)

Fotografías de los puntos de muestreo de COVs con bomba Xitech
(a) Muestra _06
(b) Muestra_05 y Muestra_08
(c) Muestra _07.

Familia	Compuesto		MUESTRA_09 24/09/2018 22:35 a 22:41 (Chimenea colada)	MUESTRA_10 24/09/2018 23:10 a 23:16 (Chimenea colada)	MUESTRA_11 25/09/2018 02:17 a 02:23 (Chimenea colada)	MUESTRA_12 25/09/2018 02:47 a 02:52 (Chimenea colada)
(1)	Dichlorodifluoromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloromethane	µg/m³	<LD	<LD	0,39	<LD
	Tetrachloroethene	µg/m³	0,45	<LD	<LD	<LD
(2)	n-Hexanal	µg/m³	<LD	<LD	<LD	<LD
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	<LD	<LD	<LD	<LD
	n-Decanal	µg/m³	<LD	0,19	<LD	<LD
(3)	Dimethyl sulphide	µg/m³	<LD	<LD	1,54	<LD
	Carbon disulphide	µg/m³	<LD	<LD	16,35	5,45
	Dimethyldisulphide	µg/m³	<LD	0,40	0,33	<LD
(4)	2-Propanol	µg/m³	2331,08	3376,75	394,92	354,95
	tert-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Butanol	µg/m³	<LD	<LD	2,93	<LD
	2-Ethyl-1-hexanol	µg/m³	<LD	<LD	<LD	<LD
(5)	Acetone	µg/m³	816,24	<LD	<LD	179,93
	2-Butanone	µg/m³	39,59	<LD	15,26	13,45
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	<LD	<LD	<LD
	Acetophenone	µg/m³	7,01	11,86	8,59	6,95
(6)	Tetrahydrofuran	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	<LD	<LD	2,93	<LD
	3-Methylpentane	µg/m³	<LD	<LD	<LD	<LD
	n-Hexane	µg/m³	<LD	1,76	<LD	<LD
	n-Heptane	µg/m³	<LD	<LD	<LD	<LD
	n-Octane	µg/m³	<LD	<LD	<LD	<LD
	3-Methyloctane	µg/m³	<LD	<LD	<LD	<LD
	n-Nonane	µg/m³	1,43	<LD	<LD	<LD
	n-Decane	µg/m³	4,93	2,76	0,39	<LD
	n-Undecane	µg/m³	5,39	4,94	<LD	<LD
	n-Dodecane	µg/m³	<LD	<LD	<LD	<LD
	Butane, 2-methyl-	µg/m³	<LD	<LD	2,30	1,31
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	90,39	<LD	<LD	6,52
(9)	Ethyl acetate	µg/m³	124,14	70,12	37,18	23,92
	Ethyl acrylate	µg/m³	<LD	38,27	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	26,44	<LD	8,61
	n-Butyl acetate	µg/m³	1,30	8,54	<LD	<LD
(10)	Benzene	µg/m³	938,05	1113,77	941,35	882,30
	Toluene	µg/m³	1577,96	1703,26	1015,89	937,86
	Ethylbenzene	µg/m³	25,12	157,98	17,49	30,74
	m-Xylene	µg/m³	89,88	60,19	25,27	17,88
	Ethynylbenzene	µg/m³	<LD	60,25	35,43	26,10
	Styrene	µg/m³	100,29	876,42	436,84	383,22
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	1,12
	Phenol	µg/m³	2,96	7,18	4,90	1,84
	n-Propylbenzene	µg/m³	1,56	<LD	1,16	<LD
	m-Ethyltoluene	µg/m³	4,53	2,70	2,00	0,98
	1,3,5-Trimethylbenzene	µg/m³	7,29	3,83	2,62	<LD

	alpha-Methylstyrene	µg/m³	<LD	1,86	<LD	3,36
	o-Ethyltoluene	µg/m³	2,59	<LD	<LD	<LD
	1,2,4-Trimethylbenzene	µg/m³	5,60	2,83	<LD	<LD
	p-Isopropyltoluene	µg/m³	<LD	0,33	<LD	<LD
	1,2,3-Trimethylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Indene	µg/m³	17,41	14,18	23,39	17,43
	Naphthalene	µg/m³	2,37	6,50	28,08	12,88
(11)	alpha-Pinene	µg/m³	3,65	9,85	<LD	2,60
	beta-Pinene	µg/m³	<LD	4,61	<LD	<LD
	Limonene	µg/m³	<LD	0,51	0,27	0,14
(12)	N,N-Dimethylformamide	µg/m³	<LD	<LD	<LD	<LD

Clasificación de los COVS en Familias: [1]Halogenados, [2]Aldehidos, [3]Azufrados, [4]Alcoholes, [5]Cetonas, [6] Éteres, [7]Alcanos/Alquenos, [8]Ácidos, [9]Esteres, [10]Aromáticos, [11]Ciclos y [12]Nitrogenados.

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En las muestras analizadas aparecen doce familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, éteres, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos, ciclos y compuestos nitrogenados.

Derio, a 23 de Enero de 2018

V°B°
Jefe de Laboratorio

I. García Robles

EUSKO JAURLARITZA GOBIERNO VASCO
OSASUN SAILA
DEPARTAMENTO DE SALUD

Responsable Unidad
Química Ambiental

J.I. Álvarez Uriarte

ANNEX VII:

Informe sobre calidad del aire ambiente: Compuestos orgánicos volátiles.

Empresa INDUSTRY 2 (Exteriores).

Made by Basque Government Laboratory.

Informe sobre la calidad del aire ambiente: Compuestos orgánicos volátiles Empresa Funsan (Exteriores) Tabira Kalea, 39, 48200 Durango, Bizkaia.

I. OBJETO

Evaluar la calidad del aire ambiente respecto a la presencia de contaminantes orgánicos volátiles (COVs).

II. ALCANCE

Entorno municipal de Durango.

III. ACTUACIONES

Se procede a la toma de muestras en espacioexterior de la Empresa Funsan-Durango, al objeto de determinar la concentración de contaminantes orgánicos volátiles (VOCs). La toma de muestra de compuestos orgánicos volátiles (VOCs) se ha realizado en tubos combinados (60:80 mesh Tenax-TA/Carboxen 1000/Carbosieve S11 de 4-1/2" x 4mm ID), durante un periodo de 15 minutos a un caudal de 0,33 L/min, lo que conlleva 5 litros de muestra. La cuantificación se ha realizado en la Unidad Móvil 7, provista de un equipo de Desorción Térmica CDS ACEM 9305 acoplado a un GC/MSD 5975T con el uso de un tubo y trampa con desorción focalizada, cuyo funcionamiento se puede controlar mediante software.La desorción final se realiza a través de una línea de transferencia al GC/MSD 5975T. Posteriormente, con el uso del Software ChemStation y del Software de Deconvolución (DRS) que emplea la librería IARTLIB.MSL (Indoor Air Toxic Library), se identifica y cuantifica los compuestos orgánicos observados. Para el caso de compuestos cuyo patrón no se posea se emplea el método de SemiQuant para una estimación del contenido en la muestra. En adición, se utiliza el Software TargetView para realizar una identificación más detallada en los casos de incertidumbre.

Todo ello permite cuantificar diferentes familias de compuestos orgánicos: hidrocarburos aromáticos, hidrocarburos alifáticos, cicloalcanos, alcoholes, esteres, halocarbonos, glicoles, aldehídos, cetonas y terpenos, entre otros. El método desarrollado permite determinar 172 compuestos estimados de referencia por la OMS y la EPA. Los datos incorporados a cada periodo de muestreo incluyen los compuestos que han superado el límite de determinación (0,1 $\mu g/m^3$). El resto de compuestos analizados presentan valores inferiores a dicho límite.

Dichlorodifluoromethane; Chloromethane; Acetaldehyde; Vinylchloride (Cloroethene); Methanethiol; Bromomethane; Chloroethane; Trichlorofluoromethane; 2-Propanol; Acetone; Propylene oxide; Furane; Ethanethiol; Dimethoxymethane; 1,1-Dichloroethene; Dimethyl sulphide; tert-Butanol; Acrylonitrile; Dichloromethane; Carbon disulphide; 1-Propanol; 1,2-Dichloroethene; 2-Methylpentane; Methyl tert-butylether; Acetic acid; 1,1-Dichloroethane; 3-Methylpentane; Vinyl acetate; n-Butanal; 1,1-Dimethoxyethane; 2-Methyl-2-propanethiol; n-Hexane; 2-Butanone (MEK); 1,2-Dichloroethene(trans); Bromochloromethane; Ethyl acetate; Chloroform; Methyl acrylate; 2,2-Dichloropropane; Methylcyclopentane; Tetrahydrofuran; 2-Methoxyethanol; 1,2-Dichloroethane(cis); 1,1,1-Trichlorethane; 1-Butanol; 1,1-Dichloropropene; Isopropyl acetate; 3-Methyl-2-butanone; 2-Methylhexane; Cyclohexane; Tetrachloromethane; Benzene; 1-Methoxy-2-propanol; 3-Methylhexane; 2,2,4-Trimethylpentane; Ethyl acrylate; n-Heptane; Dibromomethane; 1,2-Dichloropropane; Trichloroethene; Bromodichloromethane; 2-Ethoxyethanol; 1,4-Dioxane; Propyl acetate; Methyl methacrylate; Epichlorohydrin; Propylene glycol; Methylcyclohexane; cis-1,3-Dichloropropene; 4-Methyl-2-pentanone (MIBK); Pyridine; Dimethyldisulphide; Butyric acid; 1-Pentanol; 1,3-Dichloropropene; 1,1,2-Trichloroethane; 3-Methylheptane; Toluene-d8; Toluene; 1,3-Dichloropropane; N,N-Dimethylformamide; 1-Octene; n-Octane; Dibromochloromethane; n-Hexanal; n-Butyl acetate; 1,2-Dibromoethane; Tetrahydrothiophene; Tetrachloroethene; 2-Methoxyethyl acetate; Methyl ethyl disulfide; 1,1,1,2-Tetrachloroethane; 1-Hexanol; Chlorobenzene; 3-Methyloctane; Ethylbenzene; Cyclohexanol; m-Xylene; p-Xylene; Ethynylbenzene; n-Butyl acrylate; 2-Ethoxyethyl acetate; Bromoform; n-Nonane; 2-Butoxyethanol; Styrene; Cyclohexanone; 1,1,2,2-Tetrachloroethane; o-Xylene; 1,2,3-Trichloropropane; Diethyl disulfide; Isopropylbenzene (cumene); alpha-Pinene; Methyl tert-butyl disulfide; Bromobenzene; 2-Methylnonane; Phenol; n-Propylbenzene; Camphene; 2-Chlorotoluene; m-Ethyltoluene; 4-Chlorotoluene; 1-Decene; 1,3,5-Trimethylbenzene; Aniline; n-Decane; alpha-Methylstyrene; beta-Pinene; o-Ethyltoluene; n-Octanal; tert-Butylbenzene; o-Methystyrene; 1,2,4-Trimethylbenzene; 2-Ethyl-1-hexanol; p-Methylstyrene; delta-3-Carene; sec-Butylbenzene; 1,3-Dichlorobenzene; Ethyl tert-butyl disulfide; p-Dichlorobenzene; p-Isopropyltoluene; Limonene; 1,2,3-Trimethylbenzene; 1-Octanol; 1,2-Dichlorobenzene; n-Butylbenzene; 2-Butoxyethyl acetate; Indene; n-Undecane; Acetophenone; 1,2-Dibromo-3-chloropropane; n-Nonanal; 2-Ethylhexyl acetate; 1,3-Diisopropylbenzene; 2-(2-Butoxyethoxy)ethanol; n-Dodecane; n-Decanal; 1,2,4-Trichlorobenzene; Naphthalene; Hexachlorobutadiene; 1,2,3-Trichlorobenzene; n-Tridecane; Caprolactam; n-Tetradecane; n-Pentadecane; Longifolene; Dimethylphthalate; alpha-Cedrene; 2,6-di-t-Butyl-4-methylphen; n-Hexadecane, Butane,2-methyl- y Pentane.

1. Muestreo: 17/12/2018 a 18/12/2018 (Exteriores)
8 muestras

Familia	Compuesto		MUESTRA_01 17/12/2018 11:04 a 11:19 Punto 1	MUESTRA_02 17/12/2018 11:34 a 11:49 Punto 1	MUESTRA_03 17/12/2018 12:02 a 12:17 Punto 2	MUESTRA_04 17/12/2018 12:32 a 12:47 Punto 2
(1)	Chloromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	<LD	0,70	1,72	2,43
	Tetrachloromethane	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloroethene	µg/m³	0,17	<LD	<LD	<LD
	1,3-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
	1,2-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
(2)	Acetaldehyde	µg/m³	<LD	<LD	<LD	<LD
	n-Hexanal	µg/m³	0,14	0,90	0,45	<LD
	n-Octanal	µg/m³	<LD	<LD	<LD	<LD
	n-Nonanal	µg/m³	<LD	<LD	<LD	<LD
	n-Decanal	µg/m³	<LD	<LD	<LD	<LD
(3)	Carbon disulphide	µg/m³	<LD	<LD	1,80	<LD
(4)	2-Propanol	µg/m³	<LD	<LD	<LD	<LD
	tert-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Butanol	µg/m³	<LD	<LD	<LD	<LD
	1-Methoxy-2-propanol	µg/m³	<LD	<LD	<LD	<LD
(5)	Acetone	µg/m³	2,10	<LD	<LD	1,55
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	3-Methyl-2-butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	<LD	0,20	<LD
	Acetophenone	µg/m³	2,12	3,50	2,26	2,45
(6)	1,4-Dioxane	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	0,35	0,94	4,47	<LD
	3-Methylpentane	µg/m³	<LD	<LD	<LD	<LD
	n-Hexane	µg/m³	<LD	<LD	0,15	<LD
	Methylcyclopentane	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexane	µg/m³	<LD	<LD	<LD	<LD
	Methylcyclohexane	µg/m³	<LD	<LD	<LD	<LD
	n-Decane	µg/m³	<LD	<LD	<LD	<LD
	Butane, 2-methyl-	µg/m³	<LD	<LD	<LD	<LD
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	<LD	<LD	4,78	<LD
	Butyric acid	µg/m³	<LD	<LD	<LD	<LD
(9)	Ethyl acetate	µg/m³	<LD	<LD	<LD	<LD
	Isopropyl acetate	µg/m³	<LD	<LD	<LD	<LD
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	<LD	<LD	<LD
	n-Butyl acetate	µg/m³	<LD	<LD	<LD	<LD
(10)	Benzene	µg/m³	<LD	<LD	<LD	<LD
	Toluene	µg/m³	0,87	0,42	1,09	0,17
	Ethylbenzene	µg/m³	<LD	<LD	0,22	<LD
	m-Xylene	µg/m³	<LD	<LD	<LD	<LD
	Ethynylbenzene	µg/m³	0,31	0,47	<LD	<LD
	Styrene	µg/m³	0,28	<LD	0,41	<LD

	o-Xylene	µg/m³	<LD	<LD	<LD	<LD
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Phenol	µg/m³	0,11	0,14	0,22	0,11
	n-Propylbenzene	µg/m³	<LD	<LD	<LD	<LD
	m-Ethyltoluene	µg/m³	<LD	<LD	<LD	<LD
	1,3,5-Trimethylbenzene	µg/m³	<LD	<LD	<LD	<LD
	alpha-Methylstyrene	µg/m³	<LD	<LD	<LD	<LD
	p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
	Indene	µg/m³	<LD	<LD	<LD	<LD
	Naphthalene	µg/m³	<LD	<LD	<LD	<LD
(11)	alpha-Pinene	µg/m³	<LD	<LD	0,15	<LD
	beta-Pinene	µg/m³	<LD	<LD	<LD	<LD
	Limonene	µg/m³	<LD	<LD	<LD	<LD

Clasificación de los COVS en Familias: (1)Halogenados, (2)Aldehidos, (3)Azufrados, (4)Alcoholes, (5)Cetonas, (6) Éteres, (7)Alcanos/Alquenos, (8)Ácidos, (9)Esteres,(10)Aromáticos y (11)Ciclos.

(b)

(a)

Fotografías de los puntos de muestreo de COVs con bomba Xitech
(a) Muestra_01 y Muestra_02
(b) Muestra_03 y Muestra_04

Parque Tecnológico de Bizkaia. Ibaizabal Bidea, Edificio 502. 48160 Derio
Tfno. 94 403 15 11 – Fax 94 403 15 01 – E-mail: labora3bi-san@ej-gv.es

Familia	Compuesto		MUESTRA_05 18/12/2018 11:00 a 11:15 Punto 1	MUESTRA_06 18/12/2018 11:30 a 11:45 Punto 1	MUESTRA_07 18/12/2018 12:45 a 13:00 Punto 2	MUESTRA_08 18/12/2018 13:15 a 13:30 Punto 2
(1)	Chloromethane	µg/m³	<LD	<LD	<LD	<LD
	Chloroform	µg/m³	8,91	0,40	<LD	2,53
	Tetrachloromethane	µg/m³	<LD	<LD	<LD	<LD
	Tetrachloroethene	µg/m³	<LD	<LD	<LD	<LD
	1,3-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
	1,2-Dichlorobenzene	µg/m³	<LD	<LD	<LD	<LD
(2)	Acetaldehyde	µg/m³	<LD	<LD	<LD	<LD
	n-Hexanal	µg/m³	1,91	<LD	<LD	1,08
	n-Octanal	µg/m³	0,30	<LD	<LD	0,13
	n-Nonanal	µg/m³	0,52	<LD	<LD	0,16
	n-Decanal	µg/m³	0,23	<LD	<LD	0,10
(3)	Carbon disulphide	µg/m³	6,09	<LD	<LD	4,35
(4)	2-Propanol	µg/m³	<LD	<LD	<LD	<LD
	tert-Butanol	µg/m³	5,65	0,65	<LD	2,99
	1-Butanol	µg/m³	1,00	<LD	<LD	0,36
	1-Methoxy-2-propanol	µg/m³	<LD	<LD	<LD	<LD
(5)	Acetone	µg/m³	<LD	<LD	<LD	<LD
	2-Butanone	µg/m³	<LD	<LD	<LD	<LD
	3-Methyl-2-butanone	µg/m³	<LD	<LD	<LD	<LD
	4-Methyl-2-pentanone	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexanone	µg/m³	<LD	<LD	<LD	0,36
	Acetophenone	µg/m³	2,16	1,06	0,96	1,37
(6)	1,4-Dioxane	µg/m³	<LD	<LD	<LD	<LD
(7)	2-Methylpentane	µg/m³	24,24	2,59	0,60	11,62
	3-Methylpentane	µg/m³	<LD	<LD	<LD	<LD
	n-Hexane	µg/m³	0,77	<LD	<LD	0,39
	Methylcyclopentane	µg/m³	<LD	<LD	<LD	<LD
	Cyclohexane	µg/m³	<LD	<LD	<LD	<LD
	Methylcyclohexane	µg/m³	<LD	<LD	<LD	<LD
	n-Decane	µg/m³	0,19	<LD	<LD	<LD
	Butane, 2-methyl-	µg/m³	1,38	<LD	<LD	0,66
	Pentane	µg/m³	<LD	<LD	<LD	<LD
(8)	Acetic acid	µg/m³	<LD	<LD	<LD	<LD
	Butyric acid	µg/m³	<LD	<LD	<LD	<LD
(9)	Ethyl acetate	µg/m³	0,48	<LD	<LD	<LD
	Isopropyl acetate	µg/m³	<LD	<LD	<LD	<LD
	Ethyl acrylate	µg/m³	<LD	<LD	<LD	<LD
	Methyl methacrylate	µg/m³	<LD	<LD	<LD	<LD
	n-Butyl acetate	µg/m³	<LD	<LD	<LD	<LD
(10)	Benzene	µg/m³	<LD	<LD	<LD	<LD
	Toluene	µg/m³	3,49	0,30	0,85	2,36
	Ethylbenzene	µg/m³	0,83	<LD	<LD	0,44
	m-Xylene	µg/m³	0,19	<LD	<LD	<LD
	Ethynylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Styrene	µg/m³	1,65	0,17	0,22	1,00
	o-Xylene	µg/m³	0,13	<LD	<LD	0,21
	Isopropylbenzene	µg/m³	<LD	<LD	<LD	<LD
	Phenol	µg/m³	0,14	<LD	<LD	<LD
	n-Propylbenzene	µg/m³	<LD	<LD	<LD	<LD
	m-Ethyltoluene	µg/m³	<LD	<LD	<LD	<LD

	1,3,5-Trimethylbenzene	µg/m³	0,10	<LD	<LD	<LD
	alpha-Methylstyrene	µg/m³	<LD	<LD	<LD	<LD
	p-Isopropyltoluene	µg/m³	<LD	<LD	<LD	<LD
	Indene	µg/m³	<LD	<LD	<LD	<LD
	Naphthalene	µg/m³	<LD	<LD	<LD	<LD
(11)	alpha-Pinene	µg/m³	<LD	<LD	<LD	0,26
	beta-Pinene	µg/m³	<LD	<LD	<LD	<LD
	Limonene	µg/m³	0,10	<LD	<LD	<LD

Clasificación de los COVS en Familias: [1]Halogenados, [2]Aldehidos, [3]Azufrados, [4]Alcoholes, [5]Cetonas, [6] Éteres [7]Alcanos/Alquenos, [8]Ácidos, [9]Esteres,[10]Aromáticos y [11]Ciclos.

(b)

(a)

Fotografías de los puntos de muestreo de COV's con bomba Xitech
(a) Muestra_05 y Muestra_06
(b) Muestra_07 y Muestra_08

IV. CONCLUSIONES

Respecto a los indicadores de la calidad del aire.

En la campaña realizada aparecen once familias de compuestos: halogenados, aldehídos, azufrados, alcoholes, cetonas, éteres, alcanos/alquenos, ácidos, ésteres, hidrocarburos aromáticos y ciclos. En ningún caso aparecen compuestos nitrogenados.

Derio, a 23 de Enero de 2018

V°B°
Jefe de Laboratorio

I. García Robles

EUSKO JAURLARITZA
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DEPARTAMENTO DE SALUD
Dirección de Salud Pública y Adicciones
Laboratorio de Salud Pública

Responsable Unidad
Química Ambiental

J.I. Álvarez Uriarte

ANNEX VIII:

Air Quality Report of the Municipality of Durango with respect to Volatile Organic Compounds (VOCs).

Made by UPV Basque University.

eman ta zabal zazu

Universidad del País Vasco
Euskal Herriko Unibertsitatea

ZTF-FCT
Zientzia eta Teknologia Fakultatea
Facultad de Ciencia y Tecnología

tqsa

INGENIARITZA KIMIKOA SAILA
DEPARTAMENTO DE INGENIERÍA QUÍMICA
DEPARTMENT OF CHEMICAL ENGINEERING

Air Quality Report

of the Municipality of Durango with respect to

Volatile Organic Compounds (VOCs)

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1. Preamble

This report is issued at the request of the Vice-Ministry of Environment of the Basque Government, in relation to the Air Quality of the municipality of Durango (Bizkaia) with regard to the presence of Volatile Organic Compounds (VOCs). For its preparation, the analytical results of several samples extracted from emissions in various sources have been considered. These results were obtained by Tecnalabaqua, an ENAC-accredited company, with the collaboration of the Public Health Laboratory of the Basque Government, which has been in charge of taking and analysing samples in immission at various points, through the Mobile Unit of the Vice-Ministry of Environment of the Basque Government and some portable sampling equipment, all coordinated by the Vice-Ministry of Environment.

Originally, the study arose as a consequence of the existence of odours and some anomalous data in one of the automatic meters of the Durango Fixed Air Quality Station throughout 2017. For further information, the Vice-Ministry of Environment installed one of the Mobile Units of the Air Quality Network of the Basque Autonomous Community in the south-western part of the municipality. This Mobile Unit has, among other equipment, a GC-MS (Gas Chromatograph with Mass Spectroscopy), with which the concentration of VOC in immission was monitored in order to identify the compounds that may be responsible for the existence of odours.

The results obtained from the measurements made by the Mobile Unit in this first study showed concentrations of some aromatic hydrocarbons, among other VOCs. The levels were higher than expected, above those of other urban areas of the Basque Autonomous Community, and they had concentration peaks at certain times of the day, mainly during the night period. Considering the topological and meteorological characteristics of the location, specifically the direction and intensity of the wind, as well as the type of compounds detected, and the possible sources of emission that could justify these levels of concentration, the studies focused on two companies in the area: INDUSTRY 1 and INDUSTRY 2, as possible sources of emission.

Given the nature of the analysis of results, and the multiple disciplines that it covers, the Vice-Ministry contacted the Chemical Technologies Group for Environmental Sustainability (TQSA), of which I am a member, in order to look for advice. This group works for the Department of Chemical Engineering at the School of Science and Technology (ZTF-FCT) of the University of the Basque Country/Euskal Herriko Unibertsitatea (UPV/EHU). It is currently made up of 13 professors from the school and a variable number of interns, most of them developing their doctoral theses as predoctoral fellows (MEC, GV and UPV/EHU).

The TQSA group (www.ehu.eus/es/web/tqsa/home), which initially had fewer members, has been working together for more than 30 years on the development of knowledge and technologies for the purification of effluents by destruction and/or elimination of pollutants. It has studied their application in the activities that generate them, as well as the improvement and optimisation of production processes in the chemical sector with the purpose of minimising their environmental impact, promoting the trend towards chemical production characterised by cleaner processes.

Thus, together with teaching activities in Undergraduate/Graduate, Master and Doctorate programs, the group carries out intense research on different lines that can be summarized as follows: manufacture of structured catalysts, catalysis for the control of exhaust gases from mobile sources, catalysis for energy production, catalytic strategies for the elimination of recalcitrant compounds (dioxins, furans, VOC-chlorinated, methane), future technologies for the recycling and use of plastic waste, and environmental health.

As a result of this research, the group presents an extensive list of international scientific publications in the most prestigious journals in the sector. Moreover, it has defended several doctoral theses, from which many of them are international, as well as papers in numerous scientific congresses. This work is mainly financed through competitive calls from Consolidated Research Groups (GV-UPV/EHU, since 1998) and Research Projects (MICINN-MINECO, GV, UPV/EHU, UE, etc.). In terms of research rankings, in 2018, the international NTU placed Chemical Engineering of the UPV/EHU in first position in Spain, 14th position in Europe, and 81st position worldwide. Regarding international rankings of universities, in 2017, Shanghai placed Chemical Engineering of the UPV/EHU in first national position and in the group of 51-75 worldwide position. In terms of teaching quality, the ranking of Spanish universities published by "El mundo" in 2018, places the Chemical Engineering Degree of the UPV/EHU in the second position in Spain.

Concurrently, the group also carries out technology and knowledge transfer activities for companies (Heraeus, Maxam, Zabalgarbi, Repsol, etc.) and public bodies through contracts, via OTRI and Euskoiker. Some of these contracts have resulted in the creation of patents, or in the development and implementation of emission reduction systems.

Within this framework, I, M. Pilar González Marcos, (www.ehu.eus/es/web/tqsa/gonzalezmp), have been part of the research group for around 30 years, since I obtained my degree in Sciences, Chemistry section, specialising in Industrial Chemistry, in 1987, first as a predoctoral fellow (GV and MEC) and, after defending my doctoral thesis in 1991, as a full professor. I have 4 six-year periods of recognised research (CNEAI, 2013), as well as 5 five-year periods of teaching, and I am accredited as a University Professor (MECD). Currently, I am Secretary of the Council of the Institute for Research and Development of Processes (UPV/EHU), Secretary of the Territorial Section in the Basque Country of the Spanish Royal Society of Chemistry, and Dean of the Official College of Chemists and Chemical Engineers of the Basque Country, Burgos and La Rioja.

Regarding my experience in Environmental Pollution, I have taught the Environmental Impact of Industrial Activities in the Atmosphere to students in the final academic years of the Degree in Chemical Sciences, as well as in the Doctorate program of Industrial Chemistry for more than 15 years. In relation to polystyrene, the last two doctoral theses that I directed [1-2] were focused on the recycling of plastic waste, starting precisely with polystyrene. Although most of the thesis focuses on catalytic rupture, it also includes a comparative study of the thermal process.

2. Determination of Possible VOC Sources in the Municipality

The first results provided by the Mobile Unit of the Basque Government in relation to the presence of VOCs in the ambient air of the municipality of Durango indicated the presence, in concentrations that were higher than expected, of benzene, toluene, styrene and 2-propanol, mainly. Moreover, the concentrations of the first three compounds were observed to evolve in parallel, which pointed to a common origin.

Considering the possible nearby sources in the surrounding area, the study focused on the lost-foam process, used in some foundry companies, as the main probable source. The lost-foam process uses expanded polystyrene models, which decompose on contact with smelted iron casting whenever a piece is manufactured. This is a very versatile process, which allows us to manufacture very complex and varied parts on demand, at a lower cost and with less requirement for solvents.

The expanded polystyrene models are manufactured in other plants, painted, and covered with compacted refractory sand in the drawers, forming the moulds. The casting is poured over the mould, the model is decomposed, and the desired piece is formed, which is left to cool down. The advantage of expanded polystyrene over other materials used for this application is its low density and good mechanical resistance, which means that it is not necessary to use a lot of material. This generally results in lower emissions during decomposition.

Thus, for each ton of smelted iron, approximately 0.26 kg of expanded polystyrene is required. The temperature at which the process takes place depends on the type of casting. For iron, it is carried out at about 1400ºC. At this temperature, the expanded polystyrene, which is a polymer, melts and decomposes by thermal pyrolysis. In this process, although in relatively small quantities, benzene, toluene and styrene (which is the monomer), among others, can be formed as gaseous products. The proportion between them is variable, and depends mainly on temperature. These products are generated at high temperature, so they tend to rise initially. Over time, as they cool down, since they are denser than air, they would tend to accumulate in the lower areas, at ground level.

With these considerations, the subsequent study focused on two plants located in the municipality of Durango as probable main sources of these VOCs: INDUSTRY 1 and INDUSTRY 2, which mainly use the "lost-foam" method in their production processes.

3. Actions and Results Obtained about INDUSTRY 1

Firstly, and in order to analyse the results obtained in relation to the company's activity, we proceeded to visit it on Thursday, 17 May 2018. During the visit we could see the dimensions of the plant, the capacity and type of furnaces used, the gas outlets, and the gas treatment system at the outlet. The treatment focuses on the removal of particles that are present in the gases, which is the main type of emission identified in this type of company.

The capacity of the plant is around 100 t/day, although it can be very variable depending on the demand, and not all pieces are produced by "lost-foam". The gas-fired furnaces have an independent chimney gas outlet (melting point), and there is independent air extraction in the upper zone of the building (casting-moulding point), in the moulds' preparation area, and in the moulds' breaking zone. All of them are subject to the removal of particles before their release into the environment.

Overall, the extraction capacity seems high and able to renew the air in the building in about 1 or 2 hours. Different activities take place in the plant, aimed at the preparation of moulds and the separation of the manufactured pieces, in different areas, with continuous movement of machinery. At all times the central door of the building is kept open, wide, so that the machinery can circulate, which facilitates the extraction and renewal of gases. Since there is a high capacity of air intake, the open door would not act as a diffuse focus, but rather the opposite if the extractors are connected.

With this information, we proceeded to analyse the results obtained in the first action coordinated by the Vice-Ministry of Environment, and carried out on 27 (Monday) and 28 (Tuesday) November 2017. Samples in emissions were taken from the fusion and casting-moulding sources by Tecnalabaqua; and in immission, with the collaboration of the Public Health Laboratory of the Basque Government, through the Mobile Unit of the Basque Government, located in the surroundings of the plant, in a relative northeast direction with respect to the sources. The results obtained in emission and immission over time (averages and hourly averages) are shown in Figures 1 and 2, for 27 and 28 November 2017, respectively.

Figures 1 and 2 show the concentration values obtained for benzene, toluene, styrene and 2-propanol, as well as the wind regime. In the analysis, it is necessary to consider that the values in immission of the Mobile Unit are represented at the end of the analysis (25 min), while all other values are represented at the initial moment. This criterion has been maintained throughout the report and should be considered in the analysis of results. In addition, in Figures 1 and 2, the period corresponding to melting (in grey) and casting (in red) has been shaded.

As mentioned in the previous point, the concentrations of benzene, toluene and styrene evolve in parallel, which is related to a common focus or source. Therefore, they have been represented in joint graphs in order to facilitate their comparison. Winds are represented immediately below, and then, there are graphs with other VOCs.

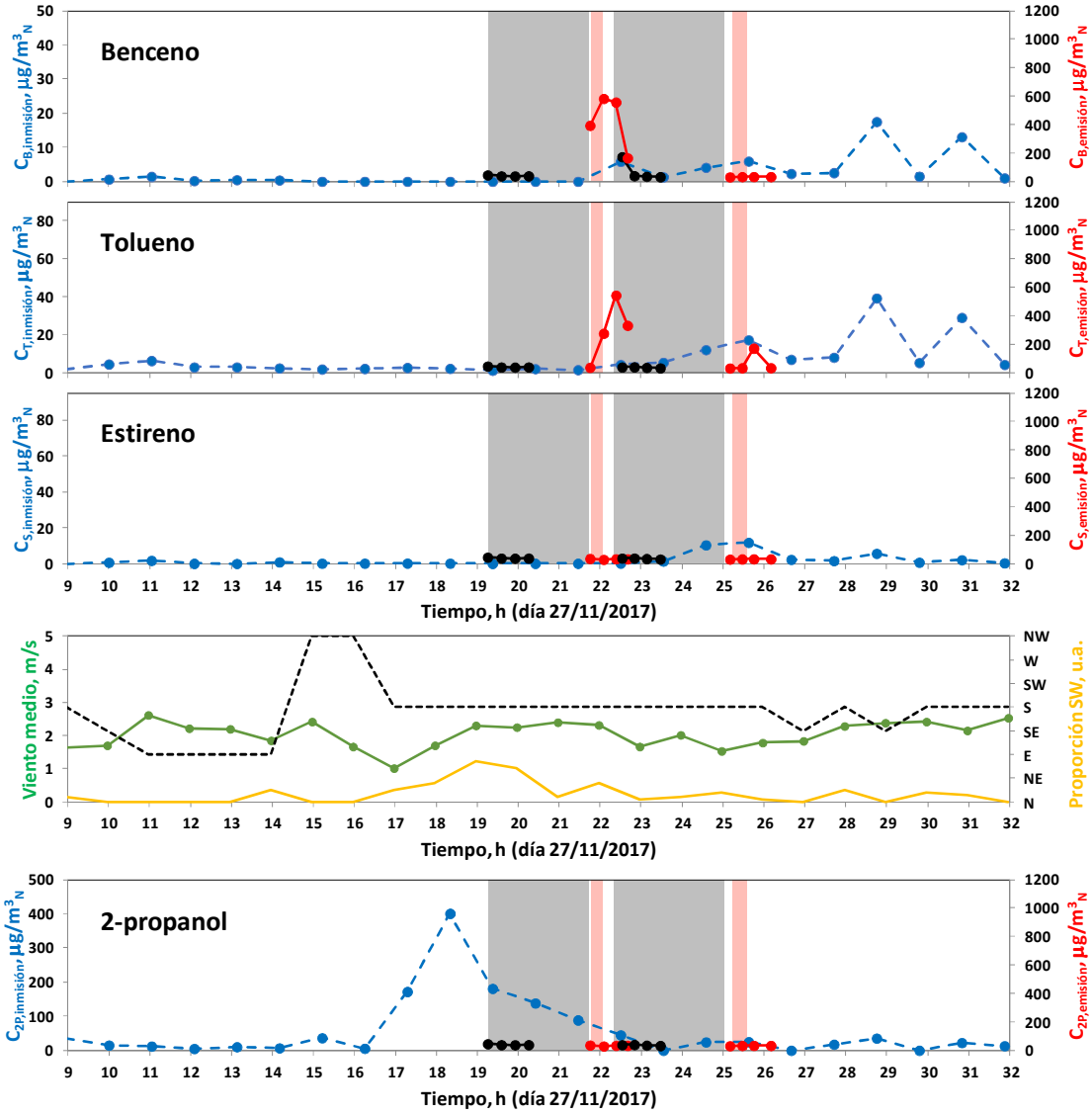

Figure 1. Concentrations in immission (blue, left scale) and in emission (black for melting and red for casting, right scale) of several VOCs, on 27 November 2017 (until the early morning of the 28th). The melting periods are shaded in grey and the casting periods in red.
The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in a south-westerly direction (orange line, right scale, arbitrary units).

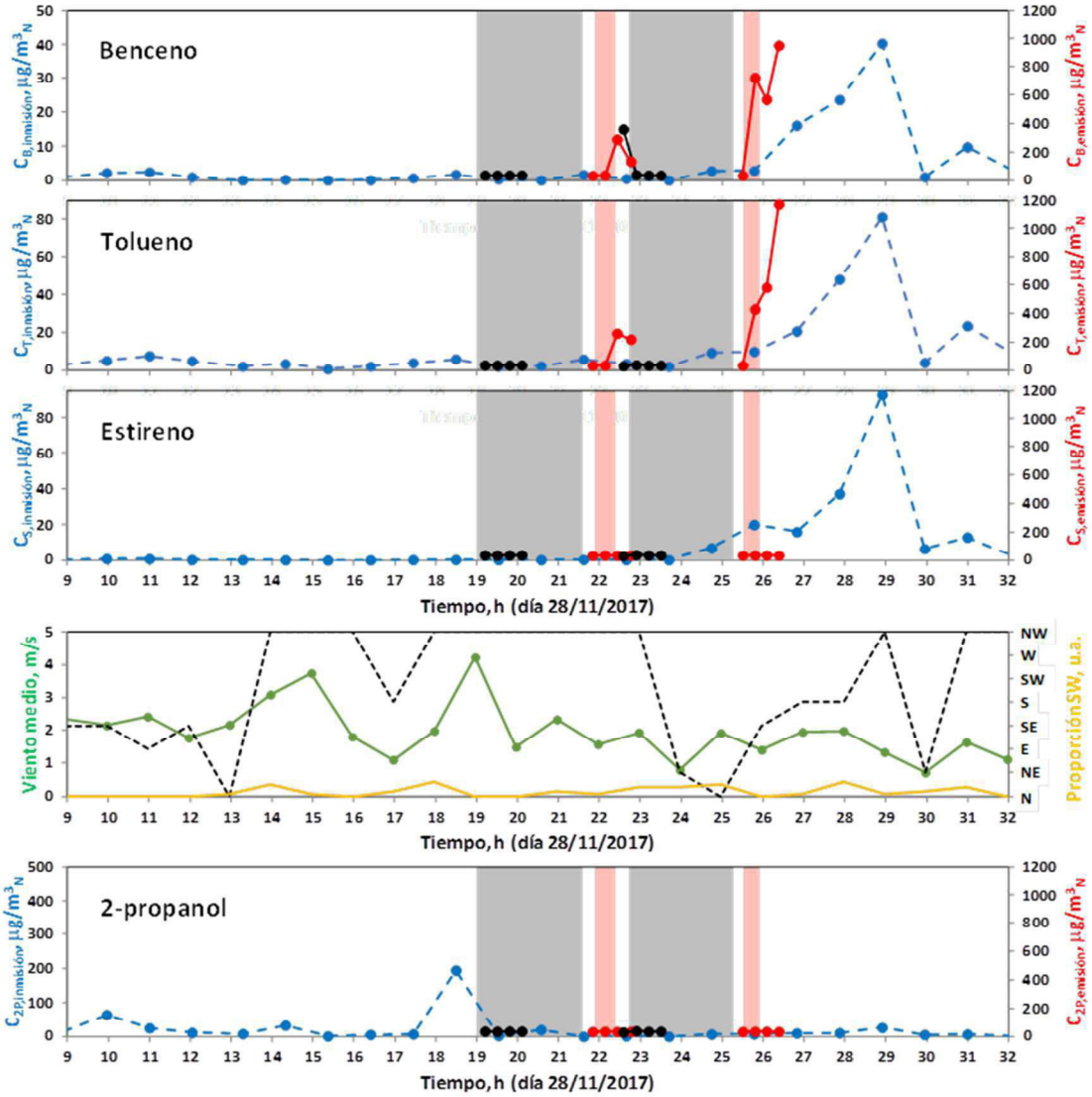

Figure 2. Concentrations in immission (blue, left scale) and in emission (black for melting and red for casting, right scale) of several VOCs, on 28 November 2017 (until the early morning of the 29th). The melting periods are shaded in grey and the casting periods in red.
The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in a south-westerly direction (orange line, right scale, arbitrary units).

As it can be observed, the melting activity of the plant starts around 19:00, with a few daily variations, and an approximate 2.5 hours length. Afterwards, the furnaces are opened and the casting-moulding activity begins, around 22:00. The red shading on the figures mainly indicates the casting time, as the moulding extends over a longer period, and the first moulding overlaps with the second melting. Once the casting has been removed, the furnaces are filled again; then, a second melting takes place starting at around 22:30. This second melting overlaps partly with the moulding of the previous casting, and it lasts for another 2.5 hours approximately. Finally, a second cast-moulding is carried out, which starts early morning in the following day, at around 1:00 - 1:30.

Figures 1 and 2 shows that there are no significant emissions of the compounds analysed during the melting periods. This result is consistent with what was expected, given the type of process that takes place in the furnace. Only some non-negative values of emissions during melting are obtained at the time of the start of the second melting, which has been attributed to the overlap with the first cast-moulding period, as discussed in the previous paragraph.

In relation to the concentrations of the emission compounds in the cast-mould focus, it is striking that the values are quite variable between the two days and between the two casts, which makes their interpretation difficult. It should be considered that the concentrations are not obtained in situ nor instantaneously, but after a subsequent analysis in the laboratory. As the activities are not continuous and the sampling time is limited, we suspect that emissions occur mainly during the moulding period, which is consistent with the process. Moreover, the data collection has not been sufficiently prolonged for the components to reach the chimney. On the other hand, it was not known if the gas extraction system was connected during the data collection. For this reason, it was decided to carry out a second coordinated data collection, once these results had been analysed and interpreted.

As for the impact on immission in the location of the Mobile Unit, the results show substantial variations between the two days. For similar productions, the different impact should be attributed mainly to meteorological aspects. The main factor would be the wind. For this reason, the winds have been represented in the fourth graph of Figures 1 and 2. Since the analytical immission data correspond to average values, with approximately one record per hour, the average hourly wind speed has been represented in the graphs (in green), also the predominant hourly direction (dashed line). It can be seen that the wind was much more stable on the 27th than on the 28th, although the average speed was similar.

The difference, therefore, should lie mainly in the direction of the wind. If the prevailing wind is southwest, given the relative position of the Mobile Unit, greater impact would be expected on its position. According to Figure 1, the wind is mostly southward throughout the period comprising the melting and cast-moulding activities, and it extends throughout the early morning. On the 28th, the wind is much more variable.

In order to try to quantify, the percentage of time that the wind blew southwest during each hour has been determined in Figures 1 and 2. This percentage has been represented with an orange line in the wind graph, in relative units. Although the southwest wind ratio is small, and similar on both days, it can be observed that the peaks of benzene, toluene and styrene concentration in immission coincide with the highest proportions in south-westerly winds.

However, the maximum peaks observed for the three components are much higher on day 28 than on day 27. This can be attributed to the combination of wind directions. Thus, the peak observed around 5:00 on day 29 in Figure 2 corresponds to predominant southward wind, which would direct the components in a northward direction, followed by north-westerly wind, which could direct the compounds in the direction of the Mobile Unit, producing the high immission concentrations that were measured. Of these three components, it is benzene that should be the focus of this study, as a volatile organic compound with specific risk phases [3].

On the other hand, it is noteworthy that the highest concentration values in immission occur, both days, into the early morning. Although the extraction of air from the plant may delay the detection of the immission to some extent, the capacity of the extractors and the wind speed would not justify such high delays if the components were generated exclusively during the first stages of casting, unless the extractors were not working properly. This aspect was also analysed during the second coordinated data collection.

Figures 1 and 2 also show another VOC with an evolution of concentrations in immission that are not linked to the other three compounds: 2-propanol. The figures show that the emission of this compound is not linked to melting or cast-moulding activities, as it was assumed; in fact, it is not detected in either of the two emission sources that were analysed. In this case, and on both days, elevated concentration peaks in immission are observed around 18:00, but the levels are significantly different. Although it is not clear which activity generates these compounds, it is believed that it is related to the preparation of the models, since some of the paints used for this purpose contain 2-propanol as a solvent. However, from a public health point of view, this does not seem to be a problem given the low toxicity of this compound, which could contribute to the presence of odours considering the concentrations detected in immission.

In this case, the effect of wind is clearly observed at the concentrations measured in immission. The proportion of south-westerly winds is much higher on the 27th than on the 28th at the time the peak concentration of 2-propanol in immission is observed, which produces a much higher impact in the area of the Mobile Unit.

The second data collection, coordinated by the Vice-Ministry of Environment, took place on September 24, 2018, Monday. On this occasion, together with those in charge of data collection: Tecnalabaqua and the Public Health Laboratory of the Basque Government, several representatives of the Basque Administration and myself were present for consultancy work. The aim was to check that the extraction systems were working properly during data collection.

For this purpose, emission and immission data were taken in the same way as in previous measurements, and the concentrations of these components inside the plant were also measured at various times during the cast-moulding, as well as at various areas inside the building: relatively far from the moulding point, in order to obtain the background values, and as close to the source as possible, within the safety limits of the activity. The aim was to see the spatial and temporal evolution of the compounds in the environment of the plant. The results obtained are shown in Figure 3.

The time scale in Figure 3 is displaced with respect to those in Figures 1 and 2, so that the area of interest is more centred on the graphs. To facilitate reading, the data referring to concentrations in the environment (immission and building) have been represented with smaller dots, and can be read on the scale on the left. The emissions analysed by Tecnalabaqua have been represented as empty circles.

Figure 3 corroborates that emissions of the three compounds of interest occur during cast-moulding, not during melting. The emission concentrations measured during cast-moulding, as it can be seen by comparing Figure 3 with Figures 1 and 2, are much higher. In fact, the emission samples analysed with the collaboration of the Public Health Laboratory of the Basque Government, which had been designed in accordance with the concentrations measured in November 2017, were saturated in several cases. Given that the production results are similar, it seems that delaying the data collection in order to focus more on moulding activities has been positive for the identification of the source. Therefore, it can be concluded that the emissions of these three compounds are mainly related to moulding activities. These activities are not punctual; they are extended into the early hours of the morning. In this way, it is justified why these compounds can be found in immission long after the end of the second casting.

With regard to the concentrations in the plant's environment, we were able to verify that the extractors were in operation. On our arrival, a certain smell of 2-propanol was detected, the presence of which was indeed detected in the analyses, as it can be observed in the figure, but the air renewal was clearly noticeable.

The concentrations of volatile organic compounds measured inside the plant are not higher than those measured in immission, which corroborates the proper functioning of the extraction system. There is a tendency, in the three compounds of interest, for the concentrations to be higher when the source is closer, compared with the background; it is also higher in the second casting-moulding operation compared with the first, as it was expected. However, higher concentration values were expected. Probably, the fact that these compounds are generated in high-temperature reactions contribute to the fast rise towards the roof of the building. In addition, the upward airflow produced by the extraction system reduces its concentration in the lower layers of the building, which is where the measurements are made.

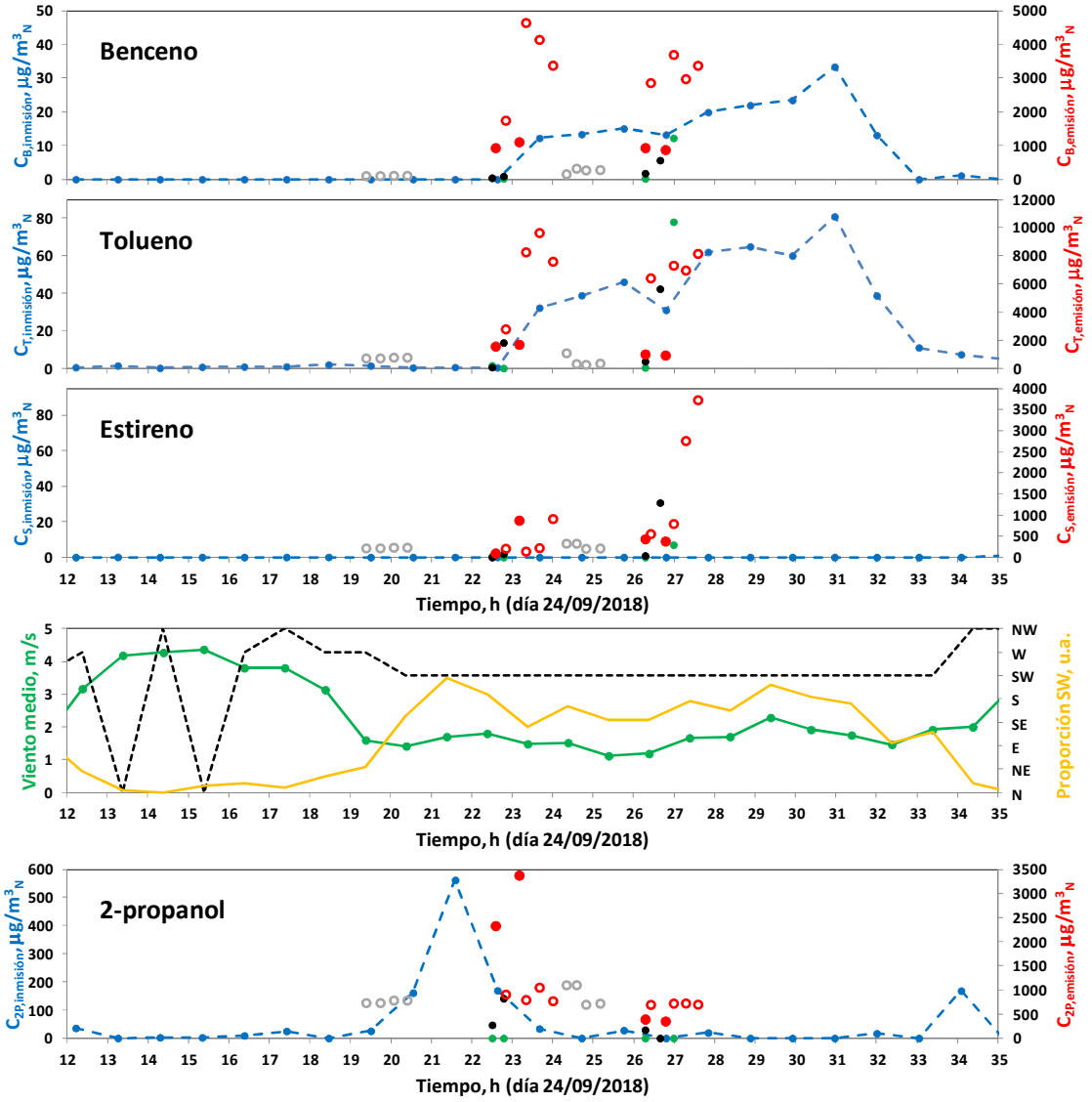

Figure 3. Concentrations in immission (blue, left scale), in the building (background, green; and near the source, black; left scale) and in emission (grey for melting and red for casting, right scale) of several VOCs, on September 24, 2018 (until the early morning of the 25th).
The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in a south-westerly direction (orange line, right scale, arbitrary units).

As for the immission concentrations of the three compounds of interest, it can be seen in Figure 3 that, after the first casting, high values are obtained for benzene and toluene, which are maintained throughout the night, with a peak around 7:00 on day 25th. No significant concentrations of styrene have been detected, although there is styrene in the emissions at some time. This is probably related to the operating conditions.

Comparing Figure 3 with Figures 1 and 2, it can be observed that the impact in immission is much higher for similar average wind speeds. This relates to the direction of the winds, as it can be seen in the figures. Figure 3 shows that the prevailing wind during the entire period of interest is maintained in a south-westerly direction, which is precisely the direction that pushes the compounds directly towards the position of the Mobile Unit. The wind proportions in that direction, as shown by the orange line, are also much higher. Thus, Figure 3 gives a sample of the maximum impact that would be expected from the plant at the position of the Mobile Unit.

4. Actions and Results Obtained about INDUSTRY 2

The Vice-Ministry of Environment decided to extend the study within the municipality of Durango to the surroundings of the company INDUSTRY 2, given that its activity is similar to that of INDUSTRY 1. To this end, in July 2018, they placed the Basque Government's Mobile Unit in a relatively northern position with respect to the plant, in the location of the municipality. At the same time, on Tuesday 24 July 2018, we visited the plant and, through the Vice-Ministry of Environment and the Public Health Laboratory of the Basque Government, a first group of VOC measurements were carried out inside the building. The objective was to determine if there was a substantial impact of the plant in the surrounding area. Although the plant is reasonably far from the municipality, it is located in an area of recreation, walking and sporting activities.

A general monitoring of volatile organic compounds was performed over a wide range of molecular weights and compositions, but focusing on the same compounds of interest. In the interior of the building, data were taken at two areas, one was close to the sources and the other was further away (background data), preferentially focused on cast-moulding activities. At the same time, data on wind direction and strength in the area were analysed in order to determine to what extent the measured values could be attributed to the activities carried out in the company. The results obtained are shown in Figure 4.

INDUSTRY 2 also carries out two daily meltings, followed by their corresponding cast-moulds, but with a different time distribution to that of INDUSTRY 1. In this case, the first melting begins around 3:30, with a length of around 2.5 hours, and the first cast-moulding begins around 6:30, with small variations. The second melting finishes around 11:00 - 11:30, and from 11:30 - 12:00 the second cast-moulding starts, until the prepared moulds are completed. The plant has a melting emission source, from the furnaces, but does not seem to have a specific extraction system for the building.

In Figure 4, the absence of data in immission between 9:00 and 17:00 can be observed due to a technical problem. These data are critical for the comparison of the immission results with those of the interior of the building; therefore, it was necessary to schedule a later coordinated measurement. In addition, since the dispersion of gases in the atmosphere is better in summer than in winter, it was decided that this second measurement should be made in the winter period. All in all, the available results have been analysed, above all to have an overview that would help us plan future coordinated measurements. In order to have a better vision of the concentrations in immission, the same values of Figure 4 have been represented in Figure 5, but extending the time scale from noon on Monday 23 July until 7:00 on 25 July 2018. Although all the data were extracted from ambient concentration, given the different values obtained, those of immission have been represented on the left scale, and those of the building on the right scale.

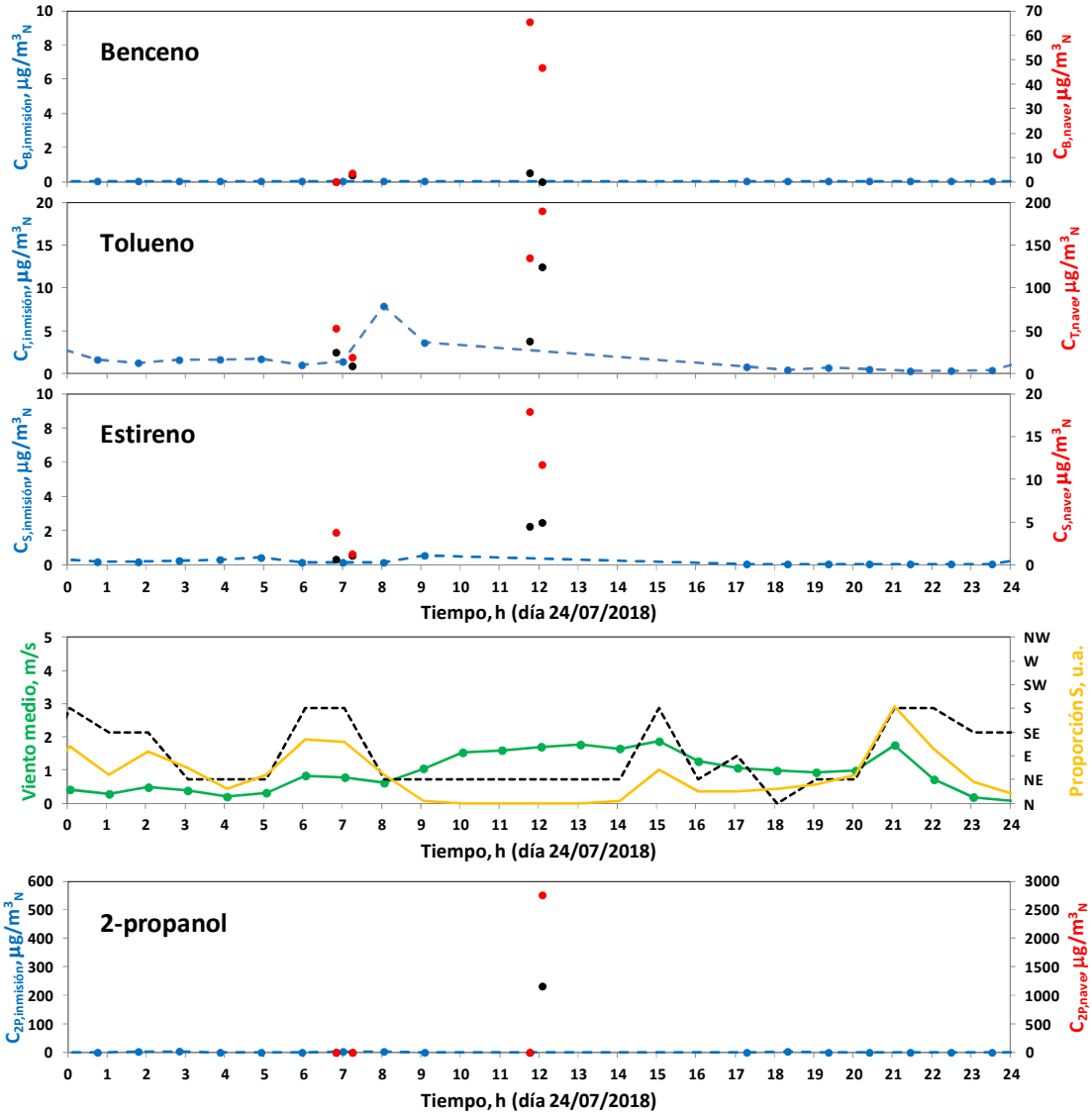

Figure 4. Concentrations in immission (blue, left scale) and in the building (background, black; and near the source, red; right scale) of several VOCs on 24 July 2018.
The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in the south direction (orange line, right scale, arbitrary units).

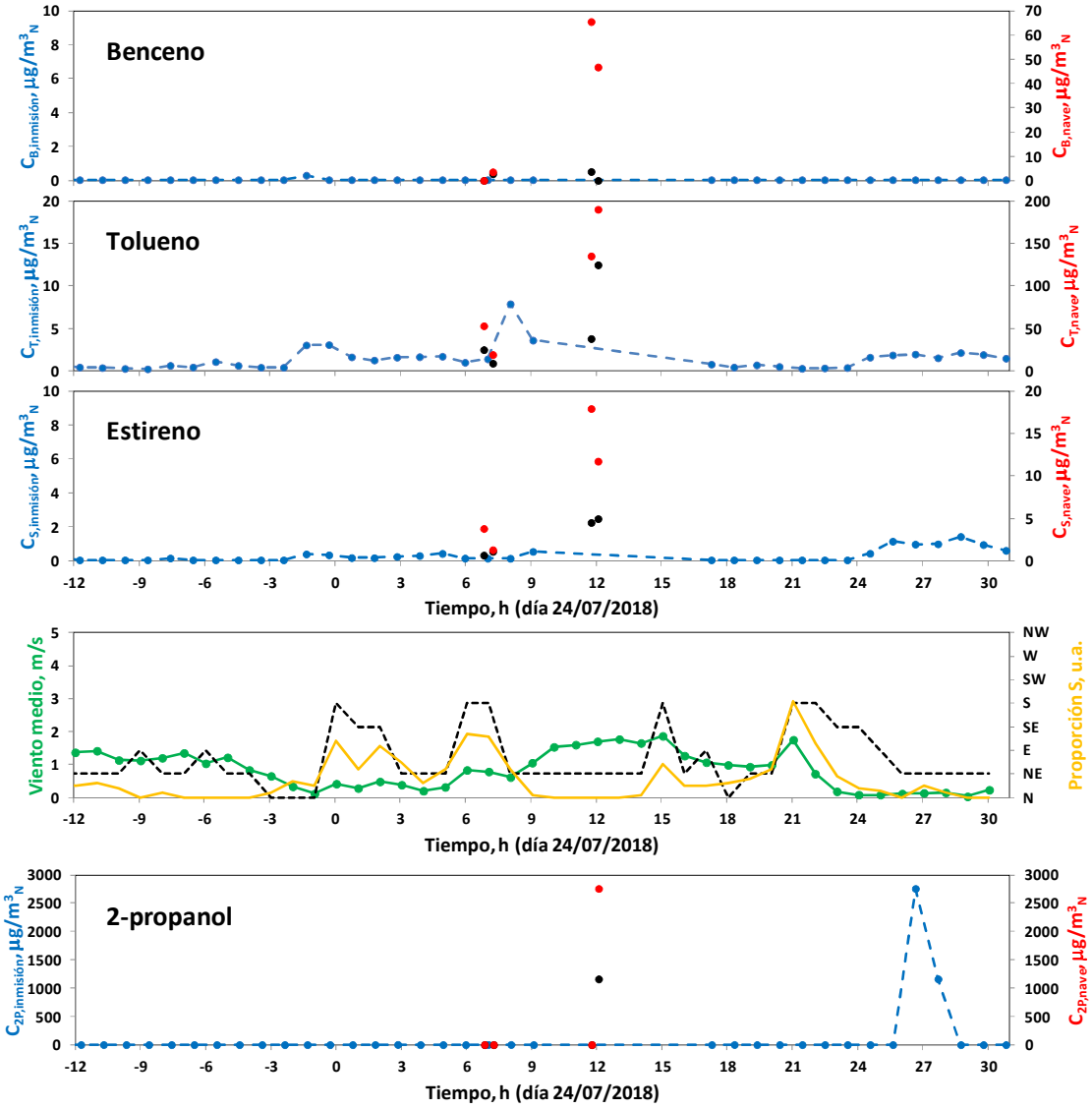

Figure 5. Concentrations in immission (blue, left scale) and in the building (background, black; and near the sources, red; right scale) of several VOCs, on 24 July 2018 (from noon on 23 July to 7:00 on 25 July).

The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in the south direction (orange line, right scale, arbitrary units).

In this first study, it was decided not to take emissions data until the results had been analysed. On the other hand, in the wind graphs, and given the relative position of the Mobile Unit with respect to the plant, the orange line represents the proportion of winds in a southward direction, and not in a southwestern direction as in the previous case.

Measurements inside the plant were made as follows: two at 6:50, and two at 7:15, in order to analyse the spatial (in the building) and temporal evolution in the first casting; other two at 11:45, and two more at 12:05, in order to analyse the evolution in the second casting. Figure 4 shows that the concentrations of the three compounds of interest are relatively low inside the building during the first casting, but increase significantly during the second casting.

With regard to spatial evolution, it can be observed that the concentrations measured near the point where the cast-moulding was carried out are significantly higher than those obtained in more remote areas (background), which confirms this activity as the main source of emissions. The fact that both background and proximity values are substantially higher in the second casting than in the first casting indicates that there is no adequate air renewal in the plant. The majority of gases leaving the building seem to be discharged through an open area around the furnaces, so the compounds generated in the different activities tend to be concentrated in the building itself. Therefore, except for melting in the furnaces, emissions to the outside would be generated mainly in a diffuse form.

It was proven that the presence in the atmosphere of the interior of the plant was not limited to the volatile organic compounds represented in Figures 4 and 5, but to several others. In addition, we could appreciate in situ the presence of a significant amount of bright solid components suspended in the environment during the second cast-moulding, probably mobilized towards the ground from the upper zone, as they could not leave the plant and be replaced by hotter gases.

In general, although the data corresponding to the period 9:00 - 17:00 are missing, the immission concentrations of the compounds of interest seem to be low. Analysing the prevailing wind, it can be observed that, during the first cast-moulding, the prevailing wind is south, which would contribute to carry the compounds in the direction of the Mobile Unit. However, since the concentration of these inside the building is still low, the diffuse emissions produced will also be small, so their immission concentrations are small.

The case of the second casting is quite different. On the one hand, the concentrations of the compounds in the environment of the building are much higher, which would imply higher emissions; on the other hand, the predominant wind blows in a north-easterly direction, without episodes of southward direction. Therefore, although immission concentration data are not available for the Mobile Unit, concentrations of the compounds of interest would not be expected to be very high during that period either.

2-propanol has been represented, as very high concentrations have been observed inside the building at around 12:00 noon. 2-propanol is not related to the cast-moulding activities themselves, but to some of the paints used for the models. During our visit, we were able to see that multiple activities were carried out simultaneously in the plant; therefore, for the moment, it is not possible to identify in which moment it occurs, or with which activity it is

related. However, the safety sheet of one of the paints used in the plant indicates the presence of 2-propanol as a solvent, so its detection is probably due to the use of that paint.

According to Figure 5, benzene concentrations in immission remain very low throughout the whole period, and toluene and styrene concentrations are also generally low, with certain concentration peaks in immission around the late hours of the night, or early morning hours from the 23rd to the 24th and from the 24th to the 25th July 2018. These times do not seem to coincide with the main hours of plant activity. Given that the measured wind intensity in those periods, particularly in the early hours of the 24th to the 25th, corresponds to practically no wind (calm), the origin of these concentrations is not clear.

As for 2-propanol, an important peak of concentration in immission is observed around 3:00 in the morning from the 24th to the 25th, in spite of the almost null wind and its scarce proportion in southward direction. Its origin is not clear, but it is probably due to the activities carried out by INDUSTRY 2 in relation to the preparation of the models.

In order to try to clarify the real impact, particularly in the winter period, which is more unfavourable to dispersion in general, additional measurements coordinated by the Basque Government's Vice-Ministry of Environment were carried out on 29 November 2018, also including measurements in emission, as well as data in immission with the Basque Government's Mobile Unit, as well as inside the plant during the casting-moulding activities. The results obtained are shown in Figure 6, and also in Figure 7, where the time scale has been extended.

In both figures, the data of concentrations in immission and those of the interior of the building is represented on the left scale. Since both values are very different, the left scale in Figure 6 has is wider, in order to focus on the highest values of concentration in the building's environment; meanwhile, the left scale in Figure 7 focuses on the immission values. The right scale has been reserved for emission concentrations. Two more compounds have been included in the figures due to the fact that significant emission or immission concentrations of these compounds have been obtained at some point with the aim of analysing whether there was a relationship between them or with any of the other compounds present in the analyses.

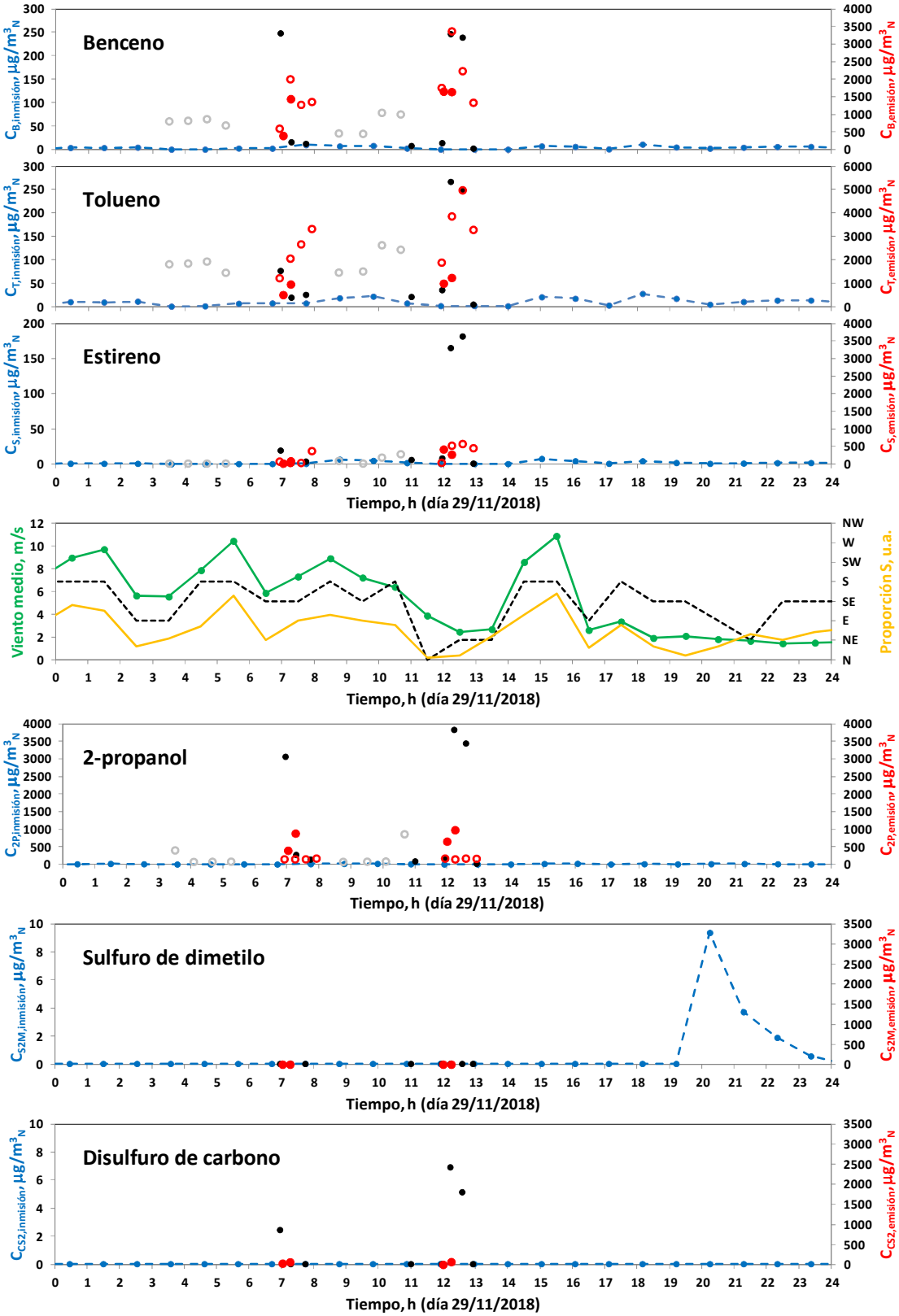

Figure 6. Concentrations in immission (blue, left scale), in the building (black, left scale) and in emission (melting, grey; cast, red; right scale) of several VOCs, on 29 November 2018.
The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in the south direction (orange line, right scale, arbitrary units).

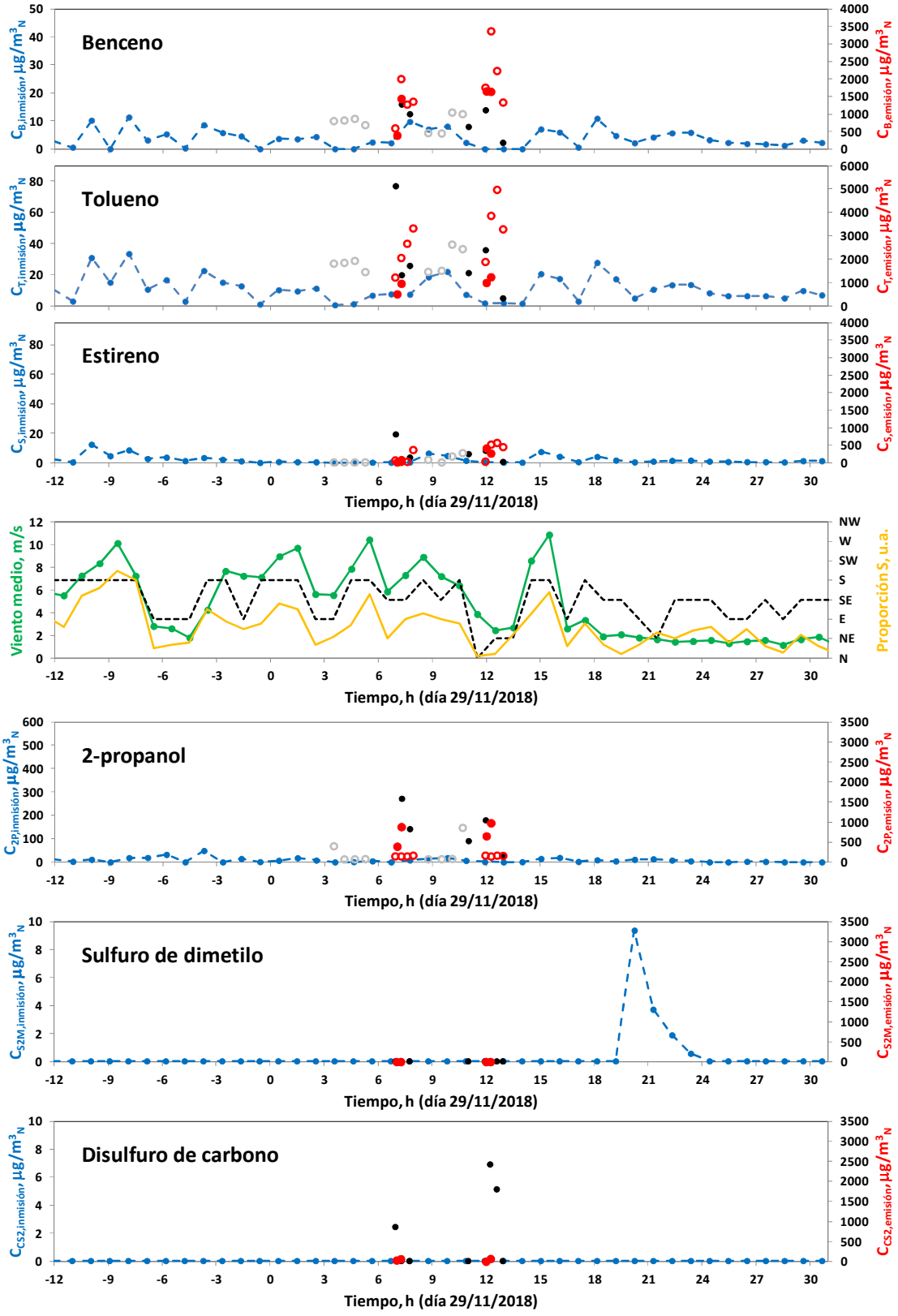

Figure 3. Concentrations in immission (blue, left scale), in the building (black, left scale) and in emission (fusion, grey; cast, red; right scale) of several VOCs, on November 29 (from noon on 28 to 7:00 a.m. on 30).

The wind graph shows the average hourly wind speed (green, left scale), the predominant hourly direction (black dotted line, right scale), and the proportion of time in the south direction (orange line, right scale, arbitrary units).

The results in Figures 6 and 7 show that the measured emission concentration for benzene and toluene is significant in all the analysed samples, both during melting and during casting, although it is substantially higher in the latter. Since the presence of these compounds in the furnace emissions would not be expected during melting, it is likely that the furnace extraction system will suck some of the air from the plant, which would justify the observed concentrations. The concentrations measured for the emitted styrene follow a similar evolution, but at much lower concentrations, often below the detection limit of the applied technique.

As it can be observed, the measured emission concentration for 2-propanol keeps at relatively low values, which seems coherent considering that the origin of 2-propanol emissions would not be located in the melting and casting-moulding sources. Although parallel activities that might involve the use of 2-propanol were carried out at the plant during our visit, they were conducted in an adjacent location, and the operators kept the communication door between the two areas closed most of the time. With respect to other components, no appreciable emissions of dimethyl sulphide are observed in any of the analysed samples; however, small amounts of carbon disulphide that are barely appreciated in the applied emission scale can be observed.

In the interior of the plant, sampling was limited to a single point, the closest to the emission source allowed by safety measures. Figure 6 shows elevated peaks of concentration of the three components of interest in the building during the cast-moulding activities. Since the sample collection inside the building takes place near the ground level, while generation occurs at high temperatures that contribute to the rise of the compounds and, since the measurements are focused on very specific times, the level of concentration of these components inside the building during the day remains unclear. From the perspective of work prevention and considering that substantial values have been recorded, it might be advisable to keep track of the evolution.

Although 2-propanol was not generated in the melting and casting-moulding activities, and even if the area where the surface treatment of the moulds took place was kept closed, we can observe very high concentrations of 2-propanol in the building at certain times. During the measurement time, there was no evidence of dimethyl sulphide levels above the detection limit in the plant's environment, and the concentration of carbon disulphide was low.

In order to analyse the impact of emissions in immission on the location of the Mobile Unit, it is convenient to analyze the results in Figure 7, as the scales on the left are more appropriate. The observed benzene concentration is moderate. For toluene and styrene, the observed trends are similar, which corroborates that the three components are generated in the same process, although in different proportions.

However, unlike in INDUSTRY 1, there were no significant peaks in immission throughout the whole analysed period. As it can be observed in Figures 6 and 7, the winds were relatively strong that day, which could absorb the concentrations; they also blew towards variable directions, at least until 18:00. The proportion of south wind, which due to the relative position of the Mobile Unit with respect to the plant would direct the emissions towards its

location, is significant; therefore, the measurements should be representative of the impact of the plant at that point.

Figure 7 shows how the concentration trends observed for the three components of interest respond very well to the evolution of the proportion of southerly winds. From all this, it can be concluded that, very probably, the benzene, toluene and styrene observed in immission in the location of the Mobile Unit were mainly originated in the plant and, given that there are no evident peaks at specific times (the distance from the Mobile Unit to the plant is similar to that of INDUSTRY 1 Foundries), these compounds would be emitted on an ongoing basis through diffuse emissions from the plant.

As for the rest of the volatile organic compounds, there are no significant concentration peaks for 2-propanol despite the high concentrations measured in the plant. This may be partly due to the high diffusivity of 2-propanol, combined with strong winds, and the fact that it is also emitted diffusely. On the other hand, there are no significant concentrations of carbon disulphide in immission. Moreover, a peak of concentration of dimethyl sulphide in immission is observed around 20:00, attributable to a specific emission whose temporal evolution gives an idea of how it is dispersed; however it cannot be clearly attributed to the plant.

Given the presence of diffuse emissions, the possible impact on immission of the plant in surrounding locations placed in different directions was analyzed. For this purpose, a portable sampling equipment, shown in Figure 8, was placed at locations P1 and P2 on 17 and 18 December 2018. This initiative had the support of the Public Health Laboratory of the Basque Government.

Figure 8. Localization of measuring points P1 and P2, in the surrounding area of San Antonio de Urkiola (INDUSTRY 2)

The values obtained in immission, together with the values in immission at the location of the Basque Government Mobile Unit, are shown in Figures 9 and 10, for 17 (Monday) and 18 (Tuesday) December 2018, respectively. In Figure 11, the global view for both days is shown, along with a portion of the previous day (from 12:00 on Sunday, 16 December) and part of the following day (until 8:00 on Wednesday, 19 December). Included in the figures are the results obtained for the three components of interest, along with 2-propanol, dimethyl sulphide, carbon disulphide and pentane. In this case, the scales have remained identical on the left and right sides, as they exclusively measure data of concentration in immission at various points.

Regarding winds, Figures 9, 10 and 11 show the proportion of southbound wind associated with the concentration in immission measured at the Mobile Unit (in blue), the proportion of north-westerly wind associated with the concentration in immission measured at point P1 (in black), and the proportion of northwesterly wind associated with the concentration in immission measured at point P2 (in red). The relative positions of each point in relation to the plant has been considered.

The average values obtained from the three compounds of interest do not differ significantly from what has been said in the previous points. This can be observed in Figure 9, and even better in Figure 11, where the values corresponding to Sunday, December 16, have also been represented from 12:00, showing how the concentrations of these three components are significantly lower during Sunday and Monday until shortly after 6:00. This fact attributes the main origin of these compounds to an activity that takes place during the work week, but not on Sunday.

Analysing the wind regime, we observe that day 18 was significantly windier, with a greater component of southerly winds than day 17; both the predominant wind direction, and the percentage of time with wind in that direction have been considered. After analysing the whole scenario, it is observed that there are no significant differences in the average concentration in immission in the Mobile Unit in these two days, which is probably due to diffuse emissions.

The impact of the plant on the concentration in immission at point P1 should be affected by distance, location, and the force and direction of the wind. In this case, and according to Figure 8, the north-westerly wind would direct the plant's emissions towards point P1. According to Figures 9, 10 and 11, although the hourly trend of wind direction is not north-westerly in any case during the measured period, there are gusts of wind in that direction, in the proportion represented by the continuous black line.

In any case, the proportion of northwesterly winds is much lower than the proportion of southwesterly winds in the same period, particularly on December 18 (compare black and yellow lines in the wind graphs in the figures). On the other hand, point P1 is slightly further away from the plant than the Mobile Unit, and at a somewhat higher height. The effect of all this is that not only the three compounds of interest, but also almost all the rest of the components analysed, have much lower concentrations in immission at point P1 than at the position of the Mobile Unit.

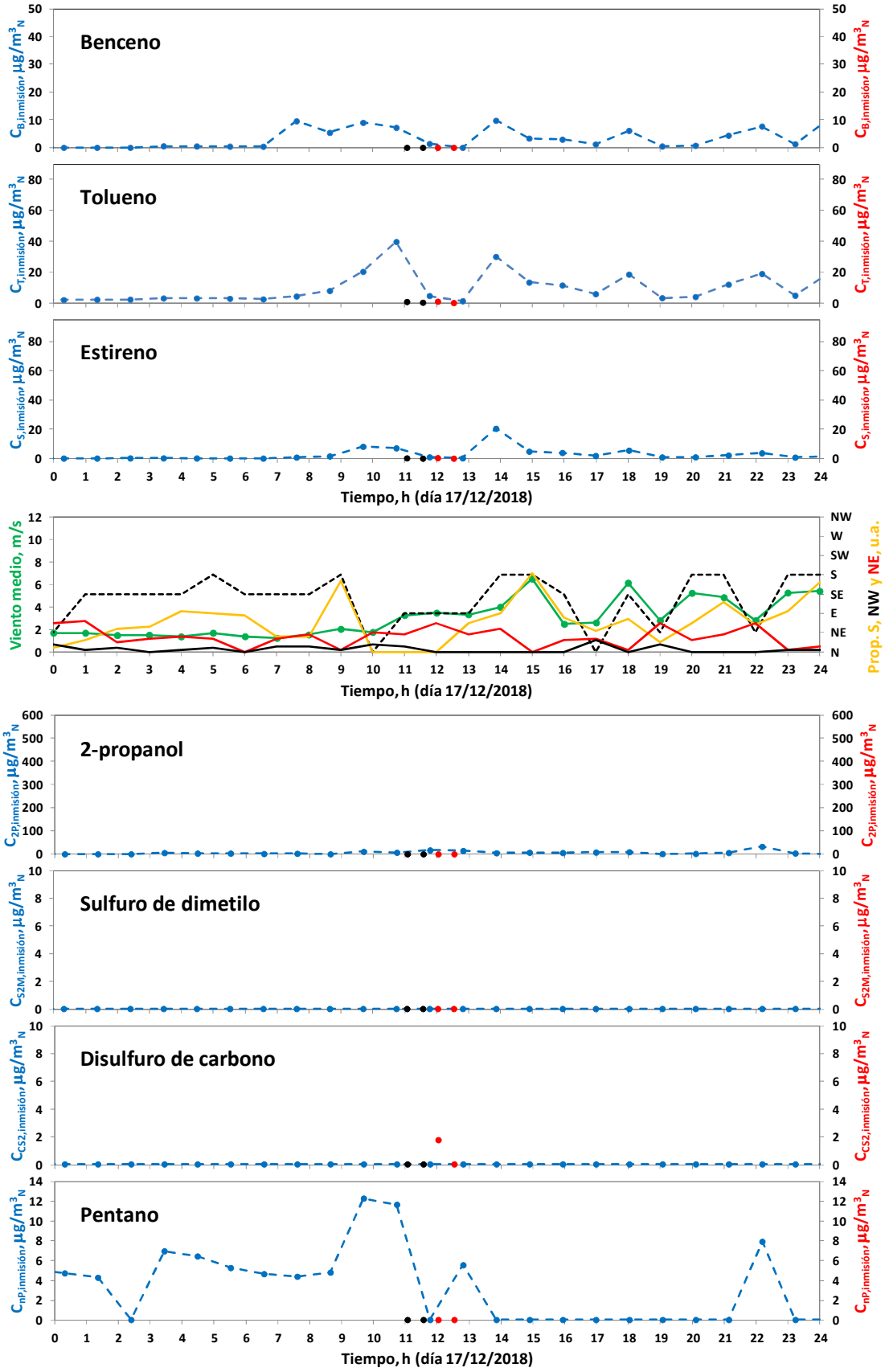

Figure 9. Concentrations in immission: in the Mobile Unit (blue), in P1 (black) and in P2 (red) of several VOCs, on 17 December 2018.
The wind graph shows the average hourly speed (green, left scale), the predominant direction (discontinuous, right scale), and the proportion of time in the south, northwest, and northeast directions (orange, black, and red lines, respectively; arbitrary units).

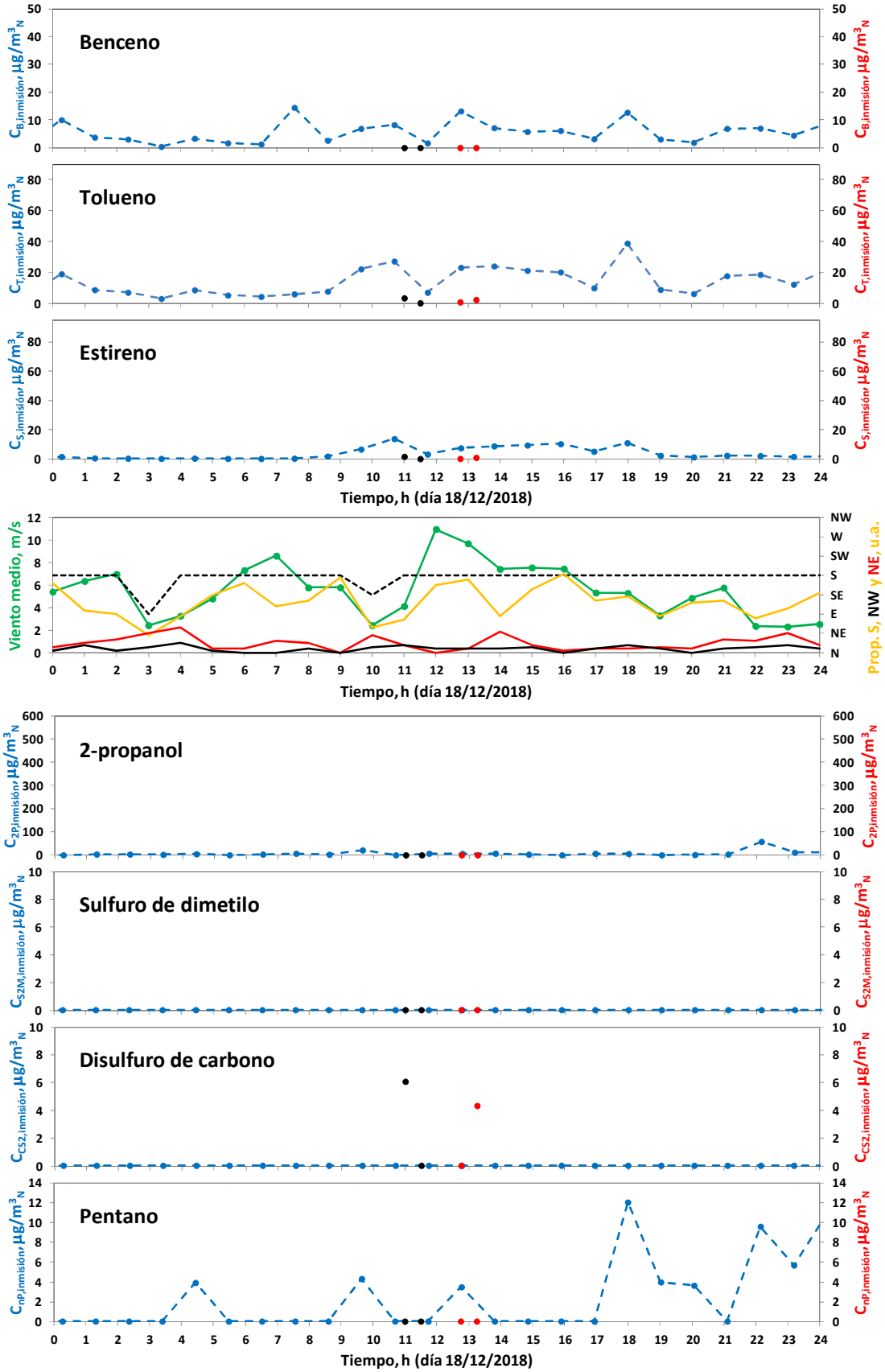

Figure 4. Concentrations in immission: in the Mobile Unit (blue), in P1 (black) and in P2 (red) of several VOCs, on 18 December 2018.
The wind graph shows the average hourly speed (green, left scale), the predominant direction (discontinuous, right scale), and the proportion of time in the south, northwest, and northeast direction (orange, black, and red lines, respectively; arbitrary units).

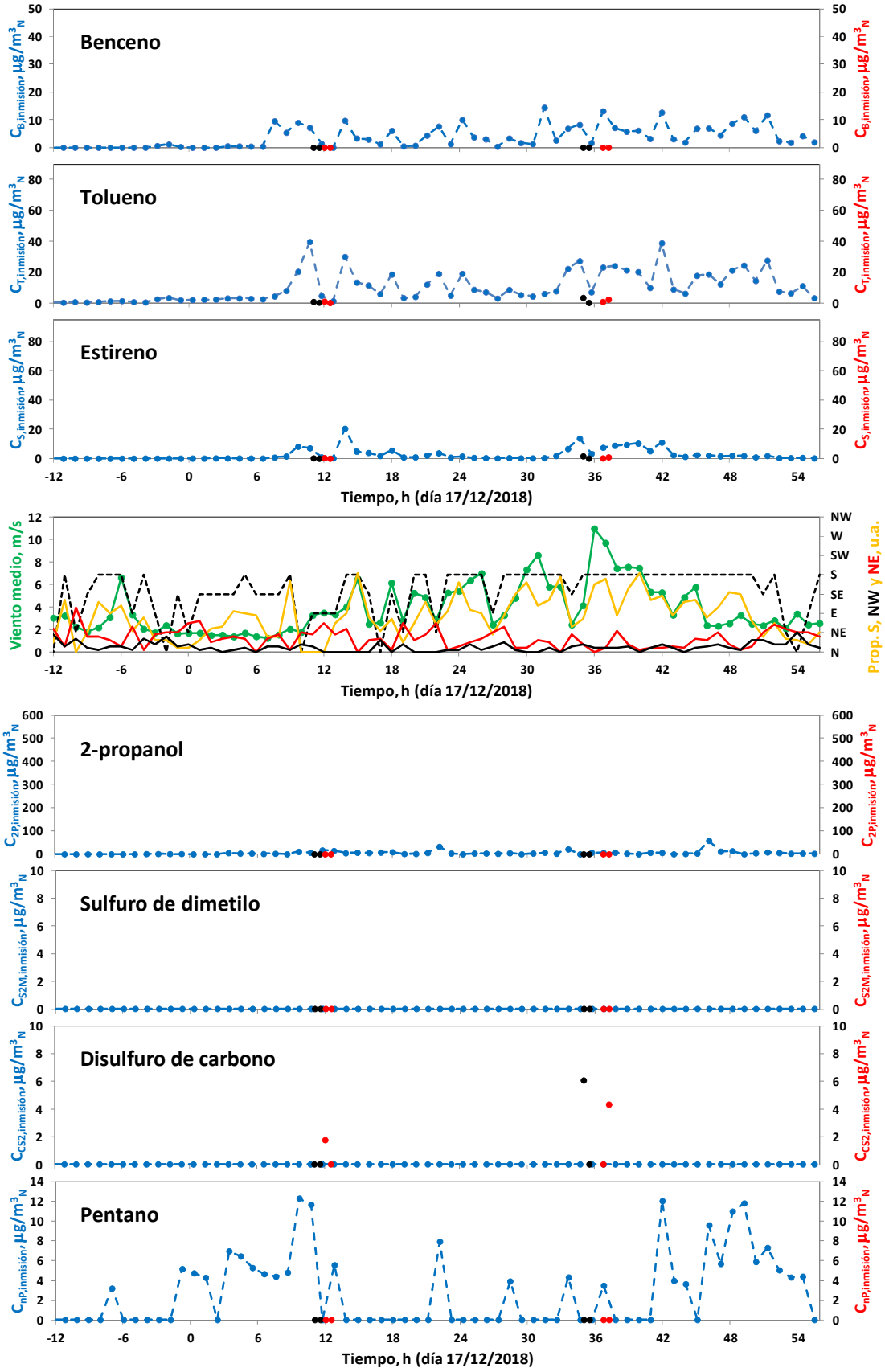

Figure 11. Concentrations in immission: in the Mobile Unit (blue), in P1 (black) and in P2 (red) of several VOCs, between 12:00 on Sunday 16 and 8:00 on Wednesday 19 December 2018.
The wind graph shows the average hourly speed (green, left scale), the predominant direction (discontinuous, right scale), and the proportion of time in the south, northwest, and northeast direction (orange, black, and red lines, respectively; arbitrary units).

With respect to point P2, north-easterly winds would contribute to the transportation of the components emitted by the plant towards it. Point P2 is located very close to the plant, as it can be seen in Figure 8, in the surroundings of a side entrance that is usually open. According to Figures 9, 10 and 11, there are some specific moments with prevailing north-easterly winds during the measurement period, and the time proportion of north-easterly wind (red line) is intermediate between the time proportions of south and north-westerly winds (compare the red lines of the wind graphs in the figures with the yellow and black lines), with less impact on day 18 than on day 17, in general.

One would expect from this that the impact of the plant at point P2 would be significant, similar or even greater than the impact measured at the position of the Mobile Unit. However, in Figures 9, 10 and 11, it can be observed that the concentrations of volatile organic compounds measured at point P2 are, in general, very low. The reasons for the low impact at point P2 may be related to the proximity to the plant, which would act as a screen. Although it is suspected that most of the emissions in the plant are of a diffuse nature, they do not occur at any point, but mostly in the open parts of the plant itself, which are located on the opposite side of the plant, in relation to point P2. The open side door does not communicate with the building in which melting and casting-moulding activities take place.

As an exception, higher concentrations of carbon disulphide have been measured in immission at points P1 and P2 than at the location of the Mobile Unit. However, it is not clear that they can be related to plant activities.

On the other hand, with regard to pentane, although the values are not very high, it seems to show a fairly similar behaviour during the week than on Sunday; therefore, its origin comes from several sources, and not necessarily from the analysed plant.

5. Discussion of the Results:

After conducting a detailed analysis of the operations at INDUSTRY 1 and INDUSTRY 2, the VOC emissions produced as a result of these operations, their concentrations in immission inside the plants, the wind regime and the impact of the emissions on immission concentrations in the municipality of Durango in the surrounding area of the plants, the following conclusions have been reached.

In relation to the VOCs generated in both plants; in both cases, it has been determined that the three compounds of interest are generated mainly during cast-moulding operations, and more specifically during the moulding stage, in which the casting comes into contact with the expanded polystyrene models at high temperature and decomposes the polymer by thermal pyrolysis. Although these compounds are produced in very small quantities during the decomposition of the polymer, a significant amount is generated due to the volume of polymer that is decomposed.

The analysis of emissions that was carried out during melting and casting-moulding operations, indicates the presence of the three components of interest in a proportion that is not constant, particularly in the case of styrene; additionally, it seems to depend on the day. This may be due to the variability of the manufactured pieces, which affects the decomposition temperature.

Despite carrying out a similar process, INDUSTRY 1 and INDUSTRY 2 are in a quite different situation in terms of emissions. In the case of INDUSTRY 1, the emissions are well channelled through the extraction system. Therefore, it is simple to determine which emissions are produced in each stage, and it is clearly observed that the emissions of the compounds of interest are produced during the casting-moulding stage. Following this line, the plant's gas extraction system works efficiently, and there are no significant concentrations of these compounds in the building's environment.

With respect to INDUSTRY 2, and given that it has an extraction system located at the outlet of the furnaces, concentrations in emission of these components are detected both in melting and in casting-moulding activities. This has been attributed to the aspiration of part of the gases from the plant, where these compounds are present. In any case, the conclusion extracted in INDUSTRY 2 is that a significant proportion of the emissions from the casting-moulding stage is diffuse.

The relevance of the winds for the impact of both plants on the concentrations in immission has been confirmed. In the case of INDUSTRY 1, due to its location, the impact increases when there are south-westerly winds, as these winds would carry the emitted compounds towards the municipality. Since the plant is not too far, the values measured in immission in the location of the Mobile Unit, which have been analysed in this report, are quite representative of the predictable impact. It has been found that the concentrations of these components in immission during the day are very low, mostly below the detection limit, but very high at night, especially in adverse wind conditions.

Values in the urban area would be expected to be lower than those measured at the location of the Mobile Unit. The fact that they occur during the night period also mitigates their impact on the general population, although there are houses near the plant.

In the case of INDUSTRY 2, no very high peaks in immission concentration of the compounds of interest in the surrounding area have been observed, which is attributed to the fact that the emissions are mostly diffuse. From the results obtained, it seems that the most significant impact occurs in the location of the Mobile Unit, which corresponds precisely to the direction in which the municipality is located.

It has been proven that the immission concentrations measured by the Mobile Unit oscillate in a relatively narrow range of values, except during the weekend, when they fall significantly to values that are mostly below the detection limit. However, the average concentrations detected in immission at the location of the Mobile Unit are higher than recommended. Moreover, in this case, these concentrations are maintained both during the day and night periods. Fortunately, the plant is relatively distant from the population, so the impact on the urban area is expected to be lower but significant. In addition, the plant is located in a recreational area, frequented by the population for outdoor activities.

On the other hand, particular attention should be paid to the situation inside the plant itself, which should be analysed in more detail. In the plant of INDUSTRY 2, due to the absence of an efficient extraction system, relatively high concentration values of various volatile organic compounds have been measured. Although the operators wear masks to filter the suspended solid compounds that are in the building's environment, these masks are not designed to retain VOCs, except for the operators who paint models. Therefore, it would be advisable to analyse this aspect in more detail.

6. Conclusions

In view of the results obtained, it can be concluded that there is a significant impact of the INDUSTRY 1 and INDUSTRY 2 plants on air quality in the municipality of Durango in relation to the presence in immission of volatile organic compounds with specific risk phases.

In the case of INDUSTRY 1, the impact is increased with the presence of southward winds, and it is limited to the night period, where very high concentrations of components are reached, remaining very low during the daytime thanks to the adequate extraction of gases in the plant.

In the case of INDUSTRY 2, the impact is increased in the presence of southward winds. Since emissions appear to be mostly diffuse in nature, relatively high concentrations are maintained in a stable way throughout the work week, with a significant decrease observed only during the weekly rest period. In addition, the concentration of volatile organic compounds inside the building should be analysed in a more detailed way from the point of view of occupational health; in fact, high concentrations have been obtained in many of the measurements taken.

For these reasons, action should be taken on emissions. In the case of INDUSTRY 1, and given the good channelling of the gases through the extraction system, a VOC retention or destruction system at the exit of the gases should be added to the particle retention system that is already installed.

In the case of INDUSTRY 2, and given that emissions are diffuse, it would be advisable to install an appropriate extraction system capable of adequately renewing the atmosphere in the building. At the exit, similar to the case of INDUSTRY 1, a VOC retention or destruction system should be installed.

In both cases, retention by absorption or destruction by combustion is considered. The most advisable, cheap and effective system in each case, depending on the characteristics of the gases emitted, flows and concentrations of volatile organic components. On the one hand, this would reduce the impact of the compounds on the workers and, on the other, it would limit the impact of the concentrations in immission in the municipality.

7. Bibliography

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ANNEX XIX:

Report of Emissions in the Manufacture of Castings through the "Lost-Foam" Process with Expanded Polystyrene Models.

Made by UPV Basque University.

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Universidad del País Vasco
Euskal Herriko Unibertsitatea

ZTF-FCT
Zientzia eta Teknologia Fakultatea
Facultad de Ciencia y Tecnología

tqsa

INGENIARITZA KIMIKOA SAILA
CHEMICAL ENGINEERING DEPARTMENT

Report of Emissions in the Manufacture of Castings through the "Lost-Foam" Process with Expanded Polystyrene Models

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Leioa, 7 June 2018

Contents

1. Preamble

This report was commissioned by the Vice-Ministry of the Environment of the Basque Government regarding the results of a Study on Air Quality in the municipality of Durango.

In the context of a series of actions initiated in October 2017 focused on improving the quality of the air in the municipality and stemming initially from the existence of odours and other anomalous data in one of the automatic meters readings of the Fixed Station of Air Quality of Durango, the study was extended by installing one of the Mobile Units of the Vice-Ministry of Environment in the area.

Among other equipment, the Mobile Unit has a gas chromatography–mass spectrometry (GC-MS) to monitor the concentration of Volatile Organic Compounds (VOCs) in immission. This study detected that the concentration of benzene, among other VOCs, was higher than expected and above the levels of different urban areas of the Autonomous Community of the Basque Country (ACBC), with concentration peaks at certain times of the day.

Given the results and considering the meteorological and topological characteristics of the environment in question, and the possible emission sources different from those of other urban areas, the study focused on several companies in the area, nearby areas and adjacent areas in which the wind regime could favour an increase in the concentration of these compounds in immission.

Several possible emission sources are known to generate benzene and some of the other VOCs detected. However, this does not seem to be considered in the lost-foam process, which is used by several companies in the vicinity of the measurement area. In any case, the timing of the peaks and other VOCs detected suggest that the process might have something to do with it. Therefore, the Vice-Ministry of the Environment would like to know whether, from a scientific-technological point of view, significant emissions of benzene and the other associated VOCs could be expected from this type of process.

To this end, the Ministry contacted the Chemical Technologies for Environmental Sustainability Group (CHES), in the Department of Chemical Engineering of the Faculty of Science and Technology (ZTF-FST) of the University of the Basque Country/Euskal Herriko Unibertsitatea (UPV/EHU), of which it is a member. This Research Group is currently composed of 14 professors of the department and several trainees, most of them preparing their doctoral theses as predoctoral fellows (MEC, GV and UPV/EHU).

The CHES group (www.ehu.eus/es/web/tqsa/home), initially with fewer components, has been working together for more than 30 years in the development of knowledge and technologies for the purification of effluents by destruction and/or elimination of pollutants, and their application in the activities that generate them, as well as in the improvement and optimisation of production processes in the chemical sector to minimise their environmental impact, promoting the trend towards chemical production characterised by cleaner processes.

Thus, together with the teaching activities in Undergraduate/Graduate, Master and Doctorate programmes, the group carries out intense research in different lines, which can be summarised as follows: manufacture of structured catalysts, catalysis for the control of exhaust gases from mobile sources, catalysis for energy production, catalytic strategies for the elimination of recalcitrant compounds (dioxins, furans, chlorinated VOCs, methane) and future technologies for the recycling and use of plastic waste and environmental health.

As a result of this research, the group presented an extensive list of international scientific publications in the most prestigious journals in the sector and defended doctoral theses, many of them foreign, as well as papers in numerous scientific congresses. This work is mainly financed through competitive calls from Consolidated Research Groups (GV-UPV/EHU, since 1998) and Research Projects (MICINN-MINECO, GV, UPV/EHU, EU, etc.). In terms of research rankings, the NTU International places the Chemical Engineering of the UPV/EHU in first position in Spain, 18th position in Europe and 90th position in the world in 2017. At the level of international university rankings, Shanghai places Chemical Engineering of the UPV/EHU in first state position and in the group of 51-75 worldwide position, in 2017. At the teaching level, the ranking of Spanish universities published by "El Mundo" in 2018 placed the Chemical Engineering Degree of the UPV/EHU in the second position in Spain.

In parallel, the group also carries out technology and knowledge transfer activities to companies (Heraeus, Maxam, Zabalgarbi, Repsol, etc.) and public bodies through contracts, via OTRI and Euskoiker, some of which have culminated in the generation of patents or the development and implementation of emission reduction systems.

As for me (www.ehu.eus/es/web/tqsa/gonzalezmp), I have been part of the Research Group for about 30 years, since I obtained my degree in Sciences, Chemistry section, specialising in Industrial Chemistry in 1987, first as a predoctoral fellow (GV and MEC) and, after defending my doctoral thesis in 1991, as a full professor. I have four recognised six-year research terms (CNEAI, 2013), five five-year teaching terms, and I am a certified university professor (MECD). I am currently Secretary of the Council of the Institute for Research and Development of Processes (UPV/EHU), Secretary of the Territorial Section of the Basque Country of the Spanish Royal Society of Chemistry and Dean of the Official Association of Chemists and Chemical Engineers of the Basque Country, Burgos and La Rioja.

As for polystyrene, the last two doctoral theses I have directed (E. G. Fuentes Ordóñez, 2015, and J. A. Salbidegoitia Samperio, 2016) focused on recycling plastic waste, starting precisely with polystyrene. Although the bulk of the thesis focuses on catalytic rupture, some also conduct comparative studies of the thermal process.

2. Process Overview

The lost-foam process is a casting process in which a model of the parts is made of expanded polystyrene (the foam), better known by its acronym EPS (Expandable Polystyrene) or by the acronym *Poliexpán* (in Spain).

In the process of manufacturing cast iron parts by casting, a cast iron furnace casting is prepared from scrap, fluxed ore or a mixture of both. This process should typically be carried out in reducing conditions to prevent iron from oxidising and at temperatures around 1400ºC. The cast iron or casting is taken to the moulding process to make the desired pieces.

The mould in which the casting is to be poured and which will be used to obtain the piece of the desired shape is prepared beforehand. For this purpose, there must be a model of the part—in the same shape and form—in expanded polystyrene. These models are usually prepared in different plants, at the customer's request, by thermal expansion of polystyrene spheres with pentane and subsequent maturation. The result is models with an average density of about 20 kg/m^3, which are then used in subsequent processes.

The models are painted with refractory material. There are several types of refractory paints for these uses. Although they are water-based paints, a small part of their composition may be resins (furanic, alkaline phenolic or alkyd) or similar, which polymerise on the model once painted, and which isolate the casting from the sand mould once the expanded polystyrene model is volatilised.

The painted and dry model of the piece in expanded polystyrene is finally covered with refractory sand (sand, coal, clay, binders and water), (i.e. the mould itself) inside a box and up to the required height. The sand is compacted manually around the EPS model, or by vibration in the case of small parts. Ducts are also left to facilitate the entry and distribution of the casting in the piece and the proper exit of gases. Finally, the casting is added to the inside of the mould.

Given the high temperature of the casting, the EPS model decomposes and transforms into gases with no solid residues, leaving a gap for the casting to cool down to the shape of the desired piece, without having to remove the model, which is for single use only.

There are several advantages to this type of processes as opposed to conventional ones. From the moulding point of view, there is no need to remove the model before casting, which greatly simplifies mould making and operation. It also reduces the need to add binders to the refractory sand in the mould, making it easier to recycle and reducing material consumption.

Since the models are not permanent, there is no need for a large storage space. The precision of the parts obtained is much higher, which reduces the need for surface finishing treatments and allows obtaining much more complex parts.

3. Atmospheric Emissions Focuses

In this process, the generation of emissions into the atmosphere can happen in two main focuses: the smelting stage and the casting stage. Along with these, the previous stage of preparation of the sand mould and the final stage of demoulding can also produce emissions.

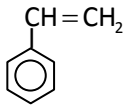
In the smelting stage, the gaseous emissions originate in the furnace and can be associated with the generation of energy and with the melting-reduction process of scrap or iron ore. The type and volume of emissions generated depend very much on the type of furnace, the process and the raw material. If energy is generated by combustion, emissions of mostly CO_2 would be expected, along with small amounts of nitrogen oxides produced by high temperatures and sulphur oxides if the fuel is not gas. In the process, the emission of particles of different composition would also be expected, particularly in the case of working with ore versus scrap. In any case, emissions at this stage are typical of any smelter. They are perfectly catalogued, and the presence of considerable amounts of organic compounds is not expected if everything works properly.

In the casting stage, the emissions produced are process specific. As discussed in Section 1, at this stage, the expanded polystyrene model destroys in full on contact with the casting due to high temperatures. Emissions at this stage will, therefore, be determined mostly by the type of gases generated in the destruction, which depend on the materials used and the conditions of the process. In principle, the process could be assimilated to polystyrene pyrolysis under reducing conditions at high temperature and atmospheric pressure. For this reason, bibliography related to this topic has been analysed. The refractory paint covering the models contains small quantities of resins of an aromatic nature. However, given the small amount, even if partly destroyed by the high temperature, it seems unlikely that they can contribute significantly to emissions. The sand, and with it, possible agglomerates, is also subjected to high temperature. However, in this type of process, the binders are quite reduced compared to conventional processes, and the majority binder is water combined with clay, so sand binders do not seem likely to be a problem in the process.

As for the initial stage of preparation of the sand mould, the emissions that are produced are of solids and stem mainly from the presence of fine particles in the sand, when distributing it in the box around the model. In the final, demoulding stage, the emissions are also mainly of solids. At this stage, the parts and sand are still hot, and along with the solids, it is likely that vapours from the decomposition of the expanded polystyrene model that may have been retained in the porous sand during casting and cooling will also be emitted.

4. *Expanded Polystyrene. Composition, Production and Properties*

Polystyrene is a solid material that is included in the group of plastics. Plastics are materials consisting mainly of high molecular weight polymers, formed by the repetition of identical molecular units or monomers. In polystyrene, the repeated unit is styrene (C_8H_8, C_6H_5-$CH=CH_2$) or ethenylbenzene, according to the nomenclature of the IUPAC (International Union of Pure and Applied Chemistry), made up of a benzene ring with an ethylene substitute, such that



(1)

Polystyrene is an addition polymer, formed by the reaction between styrene molecules. As an addition polymer, the molecular weight is an exact multiple of the molecular weight of the monomer. The molecular weight of commercial polystyrene is between 10^5 and 4×10^5 g/mol, representing approximately 1000 to 4000 monomers per chain. The nature of polystyrene molecules is mostly linear, with little branching. The density of the material is about 1050 kg/m^3, and its glass transition temperature (softening temperature, as it is a thermoplastic material: solid up to a certain temperature and mouldable from it) is about 100º C.

There are different types of polystyrene, each with different applications. The most common are crystal, normal or tactical polystyrene (GPPS, General Purpose Polystyrene); high-impact polystyrene (HIPS), expandable polystyrene (EPS) and extruded polystyrene. Atactic crystal polystyrene, in which the phenyl groups are randomly distributed in the polymer chain, is an amorphous (non-crystalline) natured polymer, which is normally referred to by the general properties of the material that can be found in the bibliography. The word crystal means that the material is transparent.

There is crystal polystyrene, namely syndiotactic, more specific, crystalline and considerably more expensive, so it is only used for specific applications, in which the phenyl groups are distributed neatly on either side of the polymer chain, alternately.

The models used in casting are, as already indicated, expanded polystyrene models. EPS is produced from a discontinuous process of polymerisation in agitated aqueous suspension of styrene droplets of diameter between 0.1 and 1 mm, with a volumetric water/styrene ratio between 1/1 and 1/3, in the presence of a small quantity of an organic solvent, normally pentane, at a controlled temperature. In this process, small spheres of polystyrene and pentane are formed—usually called "pearls"—, which constitute the expandable polystyrene, with an approximate composition of 5% pentane/95% polystyrene. Pentane, embedded in the structure of polystyrene, acts as an expansion agent and is a liquid hydrocarbon at room temperature, composed exclusively of carbon and hydrogen, of formula C_5H_{12} (semi-developed formula: CH_3-CH_2-CH_2-CH_2-CH_3).

Expandable polystyrene pearls are treated, in the process of obtaining the models, with water vapour around or slightly above the glass transition temperature of the polystyrene, in continuous agitation. Since pentane has a typical boiling point of about 36°C, heating to approximately 100°C produces its rapid vapourisation. The change of state from liquid to steam produces a sudden increase in volume since the molar volume of the steam is about 250 times the molar volume of the liquid. In the expansion, it drags the polystyrene in which it is embedded, which at that temperature is easily mouldable, so that the pearls increase dramatically in size, forming polystyrene foam spheres.

Although much of the pentane vapour diffuses out of the spheres and is removed with water vapour, these foam spheres are filled with pentane vapour. As it cools, the pentane condenses and decreases in volume again, while the Styrofoam solidifies below the glass transition temperature. This creates a vacuum inside the spheres, which must be filled with air to stabilise them. For this reason, it is necessary to let the spheres obtained rest for a minimum of 24 hours (maturation stage). During this time, the spheres are cooled and dried in silos, and the air slowly enters by diffusion into the interior of the spheres through the pores of the material. In turn, the pentane evaporates and diffuses out of the spheres and is eliminated.

Finally, the foam spheres undergo the last stage of expansion. To do this, they are introduced into the mould that defines the shape of the model and are reheated with steam until they reach their glass transition temperature more or less. Again, the pentane that may remain inside the spheres expands as it vaporises and drags polystyrene in its expansion, which fills all the holes in the mould, as it is above its glass transition temperature. Compressed in the mould and above the glass transition temperature, the spheres combine to form a solid block, which is the expanded polystyrene model, faithfully reproducing the shape and dimensions of the mould.

There is a significant increase in the volume of the material throughout the expansion process, which significantly reduces its density. Thus, the density of the expandable polystyrene pearls obtained after polymerisation can be estimated at around 1030 kg/m^3 given their composition (since the density of the pentane is about 630 kg/m^3) and the final expanded polystyrene models present apparent densities (referring to the total volume they occupy, including voids) between 10 and 35 kg/m^3. Most of the decrease in apparent density occurs in the first stage of expansion.

According to this, the volume of voids (porosity, ε) represents approximately (taking an apparent average density of EPS of 20 kg/m^3, corresponding to EPS type IV) 98% of the total volume of expanded polystyrene or, to put it another way, only 2% of the volume of the model is polystyrene, the rest is air volume [1]. Despite the low density, the material has good mechanical resistance properties (compression stress with deformation of 10%, according to UNE EN-826, 100 kPa), which makes it suitable for use in models, in thicknesses no less than 20 mm.

Although during the manufacturing process, small quantities of components can be added to improve its properties, mainly its thermal resistance. The presence of additives is not to be expected when the application of EPS is the manufacture of models for casting. Therefore, its composition is expected to contain only carbon atoms and hydrogen atoms, which constitute

polystyrene (and pentane, if any), along with the air that fills 98% of the volume of the material.

The EPS models are impermeable to liquid water (they retain between 1 and 3% of water after immersion for 28 days, according to UNE EN-12087 standard), although not to water vapour, not hygroscopic, due to their structure in impermeable cells, and resistant to a great variety of chemical substances. As an exception, they can be attacked by adhesives (so complex models can be prepared by glueing simpler parts), anhydrous acids (without water, 100% concentrates), organic solvents (except alcohols) and hydrocarbons, mainly if they contain aromatics. These substances cause contraction and/or dissolution of the material. Due to their stability, EPS models do not require too much care.

Parts made of EPS do not constitute a suitable substrate for microorganisms, so they are not attacked by them. They absorb impacts effectively, so they resist shocks well and do not transmit them. They are also good thermal, electrical and acoustic insulators, to which their structure in cells, the high porosity and the insulating properties of polystyrene itself contributes. Therefore, they are widely used as building material, packaging and insulation.

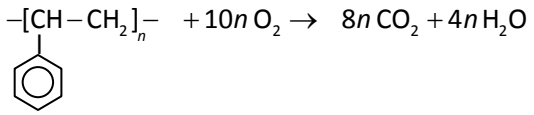
5. Thermal Behaviour of EPS

Due to its use as construction materials, mainly, the behaviour of EPS in relation to temperature has been extensively studied. Studies are mainly concerned with fire safety.

As mentioned above, polystyrene has a glass transition temperature of around 100ºC. This means that EPS materials begin to soften, and foam begins to contract from exposure to temperatures above 100ºC. The melting temperature of polystyrene is about 235°C, so the material exposed to these temperatures will melt.

However, given the properties of EPS as a thermal insulator, heat transmission within it is relatively slow. The softening and contraction of the foam, also, make it tend to move away from the heat source, as a general rule.

Under oxidising conditions, polystyrene is a combustible material due to its chemical composition. In fact, incineration with energy recovery is one of the possibilities for recycling EPS. Complete combustion of EPS takes place according to the following chemical equation:



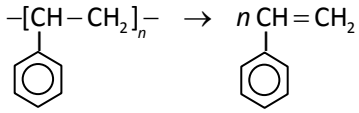
$$-[CH-CH_2]_n- \; + 10n\,O_2 \rightarrow \; 8n\,CO_2 + 4n\,H_2O \qquad (2)$$

to produce CO_2 and H_2O. Each monomer unit forms 8 molecules of CO_2 and 4 molecules of H_2O. The combustion enthalpy of EPS is about -32.3 MJ/kg, exothermic, so that about 650 MJ/m^3 of EPS is generated and burnt (type IV scenario). This value is relatively low for a combustible material and is related to the low density of the material.

However, complete combustion of EPS requires a large amount of air, as it requires abundant oxygen. According to equation (2), at least 10 moles of O_2 are required per mole of monomer, representing about 47 m^3 of O_2 per m^3 of EPS burnt. In terms of air required, approximately 225m^3 of air would be needed for the total combustion of each m^3 of EPS (type IV). Thus, the air contained in the EPS cavities, although it represents 98% of the volume of material and may seem a lot at first, 0.98m^3 per m^3 of EPS, is practically nothing compared to the 225m^3 of air required for combustion.

Under these conditions, complete combustion of the EPS does not take place, unless the combustion takes place in a very ventilated place with forced air circulation. In oxygen defect, incomplete combustion of EPS would produce significant quantities of CO, fumes (polycyclic aromatic hydrocarbons, given the low H/C ratio) and, if the oxygen defect is considerable, the primary reaction would not be the combustion of EPS, but its thermal decomposition.

Thermal decomposition of polystyrene in the absence, or severe shortage, of air, is considered to produce, for the most part, styrene monomer [2,3,4], according to the following chemical equation



(3)

at moderate temperatures (up to about 500°C), by rupture of the single C-C link in the chain, between successive monomer units, and formation of a double link in the aliphatic chain of styrene. This decomposition (depolymerisation) is endothermic and requires about 690 kJ/kg or, for type IV EPS, about 13.8 MJ/m^3 of decomposing EPS.

The thermal decomposition of plastic materials has been researched in the literature, usually to recycle polymeric waste into fuels. In these cases, the objective is to maximise fuel efficiency, whether solid, liquid or gas, and the effect of temperature, pressure, and/or the presence of catalysts on product performance and distribution is studied. Obviously, the situation from the point of view of this report is quite different.

In relation to the temperature range, published studies on oxygen defect rarely exceed 650ºC, as higher temperatures reduce the yield to hydrocarbons in the range of liquid fuels [5]. If the objective is to obtain gases, normally two stages are used, and the higher temperature stage is not applied to plastics, but to the vapours/gases formed in the first stage, usually in the presence of catalysts.

However, the EPS in the models decomposes on contact with the cast iron casting, which is in the range of 1400ºC. Under these conditions, model fusion and decomposition are immediate, both for EPS in contact with the casting and for that of the surrounding area. It is, therefore, to be expected that thermal decomposition will occur in an extensive range of temperatures, but mainly at high temperatures.

The higher the temperature, the more energy is available for broken links. Thus, at a relatively low temperature, the majority product is styrene because the breakage of the C-C bond in the polystyrene chain in the carbon that has the phenyl radical as a substitute and the formation of the double bond in the aliphatic chain is favoured by the resonant structures of the conjugated bonds.

The higher the temperature, however, the greater the availability of energy, favouring the breakage of more energetic links. Thus, an increase in temperature decreases the styrene yield and favours the formation of toluene first and then benzene. The benzene ring is very stable due to its aromaticity, and the rupture of the ring bonds requires a significantly higher amount of energy. This implies that the selectivity towards benzene as a product of the decomposition of EPS increases with temperature.

Even so, at the temperature of the casting, it is to be expected that most of the benzene rings will react, by radical reactions, forming a carbonaceous residue (given the low H/C ratio) that is probably incorporated into the casting and light hydrocarbons. The carbonaceous residue would not affect the final casting material given the low density of EPS and considering the high density of iron ore and the carbon content of the cast iron.

Consequently, given the broad temperature range at which the various parts of the EPS model can be broken down by adding casting into the mould, the presence of benzene, toluene and styrene emissions in the gases is to be expected. However, it is not easy to predict in what proportion or in what concentration, and it can probably vary throughout the process.

6. Diffusivity of Benzene, Toluene and Styrene in Air

Once it has been established that benzene, toluene and styrene can be formed in the casting process in moulds with EPS models, it is interesting to know how they dilute into the environment. Dilution depends on several factors. In the environment, these factors are primarily temperature and the shape, size and nature of the substances, since the pressure is not a significant variable.

All these factors affect the diffusivity coefficient, a parameter that gives an idea of the speed at which molecules of one substance diffuse into another (in this case, into the air). Moreover, the molecular mass of the substance to be diffused is also significant in its dilution process, since it determines the density of its vapours compared to the density of the air. If the relative density is lower than that of air, the substance will tend to accumulate at the top of the enclosure. On the other hand, if its relative density is higher than that of air, it will tend to gather in the lower part of the enclosure.

In the specific case of benzene, toluene and styrene, they all have relative densities much higher than those of air (between 2.7 for benzene and 3.6 for styrene), which means that they tend to accumulate in the lower part of the enclosure. This implies that an extractor at the top without sufficient forced diffusion ("pull" or air movement) is not likely to be able to suck the components effectively enough to prevent their accumulation in the enclosure.

Moreover, the diffusion coefficients for these three components can be estimated in the air. Since this is about the environment, it is based on atmospheric pressure and a temperature of 25º C. The higher the temperature, the higher the diffusion coefficient, and, therefore, the faster they will dilute in the environment. The moment these components are formed by the addition of casting, it is evident that they will be at a much higher temperature. However, by contact with the surrounding air, it is foreseeable that they will cool to room temperature very quickly. In any case, the values are to be used for comparative purposes only.

The values have been estimated using the Fuller et al. method [6], which is a simple yet effective method that yields good results. The estimate has been based on:

$$D_{AB} = \frac{1,43 \times 10^{-3} T^{1,75}}{P M_{AB}^{0,5} \left(V_A^{1/3} + V_B^{1/3} \right)^2} \qquad (4)$$

where the subindices A and B represent the substance to be diffused and the medium in which it is diffused (air, in this case), respectively; T is the absolute temperature of the medium (K); P is the absolute pressure (bar); V is the molar diffusion volumes (cm^3/mol); and M_{AB} is the harmonic mean of the molecular masses of the substance to be diffused and the medium

Table 1. Diffusion coefficients in air, at 25ºC and atmospheric pressure, and values related to CO.

	Benzene	Toluene	Styrene
D_{AB}, m^2/s	8.97×10^{-6}	8.06×10^{-6}	7.51×10^{-6}
D_{AB}/D_{COB}	0.449	0.403	0.376

(g/mol). Under these conditions, the diffusion coefficient in equation (4), D_{AB}, is obtained in cm^2/s.

The values obtained for the diffusion coefficients of the three components are shown in Table 1. The values for the diffusion coefficient of carbon monoxide, with a molecular mass very similar to that of air, under the same conditions, are included in the table for comparative purposes. In simple terms, the relative values in Table 1 indicate that benzene diffuses 0.449 times slower than CO in air, toluene 0.403 times slower and styrene 0.376 times slower or that under similar conditions benzene takes 2.2 times longer to diffuse, toluene 2.5 times and styrene 2.7 times.

7. Company/industries Specific Case Study

In the specific case of the industries under study, the average production of iron casting is estimated to be around 100 t/day. The company has three furnaces for this purpose: two 28-tonne furnaces and a smaller 14-tonne furnace, which means that, on average, they would make two smelting sessions a day with the furnaces, as it is always necessary to work with some excess of material. The visit took place on Thursday, 17 May 2018, from 3 to 4 pm, and Dr José Antonio González Marcos, Professor of Chemical Engineering at the UPV/EHU and also a member of the CHES Research Group, and I attended as advisers.

The furnaces are of the oxygen type, which means that they use gas as fuel. In principle, for the daily workload, it seems to be the most appropriate and efficient heating method and the one that will produce the lowest emissions per power generation.

The source of iron they use to melt is scrap, to which they add the necessary components in its composition to meet customer requirements, including carbon in the form of anthracite. This means that melting temperatures are in the region of 1400ºC. The exit of gases from the three furnaces, during melting, is channelled to the same conduction, and has cyclones, heat exchangers, for energy recovery, given that the gases come out at a high temperature, and a system of sleeve filters, all focused on retaining the particles that are predictably produced in the process and are dragged by the gases.

They receive pre-manufactured models of the pieces in the form of expanded polystyrene foam, and they prepare the sand moulds with them. The EPS used is type IV, with a density of 20 kg/m^3. Although part of the production is carried out using wood to prepare the moulds, I am going to refer exclusively to the "lost-foam" process with EPS, which seems to be the problem from the environmental point of view.

The EPS models, as already mentioned, are painted with refractory paint, so the paint acts as a support element for the sand mould when the model melts, while at the same time isolating the casting from the sand. The refractory paint they use is a water-based paint that has a reddish tone (perhaps iron oxide), and there are no significant odours around the area in which the pieces are painted. Although it is a water-based paint, this does not mean that it does not have chemical compounds of an aromatic nature, probably phenolic resins, since the

paint must cover the model with a stable layer once it dries, and that stable layer is usually a polymer of an aromatic nature. If the company has the information, it could be interesting to consider data on specifications of the paint they use. In any case, as already mentioned, given the small amount used, it does not appear to be a significant source of emissions when decomposed.

The painted and dry model is placed in the boxes, and the sand mould is prepared. The sand used is black and, therefore, appears to be chromite sand, which is quite suitable for this type of application, although the black colour may also be due to the presence of coal. Given the hardness it acquires in the mould, it is evident that it has a certain amount of binder additives, probably inorganic for the most part, although the use of expanded polystyrene models significantly reduces the binder requirements compared to the traditional process. If organic binders are used in sand, some of the emissions may be associated with them, but this is unlikely. However, it might also be interesting to have information on the quantity and specifications of the binders used.

During the sand mould preparation process, sand is pumped in, which means that fines can generate particles in the environment. For this reason, the process is carried out together with an air extractor, which sucks and filters the particles, and which is put into operation specifically when the mould is being prepared, to ensure the environment is kept free of particles. The sand is distributed and compacted manually, due to the size of the moulds, and the appropriate channels are left for the entrance of the casting and the exit of the gases.

Given the density of iron, 100 t/day is equivalent to a casting volume of cast iron of about 13m^3/day. Assuming that all the casting is processed in the moulds with EPS, this means that the mass of EPS foam that undergoes thermal decomposition is about 260 kg/day. The only way to reduce the amount of EPS consumed would be to use a lower density EPS foam. However, this is probably not feasible from a technical point of view, given the lower mechanical strength of these foams. On the other hand, as discussed in point 5, most of this 260 kg of material is incorporated as carbon in the casting, so it does not present problems from an environmental point of view.

The addition of casting, as discussed above, decomposes the expanded polystyrene model. Since the polymer contains aromatic rings, thermal decomposition at high temperature is likely to result in the emission of benzene, toluene and styrene as aromatic at least.

Other types of plastics without aromatic rings could be considered to avoid or minimise the emission of such compounds. The problem is that, at present, there are no non-aromatic foams with properties similar to EPS that could replace it in this process.

Using other plastics that are not in foam format, bearing in mind that the foam only contains 2% of plastic material in its volume, would involve processing about 50 times more polymer weight. That is neither economically nor environmentally sustainable. In addition to producing a significant increase in emissions and a tremendous waste of material, it would not be technically feasible either, because the waste generated in the casting would not be negligible.

There does not appear to be any specific extractors in the casting area during the casting process, except for the general extractors on the roof, located at least 10 m above where the emissions are generated. The volume of the warehouse is also quite large, so it is unlikely that there will be an efficient air circulation that can facilitate the dispersion and dilution of the compounds emitted through the roof extractors, even less so when the compounds generated, as discussed above, are significantly denser than air.

The warehouse doors remain open at virtually all times, given the constant circulation of vehicles through the facilities, so that, rather than through the extractors, these compounds will pass mostly to the environment as diffuse emissions, in all likelihood. This would be the aspect to study and correct, isolating the casting area, or situating an extractor mouth in the surroundings of the casting area, which would be capable of trapping these emissions at the moment they are produced.

Channelling emissions is an essential aspect of avoiding the problem, but it is not the only one. The other aspect is to avoid or minimise, as far as possible, its emission into the environment. To do this, a system for retaining or destroying the pollutants before they are released should be implemented. In principle, given that they are combustible compounds, one could think of a combustion system. However, given that emissions are discontinuous and occur at very localised moments in time, a retention system (with activated carbon, for example, but this would be something to study and is not the purpose of this report) might be preferable.

Once the mould has cooled to a reasonable temperature and hardened the piece, it is demoulded. The sand mould-breaking process also produces significant particle emissions. The sand in the mould is still hot, and it is likely that the particles will also emit a certain amount of organic vapours retained by the mould, both from the organic binders in the sand and the refractory paint, and from any thermal decomposition products of EPS that may have been absorbed (mainly if the sand contains carbon).

These emissions, probably minority, are also produced in the environment of an extraction mouth, which is connected when the demoulding operations are carried out so, from the point of view of particle emissions, they are controlled. If the significant presence of organic emissions together with the particles is detected at this stage, all the extraction ducts could be channelled through the same retention and/or destruction system.

8. Conclusions

As general conclusions of the report, it can be assured that part of the concentrations of benzene, toluene and styrene (among other aromatic compounds) that have been detected in immission come from the thermal decomposition of the expanded polystyrene foam used in the smelting processes.

This thermal decomposition, which occurs during the casting process, is not confined to the company being measured, since the extractors on the roof of the building do not appear to be effective in producing a movement of air sufficient to facilitate its diffusion, as they are significantly denser compounds than air, and therefore tend to accumulate in low areas.

For this reason, emissions of these compounds are likely to be diffuse in nature and not detected in emissions through chimneys. It would, therefore, be advisable to check the concentration of these components in the lower areas of the warehouse, rather than in the emissions themselves in the chimneys. These compounds are aromatic in nature and, therefore, have a characteristic odour and are likely to be noticed during casting.

If the concentrations are confirmed, it would be advisable to confine the emissions, probably by means of an extraction mouth in the environment of the casting, and to retain or destroy them before their emission through the chimney, taking into account in the chosen technology that the emissions have a discontinuous nature and occur only at very specific moments of the process.

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ANNEX X:

Informe número TEC-18.90-003 de 3 de diciembre de 2018 para los focos de emisión de INDUSTRY 1.

Made by TECNALABAQUA, A.I.E. laboratory.

Nº INFORME	TEC-18.90-003
CLIENTE	GOBIERNO VASCO
PERSONA DE CONTACTO	Inesa Baños (inesa-banos@euskadi.eus)
DIRECCIÓN	C/ Donostia- San Sebastian, 1, 01010 Vitoria
OBJETO	MEDIDA VOLUNTARIA DE EMISIONES ATMOSFÉRICAS
FECHA DE EMISIÓN	03/12/2018

TECNALABAQUA AIE

Fdo: Silvia Cosin
Directora Técnica

Fdo: Andoni Ibarra
Responsable Técnico de Ensayos

Í N D I C E

1.- INTRODUCCIÓN

De acuerdo a la oferta OF20085429_v3 del 18 de mayo de 2018 se recogen en el presente informe los resultados de las medidas Voluntaria de Emisiones Atmosféricas realizada en:

Empresa:	**Fundiciones Fumbarri**
Dirección:	**San Roke Kalea, 22, 48200 Durango, Bizkaia**
Fecha de la medida:	24 y 25 de septiembre 2018

El laboratorio que ha realizado las medidas por solicitud del Departamento de Medio Ambiente, Planificación Territorial y Vivienda es:

Nombre:	TECNALABAQUA A.I.E.
Dirección:	Parque Tecnológico de Bizkaia Edificio 101 48170 Zamudio (Bizkaia)
Teléfono:	94 607 35 71 Fax 94 607 35 40
Persona de Contacto:	Silvia Cosin Fuentes
CIF:	V-01526516

Los focos y parámetros medidos han sido:

Nombre del foco	Parámetros
Fusión	VOC´s
Colada	VOC´ s

Los trabajos se han realizado a lo largo de dos ciclos de fusión y de dos ciclos de colada. Por parte de TECNALABAQUA, A.I.E. se han tomado 4 muestras en tubos de carbón durante cada ciclo de fusión y 4 muestras en tubos de carbón activo durante cada ciclo de colada. Dichos tubos han sido posteriormente analizados por el laboratorio LABAQUA, S:A. (ver anexo II del presente informe). Adicionalmente y según lo acordado con los técnicos de Gobierno Vasco se han tomado dos tubos de carbón activo adicionales durante cada proceso de colada, siendo estos analizados por el propio laboratorio de Gobierno Vasco.

En todos los casos, se ha realizado un barrido de VOC´s para detectar la presencia de los compuestos mayoritarios y analizándose al menos los siguientes compuestos: Benceno, estireno, tolueno, isopropanol y n-pentano.

Asimismo, se ha realizado la determinación de los gases de combustión, caudal y humedad de los gases (ver anexo I del presente informe).

Los técnicos que realizaron las medidas fueron:

A. Ibarra: Responsable Técnico de ensayo

R. Sainz: Responsable Técnico de ensayo

2.- DESCRIPCION DE LOS FOCOS

Denominación del foco:
Foco Fusión
Características del foco y descripción de la actividad

Tipo de tramo	Vertical
Tipo de sección	Cilíndrico
Número de orificios para la toma de muestras manuales	2 a 90º
Diámetro interior de la boca de toma de muestras manuales	100 mm
Longitud del cuello de las bocas de toma de muestras manuales	10 cm
Amplitud de plataforma	<5m²
Accesibilidad	Escalera metálica vertical con protecciones laterales

Distancias y dimensiones relativas a los puntos de toma de muestras manuales	
Diámetro del conducto de humos en el punto de emisiones de gases	1,00 m
Diámetro del conducto de humos en el punto de toma de muestras	1,00 m
Altura total de la chimenea	>12 m
Altura del punto de toma de muestras manuales	>8 m
Distancia de la última perturbación al punto de toma de muestras manuales	2,0 m
Distancia entre el punto de toma de muestras manual y la siguiente perturbación	>5,5 m
Distancia perturbación anterior respecto al diámetro	2,0 ∅
Distancia perturbación posterior respecto al diámetro	>5,5 ∅

El foco medido cumple los requisitos indicados en la Instrucción técnica – 02 (IT-02) relativo a muestreos isocinéticos. Dichos requisitos se presentan en la siguiente tabla:

Medidas preliminares	Criterio de aceptación	Resultado obtenido
Ángulo con respecto al eje del conducto	< 15º	**< 15º**
Velocidad negativa	No permitida	**Velocidad +**
Mínima presión diferencial (△P) en tubo de pitot:	> 5 Pa (> 0,02 “CdA)	**>1,45 “CdA**
Relación velocidad máxima y mínima	< 3:1	**1,08:1**

Descripción de la actividad:

Fusión de hierro

Datos de producción:

Las dos primeras muestras se realizan con el horno de fusión grande en funcionamiento. Las muestras 3 y 4 se realizan con los dos hornos (grande y pequeño) en funcionamiento y las 4 últimas muestras se realizan con el horno grande en funcionamiento.

Denominación del foco:
Foco Colada
Características del foco y descripción de la actividad

Tipo de tramo	Vertical
Tipo de sección	Cilíndrico
Número de orificios para la toma de muestras manuales	2 a 90º
Diámetro interior de la boca de toma de muestras manuales	100 mm
Longitud del cuello de las bocas de toma de muestras manuales	10 cm
Amplitud de plataforma	<5m²
Accesibilidad	Escalera metálica vertical con protecciones laterales
Distancias y dimensiones relativas a los puntos de toma de muestras manuales	
Diámetro del conducto de humos en el punto de emisiones de gases	1,60 m
Diámetro del conducto de humos en el punto de toma de muestras	1,60 m
Altura total de la chimenea	>12 m
Altura del punto de toma de muestras manuales	>8 m
Distancia de la última perturbación al punto de toma de muestras manuales	7,50 m
Distancia entre el punto de toma de muestras manual y la siguiente perturbación	2,20 m
Distancia perturbación anterior respecto al diámetro	4,7 ∅
Distancia perturbación posterior respecto al diámetro	1,4 ∅

El foco medido cumple los requisitos indicados en la Instrucción técnica – 02 (IT-02) relativo a muestreos isocinéticos. Dichos requisitos se presentan en la siguiente tabla:

Medidas preliminares	Criterio de aceptación	Resultado obtenido
Ángulo con respecto al eje del conducto	< 15º	**< 15º**
Velocidad negativa	No permitida	**Velocidad +**
Mínima presión diferencial (△P) en tubo de pitot:	> 5 Pa (> 0,02 “CdA)	**>1,00 “CdA**
Relación velocidad máxima y mínima	< 3:1	**1,12:1**

Descripción de la actividad:

Colada del hierro fundido a los moldes.

3.- RESULTADO DE LAS EMISIONES

MUESTRAS ANALIZADAS POR LABAQUA, S.A.

De las ocho muestras tomadas a lo largo de los dos ciclos de fusión, en la siguiente tabla sólo se indican aquellos compuestos que han tenido valores por encima del límite de cuantificación del laboratorio.

Denominación del foco: FUSION				
Fecha	**Muestra**	**Compuesto**	**Concentración en emisión**	**Unidad**
24.09.18 y 25.09.18	6	Benceno	3.318,6	µg/Nm³
		Tolueno	331,9	
	7	Tolueno	280,3	
	8	Benceno	289,9	
		Tolueno	362,3	

De las ocho muestras tomadas a lo largo de los dos ciclos de colada, en la siguiente tabla sólo se indican aquellos compuestos con valores por encima del límite de cuantificación del laboratorio.

Denominación del foco: COLADA				
Fecha	**Muestra**	**Compuesto**	**Concentración en emisión**	**Unidad**
24.09.18 y 25.09.18	1	Benceno	1.751,93	µg/Nm³
		Tolueno	2.803,08	
		Isopropanol	911,00	
	2	Benceno	4.644,41	
		Estireno	145,14	
		Tolueno	8.272,86	
		Isopropanol	798,26	
	3	Benceno	4.144,69	
		Tolueno	9.645,82	
		Isopropanol	1.055,01	
	4	Benceno	3.380,28	
		Estireno	915,49	
		Tolueno	7.605,63	
		Isopropanol	774,65	
	5	Benceno	2.865,13	
		Estireno	559,05	
		Tolueno	6.429,07	
	6	Benceno	3.698,33	
		Estireno	797,68	
		Tolueno	7.324,15	
	7	Benceno	2.981,82	
		Estireno	2.763,64	
		Tolueno	6.981,82	
	8	Benceno	3.377,90	
		Estireno	3.729,77	
		Tolueno	8.163,27	

MUESTRAS ANALIZADAS POR EL LABORATORIO DE GOBIERNO VASCO

Denominación del foco: COLADA				
Fecha	**Muestra**	**Compuesto**	**Concentración en emisión**	**Unidad**
24.09.18 y 25.09.18	1	Benceno	938,05	µg/Nm³
		Estireno	100,29	
		Tolueno	1.577,96	
		Isopropanol	2.331,08	
		n-pentano	< 0,1	
	2	Benceno	1.113,77	
		Estireno	876,42	
		Tolueno	1.703,26	
		Isopropanol	3.376,75	
		n-pentano	< 0,1	
	3	Benceno	941,35	
		Estireno	436,84	
		Tolueno	1.015,89	
		Isopropanol	394,92	
		n-pentano	<0,1	
	4	Benceno	882,30	
		Estireno	383,22	
		Tolueno	937,86	
		Isopropanol	354,95	
		n-pentano	<0,1	

4.- MÉTODOS EMPLEADOS EN LAS MEDICIONES

TECNALABAQUA, ha realizado las mediciones indicadas de acuerdo a las Normas aplicables y procedimientos internos basados principalmente en las metodologías UNE y EN.

Concretamente se han empleado los siguientes métodos, y procedimientos internos:

TEC-EM-PO-0047. Procedimiento para el muestreo de compuestos orgánicos volátiles en emisiones de fuentes estacionarias

COV´s

El muestreo de COV´s se ha realizado mediante muestreo a caudal constante muestreado en el punto medio de la chimenea.

Para la toma de muestras se han utilizado cartuchos de carbón activo 100/50 mg (muestras analizadas por LABAQUA, S:A.) y cartuchos de carbón activo específicos para desorción térmica (muestras analizadas por el laboratorio de Gobierno Vasco).

La analítica fue realizada por el método analítico de cromatografía de gases/masas por el personal de LABAQUA, S.A. en el caso de los tubos de carbón activo y mediante cromatografía de gases por desorción térmica en el caso de los tubos facilitados por Gobierno Vasco.

La determinación de gases de combustión se ha realizado mediante analizador portátil de células electroquímicas de acuerdo con lo establecido en el procedimiento interno TEC-EM-PO-0022.

5.- EQUIPOS DE MEDIDA

	FLEXÓMETROS		MANÓMETROS		TERMOPARES INT. SONDA
	EM0103		EM0411 (0 a 1 “H2O)		EM0521
	EM0134		EM0412 (0 a 30 “H2O)		EM0522
☑	EM0135		EM0413 (0 a 12 “Hg)		EM0523
	BOQUILLAS TITANIO				EM0524
	EM0104 (nº 1)		**SISTEMA ISOCINÉTICO 1 (Pies³)**		EM0525
	EM0105 (nº 2)		EM0403 (0 a 10 “H2O)		EM0526
	EM0106 (nº 3)		EM 0404 (0 a 5 “H2O)		EM0527
	BOQUILLAS ACERO INOX.		EM0405 (0 a 0,5 “H2O)		EM0528
	EM0107 (nº 9)		EM0516 (Termopar “IN”)		EM0529
	EM0108 (nº 10)		EM0517 (Termopar “OUT”)		EM0530
	EM0109 (nº 15)		EM1118 (Contador)		EM0531
	EM0110 (nº 16)		**SISTEMA ISOCINÉTICO 2 (m³)**		**HORNO DE TRATAMIENTO**
	EM0111 (nº 18)		EM0407 (0 a 10 “H2O)		EM0532
	EM0112 (nº 19)		EM0408 (0 a 5 “H2O)		
	EM0113 (nº 20)		EM0409 (0 a 0,5 “H2O)		**TUBOS PITOT**
	EM0114 (nº 21)		EM0518 (Termopar “IN”)	☑	EM1112 (nº 2)
	EM0115 (nº 22)		EM0519 (Termopar “OUT”)		EM1113 (nº 7)
	EM0116 (nº 23)		EM1119 (Contador)		EM1114 (nº 8)
	EM0117 (nº 24)		**SISTEMA ISOCINÉTICO 3 (Pies³)**		EM1115 (nº 9)
	EM0118 (nº 25)		EM0414 (0 a 10 “H2O)		EM1116 (1 m)
	EM0119 (nº 26)	☑	EM0415 (0 a 5 “H2O)		EM1117 (1,8 m)
	EM0120 (nº 27)		EM0416 (0 a 0,5 “H2O)		
	EM0133 (nº 14)		EM0534 (Termopar “IN”)		**DILUIDOR**
	BOQUILLAS VIDRIO		EM0535 (Termopar “OUT”)		EM1120 (Nitrógeno)
	EM0121 (nº 4)		EM1135 (Contador)		EM1121 (Gas patrón)
	EM0122 (nº 5)		**TERMÓMETROS**		EM1122 (Gas patrón)
	EM0123 (nº 6)		EM0503 (CHY)		EM1123 (Gas patrón)
	EM0124 (nº 7)		EM0504 (Hibok)		
	EM0125 (nº 8)	☑	EM0536 (Hibok)		**BOMBAS ASPIRACIÓN**
	EM0126 (nº 9)		EM0505 (punta)		EM1124
	EM0127 (nº 10)			☑	EM1125
	EM0128 (nº 11)				EM1126
	EM0129 (nº 12)		**TERMOPARES**		EM1128
	EM0130 (nº 13)		EM0506 (1 m)		EM1130
	EM0131 (nº 14)		EM0507 (1 m)		EM1131
	EM0132 (nº 15)	☑	EM0508 (1,75 m)	☑	EM1132
	CRONÓMETROS		EM0509 (1,75 m)		EM1134
	EM0201				**ANALIZADORES DE GASES**
	EM0202		**TERMÓMETROS ESFERA**		EM1201 (Testo 350 XL)
☑	EM0203		EM0510		EM1202 (Testo 350 XL)
	BALANZAS		EM0511	☑	EM1207 (Testo 350 XL)
	EM0301 (R220D)		EM0512		EM1203 (Horiba)
	EM0302 (BD1201)				EM1204 (Horiba)
	EM0303 (PL1501-S)		**TERMÓMETROS CODO FLEXIBLE**		EM1205 (MiniFID)
☑	EM0304 (PL1501-S)		EM0513		EM1206 (MiniFID)
	BARÓMETROS		EM0514		EM1208 (Fid SKC)
☑	EM0401 (Lambrech)		EM0515		**INDICADOR BACHARACH**
	EM0402 (Barigo)				EM1209
	EM0417 (Barigo)				EM1210

CODIGO EQUIPO	EQUIPO	MARCA/MODELO	ÚLTIMA CALIBRACIÓN	PERIODO DE CALIBRACIÓN
EM0304	BALANZA (1.510 g.)	METTLER/PL1501-S	09/04/2018	1 año
EM0401	SENSOR	LAMBRECH	10/04/2018	1 año
EM0536	TERMÓMETRO DIGITAL	HIBOK 14	18/04/2018	1 año
EM0508	TERMOPAR (1,75m.)	E.N.I.	05/01/2018	1 año
EM1207	ANALIZADOR DE GASES	TESTO/TESTO 350 XL	06/03/2018	1 año
EM0134	FLEXOMETRO	FISCHER DAREX	14/03/2018	1 año
EM0203	CRONOMETRO DIGITAL	OREGON SCIENTIFIC	21/03/2018	1 año
EM1112	TUBO DE PITOT TIPO "S" (Nº 2)	MINI	15/03/2018	1 año
EM0415	MANOMETRO (0-5 "H2O)	DWYER INSTRUMENTS	06/04/2018	1 año
EM1125	CONTADOR	ACTARIS	13/09/2018	1 año
EM1132	CONTADOR	ACTARIS	16/05/2018	1 año

ANEXO I.- DATOS DE CAMPO Y CÁLCULOS EFECTUADOS

Lugar de medida:	**Chimenea de salida de gases de Fusión**
Contaminantes a medir:	**COV´s (tubos de carbón activo analizados en LABAQUA, S.A.)** **CO** **NO_x** **O_2** **Caudal** **Humedad**
Fecha de medida:	**24.09.18 y 25.09.18**
Fecha de envío de muestras al laboratorio:	**02.10.18**
Fecha de análisis químicos:	**Del 02.10.18 al 16.10.18**
Realizado por:	**R. Sainz y A. Ibarra**

FUSION							
Fecha	Muestra	Horario de medida	Parametro	mg	volumen (m3N)		microgramos/m3N
24-25.09.18	Muestra 6	0:35	Benceno	0,03	0,00904		3318,6
			Tolueno	0,003	0,00904		331,9
	Muestra 7	0:49	Tolueno	0,004	0,01427		280,3
	Muestra 8	1:10	Benceno	0,004	0,0138		289,9
			Tolueno	0,005	0,0138		362,3

EMPRESA: FUMBARRI
FOCO: FUSIÓN

FECHA: 24.09.18
Expediente nº: TEC-18.90

Horario de muestreo:	20:45-21:00	h.			Nº de bridas	2
Presión atmosférica:	761	mmHg.	1.014	mbar	Puntos de muestreo:	6
Presión en conducto:	-1,10	"H_2O			Tª media de los gases (Ts):	78 ºC
					Tiempo de muestreo:	3.600 s

DATOS DE MUESTREO

		BRIDA 1		BRIDA 2						
Punto de muestreo	Distancia (cm)	Presión (DP) "H2O	Velocidad (m/s)	Presión (DP) "H2O	Velocidad (m/s)					Temperatura (ºC)
1	5,0	1,45	22,4	1,55	23,1					78
2	14,6	1,55	23,1	1,60	23,5					79
3	29,6	1,60	23,5	1,70	24,2					77
4	70,4	1,55	23,1	1,60	23,5					75
5	85,4	1,60	23,5	1,55	23,1					78
6	95,0	1,65	23,9	1,50	22,8					79

VELOCIDAD DE LOS GASES		
Media de las raices cuadradas de las DP:	1,2547	"CdA
Presión absoluta en el conducto (Ps):	758,95	mmHg
Factor de corrección del tubo de pitot (Cp):	0,8250	
Velocidad de los gases (V):	23,3105	m/s

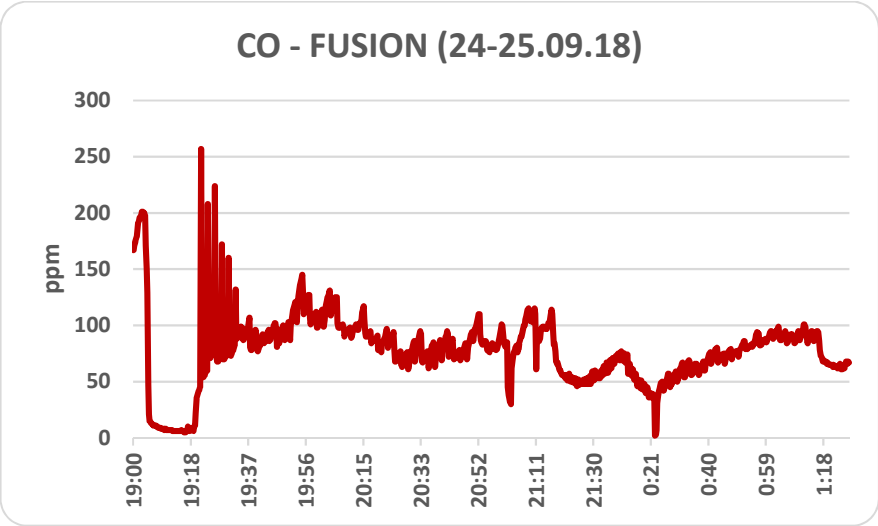
HUMEDAD DE LOS GASES							
Peso vapor agua condensado (G):	11,7 g.	nº	Solución	Extremo	Peso inicial	Peso final	Diferencia
Fracción húmeda en volumen (Fh):	0,048	1	H_2O	R	521,9	529,4	7,5
Fracción gas seco (Fs):	0,952	2	H_2O	R	501,2	502,9	1,7
Humedad de los gases:	4,8%	3	Vacío	G-S	416,7	417,8	1,1
		4	Gel silice	R	707,3	708,5	1,2

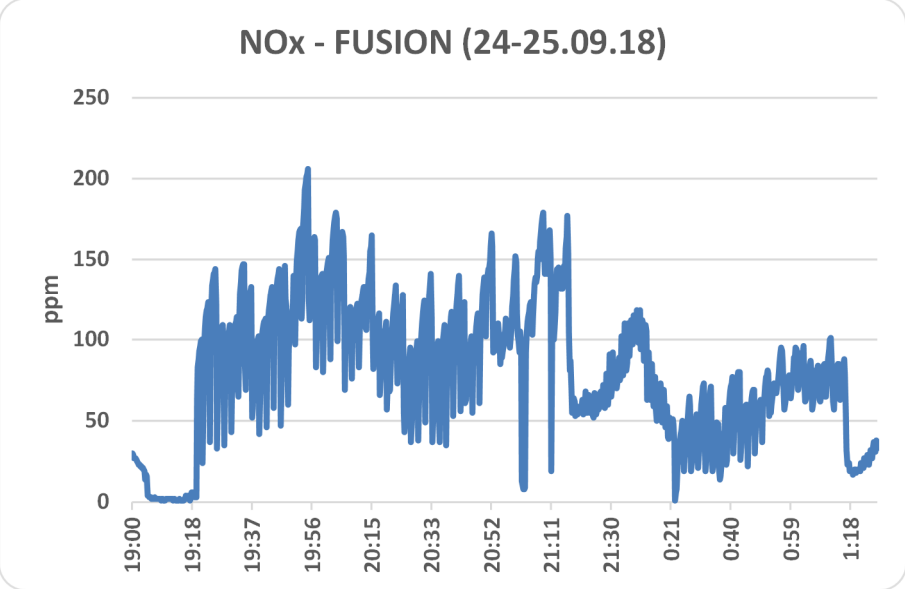
COMPOSICIÓN DE LOS GASES		
CO_2 (%)		<0,1
O_2 (%)	20,5	
CO (%)		<0,1

PESO MOLECULAR DE LOS GASES		
P.m seco (Ms):	28,82	g/mol
P.m húmedo (Mh):	28,30	g/mol
Densidad gases:	1,2866	g/l

CAUDAL HORARIO DE GASES		
Medidas interiores del conducto circular	1,000	m. diámetro
Sección interior del conducto (Si):	0,7854	m^2.
Caudal hora efectivo (Q):	65.909	m^3/h.
Caudal hora cond. normales. Base húmeda (Qcnh):	51.240	m^3N/h.
Caudal hora cond. normales. Base seca (Qcns):	48.788	m^3N/h.

Tª media contador:	17,2 ºC	Tª media contador:		290 ºK
Aspiración:	5 l/min.			
Volumen aspirado:	308 litros	Corrección:		litros/hora
Volumen aspirado (C.N):	290,1 litros	Corrección:	0,000	litros en el muestreo.
Volumen de la muestra en condiciones del contador (Vm):			0,3080	m^3.
Volumen de la muestra en condiciones normales (Vcn)(corregido):			0,2901	m^3N.
Presión media en el contador (Pm):			761	mmHg.


CO - FUSION (24-25.09.18)
ppm
300
250
200
150
100
50
0
19:00
19:18
19:37
19:56
20:15
20:33
20:52
21:11
21:30
0:21
0:40
0:59
1:18


NOx - FUSION (24-25.09.18)
ppm
250
200
150
100
50
0
19:00
19:18
19:37
19:56
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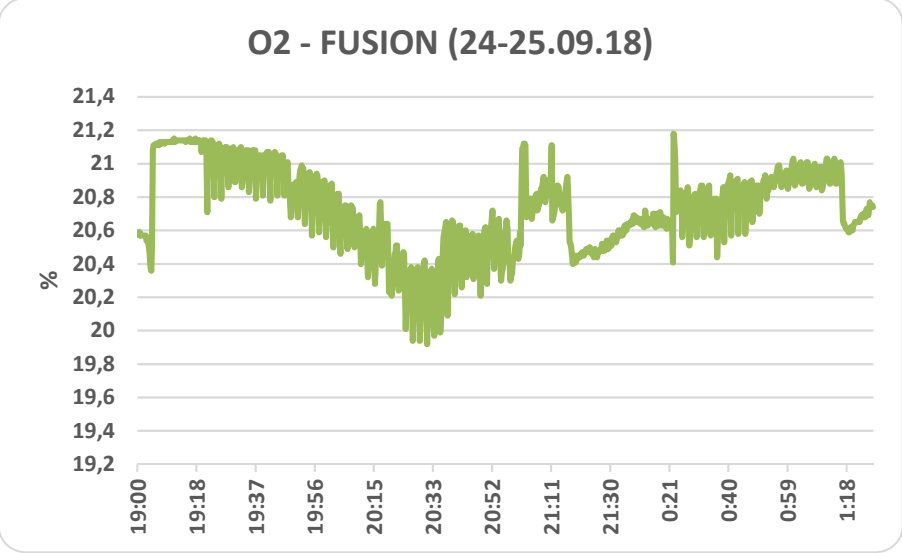
20:52
21:11
21:30
0:21
0:40
0:59
1:18


O2 - FUSION (24-25.09.18)
%
21,4
21,2
21
20,8
20,6
20,4
20,2
20
19,8
19,6
19,4
19,2
19:00
19:18
19:37
19:56
20:15
20:33
20:52
21:11
21:30
0:21
0:40
0:59
1:18

Lugar de medida:	**Chimenea de salida de gases de Colada**
Contaminantes a medir:	**COV´s (tubos de carbón activo analizados en LABAQUA, S.A.)** **CO** **NO_x** **O_2** **Caudal** **Humedad**
Fecha de medida:	**24.09.18 y 25.09.18**
Fecha de envío de muestras al laboratorio:	**02.10.18**
Fecha de análisis químicos:	**Del 02.10.18 al 16.10.18**
Realizado por:	**R. Sainz y A. Ibarra**

COLADA							
Fecha	Muestra	Horario de medida	Parametro	mg	volumen (m3N)		microgramos/m3N
24-25.09.18	Muestra 1	22:50	Benceno	0,025	0,01427		1751,93
			Tolueno	0,04	0,01427		2803,08
			Isopropanol	0,013	0,01427		911,00
	Muestra 2	23:20	Benceno	0,064	0,01378		4644,41
			Estireno	0,002	0,01378		145,14
			Tolueno	0,114	0,01378		8272,86
			Isopropanol	0,011	0,01378		798,26
	Muestra 3	23:40	Benceno	0,055	0,01327		4144,69
			Tolueno	0,128	0,01327		9645,82
			Isopropanol	0,014	0,01327		1055,01
	Muestra 4	0:00	Benceno	0,048	0,0142		3380,28
			Estireno	0,013	0,0142		915,49
			Tolueno	0,108	0,0142		7605,63
			Isopropanol	0,011	0,0142		774,65
	Muestra 5	2:25	Benceno	0,041	0,01431		2865,13
			Estireno	0,008	0,01431		559,05
			Tolueno	0,092	0,01431		6429,07
	Muestra 6	2:59	Benceno	0,051	0,01379		3698,33
			Estireno	0,011	0,01379		797,68
			Tolueno	0,101	0,01379		7324,15
	Muestra 7	3:17	Benceno	0,041	0,01375		2981,82
			Estireno	0,038	0,01375		2763,64
			Tolueno	0,096	0,01375		6981,82
	Muestra 8	3:35	Benceno	0,048	0,01421		3377,90
			Estireno	0,053	0,01421		3729,77
			Tolueno	0,116	0,01421		8163,27

EMPRESA: FUMBARRI
FOCO: COLADA

FECHA: 25.09.18
Expediente nº: TEC-18.90

Horario de muestreo:	03:45-04:00	h.			
Presión atmosférica:	761	mmHg.	1.014	mbar	
Presión en conducto:	-0,75	"H_2O			

Nº de bridas	2	
Puntos de muestreo:	8	
Tª media de los gases (Ts):	25 ºC	
Tiempo de muestreo:	1.800	s

DATOS DE MUESTREO

		BRIDA 1		BRIDA 2						
Punto de muestreo	Distancia (cm)	Presión (DP) "H2O	Velocidad (m/s)	Presión (DP) "H2O	Velocidad (m/s)					Temperatura (ºC)
1	5,1	1,15	18,2	1,10	17,8					25
2	16,8	1,20	18,6	1,00	17,0					25
3	31,0	1,15	18,2	1,05	17,4					25
4	51,7	1,15	18,2	1,10	17,8					25
5	108,3	1,20	18,6	1,15	18,2					25
6	129,0	1,15	18,2	1,20	18,6					24
7	143,2	1,20	18,6	1,25	19,0					24
8	154,9	1,15	18,2	1,20	18,6					24

VELOCIDAD DE LOS GASES		
Media de las raices cuadradas de las DP:	1,0720	"CdA
Presión absoluta en el conducto (Ps):	759,60	mmHg
Factor de corrección del tubo de pitot (Cp):	0,8250	
Velocidad de los gases (V):	18,1980	m/s

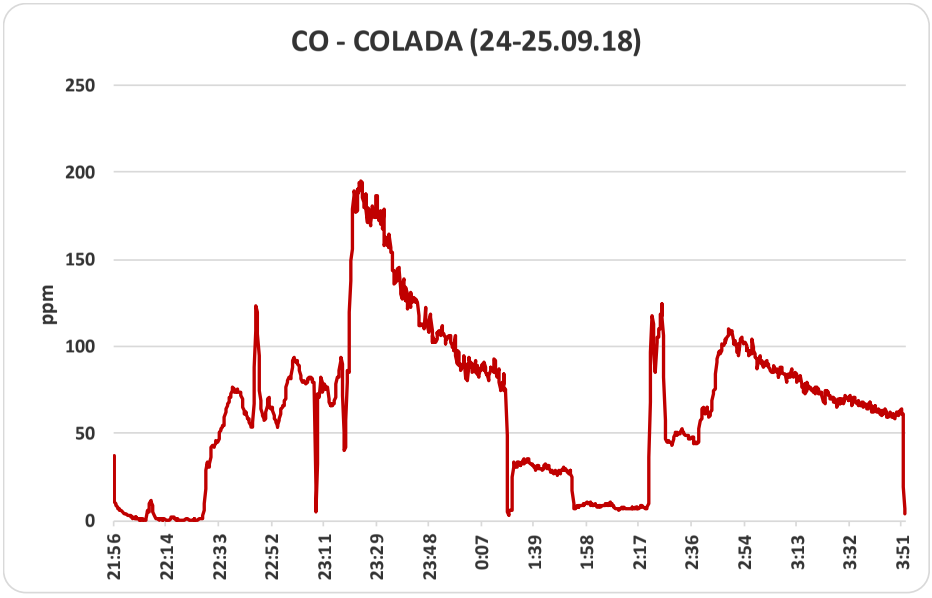
HUMEDAD DE LOS GASES							
Peso vapor agua condensado (G):	,9 g.	nº	Solución	Extremo	Peso inicial	Peso final	Diferencia
Fracción húmeda en volumen (Fh):	0,009	1	H_2O	R	527,8	528,2	0,4
Fracción gas seco (Fs):	0,991	2	H_2O	R	516,1	516,3	0,2
Humedad de los gases:	0,9%	3	Vacío	G-S	406,3	406,3	0,0
		4	Gel silice	R	695,1	695,4	0,3

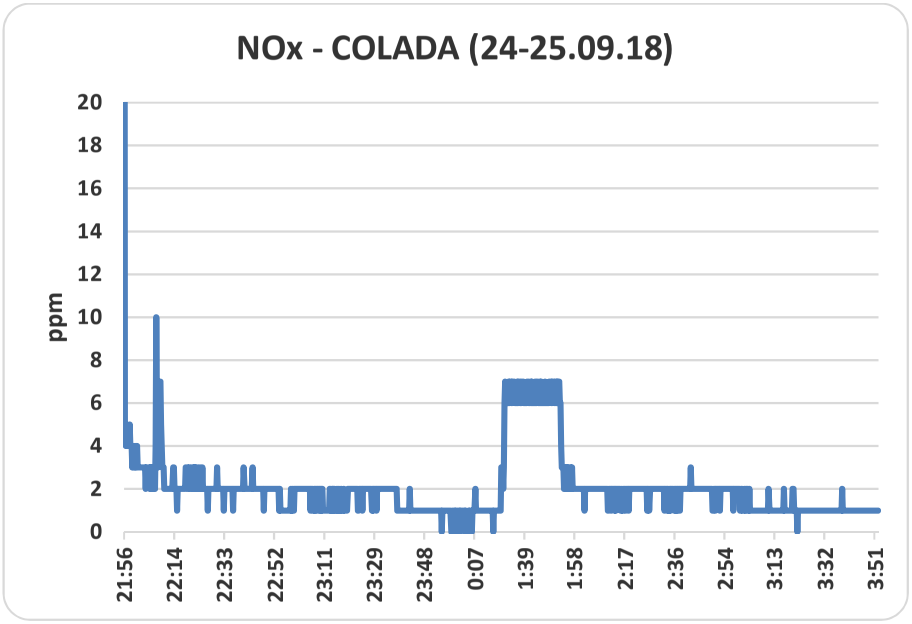
COMPOSICIÓN DE LOS GASES		
CO_2 (%)		<0,1
O_2 (%)	21,0	
CO (%)		<0,1

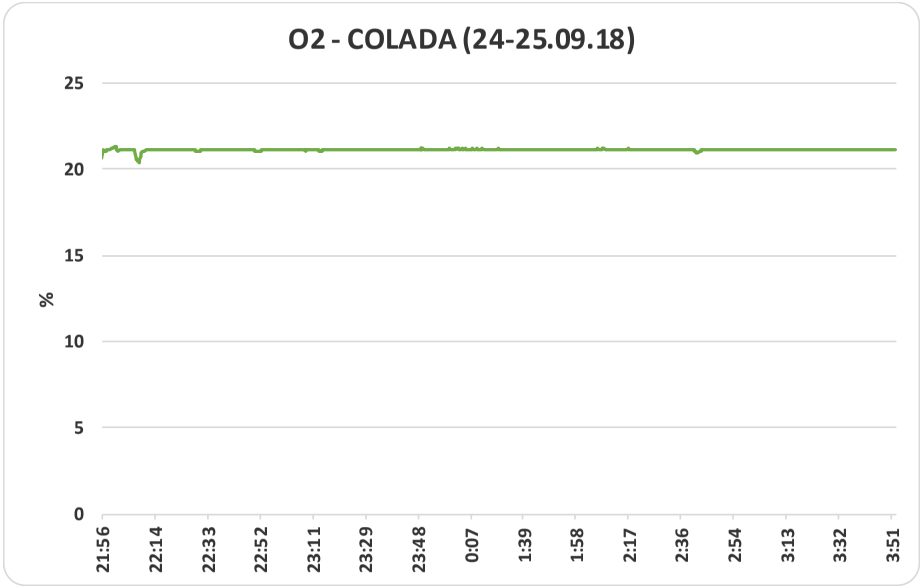
PESO MOLECULAR DE LOS GASES		
P.m seco (Ms):	28,84	g/mol
P.m húmedo (Mh):	28,74	g/mol
Densidad gases:	1,2875	g/l

CAUDAL HORARIO DE GASES		
Medidas interiores del conducto circular	1,600	m. diámetro
Sección interior del conducto (Si):	2,0106	m^2.
Caudal hora efectivo (Q):	131.722	m^3/h.
Caudal hora cond. normales. Base húmeda (Qcnh):	120.760	m^3N/h.
Caudal hora cond. normales. Base seca (Qcns):	119.693	m^3N/h.

Tª media contador:	12,0 ºC	Tª media contador:		285 ºK
Aspiración:	4 l/min.			
Volumen aspirado:	134 litros	Corrección:		litros/hora
Volumen aspirado (C.N):	128,0 litros	Corrección:	0,000	litros en el muestreo.
Volumen de la muestra en condiciones del contador (Vm):			0,1335	m^3.
Volumen de la muestra en condiciones normales (Vcn)(corregido):			0,1280	m^3N.
Presión media en el contador (Pm):			761	mmHg.


CO - COLADA (24-25.09.18)
ppm
250
200
150
100
50
0
21:56
22:14
22:33
22:52
23:11
23:29
23:48
0:07
1:39
1:58
2:17
2:36
2:54
3:13
3:32
3:51


NOx - COLADA (24-25.09.18)
ppm
20
18
16
14
12
10
8
6
4
2
0
21:56
22:14
22:33
22:52
23:11
23:29
23:48
0:07
1:39
1:58
2:17
2:36
2:54
3:13
3:32
3:51


O2 - COLADA (24-25.09.18)
%
25
20
15
10
5
0
21:56
22:14
22:33
22:52
23:11
23:29
23:48
0:07
1:39
1:58
2:17
2:36
2:54
3:13
3:32
3:51

Lugar de medida:	**Chimenea de salida de gases de Colada**
Contaminantes a medir:	**COV´s (tubos de carbón activo analizados en Gobierno Vasco)**
Fecha de medida:	**24.09.18 y 25.09.18**
Fecha de envío de muestras al laboratorio:	**26.09.18**
Horario de muestreo:	**Muestra 1: 22:35 – 22:41 h** **Muestra 2: 23:10 – 23:16 h** **Muestra 3: 02:17 – 02:23 h** **Muestra 4: 02:47 – 02:52 h**
Realizado por:	**R. Sainz y A. Ibarra**

COLADA					
Fecha	Muestra	Horario de medida	Parametro		microgramos/m3N
24-25.09.18	Muestra 1	22:35	Benceno		938,05
			Estireno		100,29
			Tolueno		1577,96
			Isopropanol		2331,08
			n-pentano	<	0,10
	Muestra 2	23:10	Benceno		1113,77
			Estireno		876,42
			Tolueno		1703,26
			Isopropanol		3376,75
			n-pentano	<	0,10
	Muestra 3	2:17	Benceno		941,35
			Estireno		436,84
			Tolueno		1015,89
			Isopropanol		394,92
			n-pentano	<	0,10
	Muestra 4	2:47	Benceno		882,30
			Estireno		383,22
			Tolueno		937,86
			Isopropanol		354,95
			n-pentano	<	0,10

MUESTREO DE CARTUCHOS DEL GOBIERNO VASCO					
1ª MUESTRA DE COLADA			**2ª MUESTRA DE COLADA**		
REF. CARTUCHO:	**Nº 55**		REF. CARTUCHO:	**Nº 56**	
FECHA:	24.09.18		FECHA:	24.09.18	
HORA MUESTREO:	22:35 a 22:41		HORA MUESTREO:	23:10 a 23:16	
DURACIÓN DEL MUESTREO:	6	minutos	DURACIÓN DEL MUESTREO:	6	minutos
CAUDAL DE ASPIRACIÓN:	0,144	litros/minuto	CAUDAL DE ASPIRACIÓN:	0,141	litros/minuto
	0,143			0,142	
	0,144			0,141	
	0,142			0,140	
	0,141			0,139	
	0,142			0,138	
	0,141			0,139	
	0,142			0,138	
	0,140			0,139	
MEDIA:	0,142		MEDIA:	0,140	
VOLUMEN MUESTREADO:	0,853	litros	VOLUMEN MUESTREADO:	0,838	litros
Tª CONTADOR:	293,7	kelvin	Tª CONTADOR:	294,3	kelvin
PRESIÓN EN EL CONTADOR:	761	mm Hg	PRESIÓN EN EL CONTADOR:	761	mm Hg
VOLUMEN MUESTREADO (C.N.):	**0,794**	litros (C.N.)	VOLUMEN MUESTREADO (C.N.):	**0,779**	litros (C.N.)
	0,000794	m3 (C.N.)		0,000779	m3 (C.N.)

3ª MUESTRA DE COLADA			**4ª MUESTRA DE COLADA**		
REF. CARTUCHO:	**Nº 57**		REF. CARTUCHO:	**Nº 58**	
FECHA:	25.09.18		FECHA:	25.09.18	
HORA MUESTREO:	02:17 a 02:23		HORA MUESTREO:	02:47 a 02:52	
DURACIÓN DEL MUESTREO:	6	minutos	DURACIÓN DEL MUESTREO:	5	minutos
CAUDAL DE ASPIRACIÓN:	0,164	litros/minuto	CAUDAL DE ASPIRACIÓN:	0,206	litros/minuto
	0,165			0,206	
	0,164			0,205	
	0,164			0,205	
	0,163			0,205	
	0,162			0,205	
	0,162			0,205	
	0,161			0,205	
	0,161			0,206	
MEDIA:	0,163		MEDIA:	0,205	
VOLUMEN MUESTREADO:	0,977	litros	VOLUMEN MUESTREADO:	1,027	litros
Tª CONTADOR:	290,1	kelvin	Tª CONTADOR:	296,1	kelvin
PRESIÓN EN EL CONTADOR:	761	mm Hg	PRESIÓN EN EL CONTADOR:	761	mm Hg
VOLUMEN MUESTREADO (C.N.):	**0,921**	litros (C.N.)	VOLUMEN MUESTREADO (C.N.):	**0,948**	litros (C.N.)
	0,000921	m3 (C.N.)		0,000948	m3 (C.N.)

ANEXO II.- RESULTADOS ANALITICOS

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

Informe de análisis

DATOS GENERALES
INFORME Nº: 2357809
FECHA FINALIZACIÓN Y EMISIÓN: 16/10/2018

GOBIERNO VASCO EUSKO JAURLARITZA
DONOSTIA SAN SEBASTIAN, 1
01010-Vitoria-Gasteiz

REFERENCIA CLIENTE
TEC-18.90 COVs Foco Fusion

ANÁLISIS Nº	DENOMINACIÓN MUESTRA	DESCRIPCIÓN MUESTRA	FECHA DE TOMA	FECHA RECEPCIÓN
4614540	TEC-18.90 Foco Fusion Muestra 1 de 9	conteniendo muestreo de higiene	**24/09/2018	2/10/2018
4614541	TEC-18.90 Foco Fusion Muestra 2 de 9	conteniendo muestreo de higiene	**24/09/2018	2/10/2018
4614542	TEC-18.90 Foco Fusion Muestra 3 de 9	conteniendo muestreo de higiene	**24/09/2018	2/10/2018
4614543	TEC-18.90 Foco Fusion Muestra 4 de 9	conteniendo muestreo de higiene	**24/09/2018	2/10/2018
4614544	TEC-18.90 Foco Fusion Muestra 5 de 9	conteniendo muestreo de higiene	**25/09/2018	2/10/2018
4614545	TEC-18.90 Foco Fusion Muestra 6 de 9	conteniendo muestreo de higiene	**25/09/2018	2/10/2018
4614546	TEC-18.90 Foco Fusion Muestra 7 de 9	conteniendo muestreo de higiene	**25/09/2018	2/10/2018
4614547	TEC-18.90 Foco Fusion Muestra 8 de 9	conteniendo muestreo de higiene	**25/09/2018	2/10/2018
4614548	TEC-18.90 Foco Fusion Muestra 9 de 9	conteniendo muestreo de higiene	**25/09/2018	2/10/2018

** * INFORMACIÓN SUMINISTRADA POR EL CLIENTE

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº: 2357809

Tipo de análisis TUBOS HIGIENE

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:

ANÁLISIS Nº	MÉTODOS	RESULTADOS	UNIDADES
COVs Barrido		Compuestos orgánicos volátiles	
4614540	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614541	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614542	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614543	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614544	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614545	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614546	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614547	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614548	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
Benceno (Número CAS: 71-43-2)		BTEXs	
4614540	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614541	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614542	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614543	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614544	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614545	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614546	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614547	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
4614548	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
Estireno (Número CAS: 100-42-5)			
4614540	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614541	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614542	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614543	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614544	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614545	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614546	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614547	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614548	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
Tolueno (Número CAS: 108-88-3)			
4614540	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614541	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614542	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614543	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614544	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614545	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614546	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614547	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614548	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
Isopropanol		Alcoholes	

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº: 2357809

ANÁLISIS Nº	MÉTODOS	RESULTADOS	UNIDADES
4614540	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614541	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614542	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614543	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614544	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614545	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614546	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614547	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614548	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
n-Pentano		**Gas en bolsa**	
* 4614540	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614541	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614542	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614543	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614544	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614545	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614546	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614547	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614548	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra

Aprobado en Labaqua Alicante por Técnico Superior: Blanca San Vicente De La Riva, Director Técnico: Francisco García Andreu.

Documento firmado electrónicamente en su formato digital. Autenticidad verificable utilizando el certificado raíz de la Fábrica Nacional de Moneda y Timbre.

Emitido en ALICANTE, 16 de Octubre de 2018

ENAC
ENSAYOS
Nº 109/LE285

LABAQUA

Informe de análisis

DATOS GENERALES
INFORME Nº: 2362126
FECHA FINALIZACIÓN Y EMISIÓN: 22/10/2018

GOBIERNO VASCO EUSKO JAURLARITZA
DONOSTIA SAN SEBASTIAN, 1
01010-Vitoria-Gasteiz

REFERENCIA CLIENTE
TEC-18.90 COVs Foco colada

ANÁLISIS Nº	DENOMINACIÓN MUESTRA	DESCRIPCIÓN MUESTRA	FECHA DE TOMA	FECHA RECEPCIÓN
4614549	TEC-18.90 Colada Muestra 1 de 9	conteniendo resultado muestreo	**24/09/2018	2/10/2018
4614550	TEC-18.90 Colada Muestra 2 de 9	conteniendo resultado muestreo	**24/09/2018	2/10/2018
4614551	TEC-18.90 Colada Muestra 3 de 9	conteniendo resultado muestreo	**24/09/2018	2/10/2018
4614552	TEC-18.90 Colada Muestra 4 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018
4614553	TEC-18.90 Colada Muestra 5 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018
4614554	TEC-18.90 Colada Muestra 6 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018
4614555	TEC-18.90 Colada Muestra 7 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018
4614556	TEC-18.90 Colada Muestra 8 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018
4614557	TEC-18.90 Colada Muestra 9 de 9	conteniendo resultado muestreo	**25/09/2018	2/10/2018

** * INFORMACIÓN SUMINISTRADA POR EL CLIENTE

Este informe sólo afecta a la muestra analizada. Sólo podrá reproducirse parcialmente con la autorización por escrito del laboratorio. El laboratorio dispone de la incertidumbre de sus medidas a disposición del cliente.

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº: 2362126

Tipo de análisis resultado muestreo

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:

ANÁLISIS Nº	MÉTODOS	RESULTADOS	UNIDADES
COVs Barrido		Compuestos orgánicos volátiles	
4614549	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614550	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614551	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614552	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614553	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614554	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614555	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614556	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
4614557	MAD-C-PE-0093 VO en C.A.	Realizado	mg/muestra
Benceno (Número CAS: 71-43-2)		BTEXs	
4614549	MAD-C-PE-0093 VO en C.A.	0.025	mg/muestra
4614550	MAD-C-PE-0093 VO en C.A.	0.064	mg/muestra
4614551	MAD-C-PE-0093 VO en C.A.	0.055	mg/muestra
4614552	MAD-C-PE-0093 VO en C.A.	0.048	mg/muestra
4614553	MAD-C-PE-0093 VO en C.A.	0.041	mg/muestra
4614554	MAD-C-PE-0093 VO en C.A.	0.051	mg/muestra
4614555	MAD-C-PE-0093 VO en C.A.	0.041	mg/muestra
4614556	MAD-C-PE-0093 VO en C.A.	0.048	mg/muestra
4614557	MAD-C-PE-0093 VO en C.A.	< 0.010	mg/muestra
Estireno (Número CAS: 100-42-5)			
4614549	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614550	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614551	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614552	MAD-C-PE-0093 VO en C.A.	0.013	mg/muestra
4614553	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614554	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
4614555	MAD-C-PE-0093 VO en C.A.	0.038	mg/muestra
4614556	MAD-C-PE-0093 VO en C.A.	0.053	mg/muestra
4614557	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
Tolueno (Número CAS: 108-88-3)			
4614549	MAD-C-PE-0093 VO en C.A.	0.040	mg/muestra
4614550	MAD-C-PE-0093 VO en C.A.	0.114	mg/muestra
4614551	MAD-C-PE-0093 VO en C.A.	0.128	mg/muestra
4614552	MAD-C-PE-0093 VO en C.A.	0.108	mg/muestra
4614553	MAD-C-PE-0093 VO en C.A.	0.092	mg/muestra
4614554	MAD-C-PE-0093 VO en C.A.	0.101	mg/muestra
4614555	MAD-C-PE-0093 VO en C.A.	0.096	mg/muestra
4614556	MAD-C-PE-0093 VO en C.A.	0.116	mg/muestra
4614557	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
Isopropanol		Alcoholes	

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº: 2362126

ANÁLISIS Nº	MÉTODOS	RESULTADOS	UNIDADES
4614549	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614550	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614551	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614552	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614553	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614554	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614555	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614556	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
4614557	MAD-C-PE-0093 VO en C.A.	< 0.060	mg/muestra
n-Pentano		**Gas en bolsa**	
* 4614549	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614550	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614551	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614552	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614553	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614554	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614555	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614556	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra
* 4614557	MAD-C-PE-0093 VO en C.A.	< 0.020	mg/muestra

Aprobado en Labaqua Alicante por Técnico Superior: Blanca San Vicente De La Riva, Director Técnico: Francisco García Andreu.

Documento firmado electrónicamente en su formato digital. Autenticidad verificable utilizando el certificado raíz de la Fábrica Nacional de Moneda y Timbre.

Emitido en ALICANTE, 22 de Octubre de 2018

ANNEX XI:

Informe número TEC-18.90-002 de 11 de diciembre de 2018 para el foco de emisión a la atmósfera de: INDUSTRY 2.

Made by TECNALABAQUA, A.I.E. laboratory.

Nº INFORME	TEC-18.90-002
CLIENTE	GOBIERNO VASCO
PERSONA DE CONTACTO	Inesa Baños (inesa-banos@euskadi.eus)
DIRECCIÓN	C/ Donostia- San Sebastian, 1, 01010 Vitoria
OBJETO	MEDIDA VOLUNTARIA DE EMISIONES ATMOSFÉRICAS
FECHA DE EMISIÓN	11/12/2018

TECNALABAQUA AIE

Fdo: Silvia Cosin
Directora Técnica

Fdo: Andoni Ibarra
Responsable Técnico de Ensayos

Í N D I C E

1.- INTRODUCCIÓN

De acuerdo a la oferta OF20085429_v3 del 18 de mayo de 2018 se recogen en el presente informe los resultados de las medidas Voluntaria de Emisiones Atmosféricas realizada en:

Empresa:	**Fundiciones San Antonio de Urkiola, S.L.**
Dirección:	**Tabirakalea, 39 48200 Durango (Bizkaia)**
Fecha de la medida:	29 de noviembre de 2018

El laboratorio que ha realizado las medidas por solicitud del Departamento de Medio Ambiente, Planificación Territorial y Vivienda es:

Nombre:	TECNALABAQUA A.I.E.
Dirección:	Parque Tecnológico de Bizkaia Edificio 101 48170 Zamudio (Bizkaia)
Teléfono:	94 607 35 71 Fax 94 607 35 40
Persona de Contacto:	Silvia Cosin Fuentes
CIF:	V-01526516

Los focos y parámetros medidos han sido:

Nombre del foco	Parámetros
Fusión	VOC´s
Colada	VOC´ s

Los trabajos se han realizado a lo largo de dos ciclos de fusión y de dos ciclos de colada. Por parte de TECNALABAQUA, A.I.E. se han tomado 4 muestras en tubos de carbón durante cada ciclo de fusión y 4 muestras en tubos de carbón activo durante cada ciclo de colada. Dichos tubos han sido posteriormente analizados por el laboratorio LABAQUA, S:A. (ver anexo II del presente informe).

En todos los casos, se ha realizado un barrido de VOC´s para detectar la presencia de los compuestos mayoritarios y analizándose al menos los siguientes compuestos: Benceno, estireno, tolueno, isopropanol y n-pentano.

Asimismo, se ha realizado la determinación de los gases de combustión, caudal y humedad de los gases (ver anexo I del presente informe).

Los técnicos que realizaron las medidas fueron:

A. Ibarra: Responsable Técnico de ensayo

R. Sainz: Responsable Técnico de ensayo

2.- DESCRIPCION DE LOS FOCOS

Denominación del foco:
Foco Fusión y colada
Características del foco y descripción de la actividad

Tipo de tramo	Horizontal
Tipo de sección	Cilíndrico
Número de orificios para la toma de muestras manuales	2 a 90º
Diámetro interior de la boca de toma de muestras manuales	100 mm
Longitud del cuello de las bocas de toma de muestras manuales	10 cm
Amplitud de plataforma	>5m²
Accesibilidad	Escalera metálica vertical con protecciones laterales
Distancias y dimensiones relativas a los puntos de toma de muestras manuales	
Diámetro del conducto de humos en el punto de emisiones de gases	1,70 m
Diámetro del conducto de humos en el punto de toma de muestras	1,70 m
Altura total de la chimenea	>10 m
Altura del punto de toma de muestras manuales	>10 m
Distancia de la última perturbación al punto de toma de muestras manuales	>5,0 m
Distancia entre el punto de toma de muestras manual y la siguiente perturbación	>8,0 m
Distancia perturbación anterior respecto al diámetro	>2,9 ∅
Distancia perturbación posterior respecto al diámetro	>4,7 ∅

El foco medido cumple los requisitos indicados en la Instrucción técnica – 02 (IT-02) relativo a muestreos isocinéticos. Dichos requisitos se presentan en la siguiente tabla:

Medidas preliminares	Criterio de aceptación	Resultado obtenido
Ángulo con respecto al eje del conducto	< 15º	**< 15º**
Velocidad negativa	No permitida	**Velocidad +**
Mínima presión diferencial (△P) en tubo de pitot:	> 5 Pa (> 0,02 "CdA)	**>1,15 "CdA**
Relación velocidad máxima y mínima	< 3:1	**1,3:1**

Descripción de la actividad:

Fusión de hierro

Datos de producción:

Todas las muestras de fusión se realizan con los dos hornos de fusión disponibles en funcionamiento. El proceso de fusión tiene una duración aproximada de tres horas, mas otra media hora aproximadamente para el desescoriado.

El proceso de colada tiene una duración aproximada de una hora.

3.- RESULTADO DE LAS EMISIONES

Denominación del foco: FUSION Y COLADA (durante proceso de fusión)				
Fecha	**Muestra**	**Compuesto**	**Concentración en emisión**	**Unidad**
29.11.18	1	Benceno	806,5	µg/Nm³
		Estireno	< 40,3	
		Tolueno	1.822,6	
		Isopropanol	403,2	
		n-pentano	< 161,3	
	2	Benceno	822,7	
		Estireno	< 37,4	
		Tolueno	1.854,9	
		Isopropanol	< 149,6	
		n-pentano	< 149,6	
	3	Benceno	868,9	
		Estireno	< 38,8	
		Tolueno	1.939,5	
		Isopropanol	< 155,2	
		n-pentano	< 155,2	
	4	Benceno	689,4	
		Estireno	< 41,0	
		Tolueno	1.460,8	
		Isopropanol	< 164,1	
		n-pentano	< 164,1	
	5	Benceno	463,7	
		Estireno	92,7	
		Tolueno	1.468,3	
		Isopropanol	< 154,6	
		n-pentano	< 154,6	
	6	Benceno	451,8	
		Estireno	< 40,3	
		Tolueno	1.516,7	
		Isopropanol	< 161,4	
		n-pentano	< 161,4	
	7	Benceno	1.050,4	
		Estireno	189,4	
		Tolueno	2.634,5	
		Isopropanol	< 172,2	
		n-pentano	< 172,2	
	8	Benceno	1.004,5	
		Estireno	284,9	
		Tolueno	2.443,8	
		Isopropanol	862,1	
		n-pentano	< 149,9	

Denominación del foco: FUSION Y COLADA (durante proceso de colada)				
Fecha	**Muestra**	**Compuesto**	**Concentración en emisión**	**Unidad**
29.11.18	1	Benceno	598,35	µg/Nm³
		Estireno	74,79	
		Tolueno	1.226,63	
		Isopropanol	< 299,18	
		n-pentano	< 299,18	
	2	Benceno	2.004,49	
		Estireno	< 74,79	
		Tolueno	2.064,32	
		Isopropanol	< 299,18	
		n-pentano	< 299,18	
	3	Benceno	1.188,67	
		Estireno	< 69,11	
		Tolueno	2.487,91	
		Isopropanol	< 276,43	
		n-pentano	< 276,43	
	4	Benceno	1.358,23	
		Estireno	373,51	
		Tolueno	3.327,67	
		Isopropanol	< 339,56	
		n-pentano	< 339,56	
	5	Benceno	1.758,24	
		Estireno	< 84,53	
		Tolueno	1.893,49	
		Isopropanol	< 338,12	
		n-pentano	< 338,12	
	6	Benceno	3.367,50	
		Estireno	527,09	
		Tolueno	3.865,30	
		Isopropanol	< 292,83	
		n-pentano	< 292,83	
	7	Benceno	2.235,39	
		Estireno	575,78	
		Tolueno	4.978,83	
		Isopropanol	< 338,70	
		n-pentano	< 338,70	
	8	Benceno	1.335,50	
		Estireno	456,03	
		Tolueno	3.289,90	
		Isopropanol	< 325,73	
		n-pentano	< 325,73	

4.- MÉTODOS EMPLEADOS EN LAS MEDICIONES

TECNALABAQUA, ha realizado las mediciones indicadas de acuerdo a las Normas aplicables y procedimientos internos basados principalmente en las metodologías UNE y EN.

Concretamente se han empleado los siguientes métodos, y procedimientos internos:

TEC-EM-PO-0047. Procedimiento para el muestreo de compuestos orgánicos volátiles en emisiones de fuentes estacionarias

COV´s

El muestreo de COV´s se ha realizado mediante muestreo a caudal constante muestreado en el punto medio de la chimenea.

Para la toma de muestras se han utilizado cartuchos de carbón activo 100/50 mg (muestras analizadas por LABAQUA, S:A.)

La analítica fue realizada por el método analítico de cromatografía de gases/masas por el personal de LABAQUA, S.A.

La determinación de gases de combustión se ha realizado mediante analizador portátil de células electroquímicas de acuerdo con lo establecido en el procedimiento interno TEC-EM-PO-0022.

5.- EQUIPOS DE MEDIDA

	FLEXÓMETROS		MANÓMETROS		TERMOPARES INT. SONDA
☑	EM0103		EM0411 (0 a 1 “H2O)		EM0521
	EM0134		EM0412 (0 a 30 “H2O)		EM0522
	EM0135		EM0413 (0 a 12 “Hg)		EM0523
	BOQUILLAS TITANIO				EM0524
	EM0104 (nº 1)		**SISTEMA ISOCINÉTICO 1 (Pies³)**		EM0525
	EM0105 (nº 2)		EM0403 (0 a 10 “H2O)		EM0526
	EM0106 (nº 3)	☑	EM 0404 (0 a 5 “H2O)		EM0527
	BOQUILLAS ACERO INOX.		EM0405 (0 a 0,5 “H2O)		EM0528
	EM0107 (nº 9)		EM0516 (Termopar “IN”)		EM0529
	EM0108 (nº 10)		EM0517 (Termopar “OUT”)		EM0530
	EM0109 (nº 15)		EM1118 (Contador)		EM0531
	EM0110 (nº 16)		**SISTEMA ISOCINÉTICO 2 (m³)**		**HORNO DE TRATAMIENTO**
	EM0111 (nº 18)		EM0407 (0 a 10 “H2O)		EM0532
	EM0112 (nº 19)		EM0408 (0 a 5 “H2O)		
	EM0113 (nº 20)		EM0409 (0 a 0,5 “H2O)		**TUBOS PITOT**
	EM0114 (nº 21)		EM0518 (Termopar “IN”)		EM1112 (nº 2)
	EM0115 (nº 22)		EM0519 (Termopar “OUT”)		EM1113 (nº 7)
	EM0116 (nº 23)		EM1119 (Contador)		EM1114 (nº 8)
	EM0117 (nº 24)		**SISTEMA ISOCINÉTICO 3 (Pies³)**	☑	EM1115 (nº 9)
	EM0118 (nº 25)		EM0414 (0 a 10 “H2O)		EM1116 (1 m)
	EM0119 (nº 26)		EM0415 (0 a 5 “H2O)		EM1117 (1,8 m)
	EM0120 (nº 27)		EM0416 (0 a 0,5 “H2O)		
	EM0133 (nº 14)		EM0534 (Termopar “IN”)		**DILUIDOR**
	BOQUILLAS VIDRIO		EM0535 (Termopar “OUT”)		EM1120 (Nitrógeno)
	EM0121 (nº 4)		EM1135 (Contador)		EM1121 (Gas patrón)
	EM0122 (nº 5)		**TERMÓMETROS**		EM1122 (Gas patrón)
	EM0123 (nº 6)		EM0503 (CHY)		EM1123 (Gas patrón)
	EM0124 (nº 7)	☑	EM0504 (Hibok)		
	EM0125 (nº 8)		EM0536 (Hibok)		**BOMBAS ASPIRACIÓN**
	EM0126 (nº 9)		EM0505 (punta)		EM1124
	EM0127 (nº 10)				EM1125
	EM0128 (nº 11)			☑	EM1126
	EM0129 (nº 12)		**TERMOPARES**		EM1128
	EM0130 (nº 13)		EM0506 (1 m)	☑	EM1130
	EM0131 (nº 14)		EM0507 (1 m)		EM1131
	EM0132 (nº 15)	☑	EM0508 (1,75 m)		EM1132
	CRONÓMETROS		EM0509 (1,75 m)		EM1134
☑	EM0201				**ANALIZADORES DE GASES**
	EM0202		**TERMÓMETROS ESFERA**		EM1201 (Testo 350 XL)
	EM0203		EM0510	☑	EM1202 (Testo 350 XL)
	BALANZAS		EM0511		EM1207 (Testo 350 XL)
	EM0301 (R220D)		EM0512		EM1203 (Horiba)
	EM0302 (BD1201)				EM1204 (Horiba)
☑	EM0303 (PL1501-S)		**TERMÓMETROS CODO FLEXIBLE**		EM1205 (MiniFID)
	EM0304 (PL1501-S)		EM0513		EM1206 (MiniFID)
	BARÓMETROS		EM0514		EM1208 (Fid SKC)
☑	EM0401 (Lambrech)		EM0515		**INDICADOR BACHARACH**
	EM0402 (Barigo)				EM1209
	EM0417 (Barigo)				EM1210

CODIGO EQUIPO	EQUIPO	MARCA/MODELO	ÚLTIMA CALIBRACIÓN	PERIODO DE CALIBRACIÓN
EM303	Balanza	METTLER	09/04/18	1 año
EM401	Barómetro	LAMBRECH	10/04/18	1 año
EM504	Termómetro	HIBOK 14	06/11/18	1 año
EM508	Termopar tipo K	E.N.I.	05/01/18	1 año
EM1202	Analizador de gases	TESTO 350 XL	04/10/18	1 año
EM0103	Flexómetro	STANLEY	14/03/18	1 año
EM0201	Cronómetro digital	OREGON SCIENTIFIC	08/03/18	1 año
EM1115	Tubo Pitot “s”	MINI	19/04/18	1 año
EM0404	Manómetro	DWYER INSTRUMENTS	02/05/18	1 año
EM1125	Bomba de aspiración	ACTARIS	06/07/18	1 año
EM1130	Bomba de aspiración	ITRON	14/09/18	1 año

ANEXO I.- DATOS DE CAMPO Y CÁLCULOS EFECTUADOS

Lugar de medida:	**Chimenea de salida de gases de Fusión**
Contaminantes a medir:	**COV´s** **CO** **NO_x** **O_2** **Caudal** **Humedad**
Fecha de medida:	**29.11.18**
Fecha de envío de muestras al laboratorio:	**04.12.18**
Fecha de análisis químicos:	**Del 04.12.18 al 11.12.18**
Realizado por:	**R. Sainz y A. Ibarra**

FUSION							
Fecha	Muestra	Horario de medida	Parametro	microgramos	volumen (m3N)		microgramos/m3N
29.11.18	Muestra 1	3:30 - 4:00	Benceno	20	0,0248		806,5
			Estireno	1	0,0248	<	40,3
			Tolueno	45,2	0,0248		1.822,6
			Isopropanol	10	0,0248		403,2
			n-Pentano	4	0,0248	<	161,3
	Muestra 2	4:05 - 4:35	Benceno	22	0,02674		822,7
			Estireno	1	0,02674	<	37,4
			Tolueno	49,6	0,02674		1.854,9
			Isopropanol	4	0,02674	<	149,6
			n-Pentano	4	0,02674	<	149,6
	Muestra 3	4:40 - 5:10	Benceno	22,4	0,02578		868,9
			Estireno	1	0,02578	<	38,8
			Tolueno	50	0,02578		1.939,5
			Isopropanol	4	0,02578	<	155,2
			n-Pentano	4	0,02578	<	155,2
	Muestra 4	5:15 - 5:45	Benceno	16,8	0,02437		689,4
			Estireno	1	0,02437	<	41,0
			Tolueno	35,6	0,02437		1.460,8
			Isopropanol	4	0,02437	<	164,1
			n-Pentano	4	0,02437	<	164,1
	Muestra 5	8:45 - 9:15	Benceno	12	0,02588		463,7
			Estireno	2,4	0,02588		92,7
			Tolueno	38	0,02588		1.468,3
			Isopropanol	4	0,02588	<	154,6
			n-Pentano	4	0,02588	<	154,6
	Muestra 6	9:30 - 10:00	Benceno	11,2	0,02479		451,8
			Estireno	1	0,02479	<	40,3
			Tolueno	37,6	0,02479		1.516,7
			Isopropanol	4	0,02479	<	161,4
			n-Pentano	4	0,02479	<	161,4
	Muestra 7	10:05 - 10:35	Benceno	24,4	0,02323		1.050,4
			Estireno	4,4	0,02323		189,4
			Tolueno	61,2	0,02323		2.634,5
			Isopropanol	4	0,02323	<	172,2
			n-Pentano	4	0,02323	<	172,2
	Muestra 8	10:40 - 11:10	Benceno	26,8	0,02668		1.004,5
			Estireno	7,6	0,02668		284,9
			Tolueno	65,2	0,02668		2.443,8
			Isopropanol	23	0,02668		862,1
			n-Pentano	4	0,02668	<	149,9

EMPRESA: FUNSAN
FOCO: CHIMENEA DE HORNOS (EN FUSIÓN)

FECHA: 29.11.18
Expediente nº: TEC-18.90-002

Horario de muestreo:	9:20 a 9:35	h.			Nº de bridas	2
Presión atmosférica:	761	mmHg.	1.015	mbar	Puntos de muestreo:	8
Presión en conducto:	-0,35	"H_2O			Tª media de los gases (Ts):	63 ºC
					Tiempo de muestreo:	1.800 s

DATOS DE MUESTREO

		BRIDA 1		BRIDA 2						
Punto de muestreo	Distancia (cm)	Presión (DP) "H2O	Velocidad (m/s)	Presión (DP) "H2O	Velocidad (m/s)					Temperatura (ºC)
1	5,4	1,00	18,1	0,70	15,2					60,5
2	17,9	1,00	18,1	0,70	15,2					61,4
3	33,0	0,90	17,2	0,80	16,2					61,8
4	54,9	0,80	16,2	0,90	17,2					63,1
5	115,1	0,80	16,2	0,70	15,2					63,6
6	137,0	0,75	15,7	0,80	16,2					63,9
7	152,2	0,65	14,6	0,95	17,7					64,1
8	164,6	0,70	15,2	1,10	19,0					63,8

VELOCIDAD DE LOS GASES		
Media de las raices cuadradas de las DP:	0,9073	"CdA
Presión absoluta en el conducto (Ps):	760,35	mmHg
Factor de corrección del tubo de pitot (Cp):	0,8334	
Velocidad de los gases (V):	16,4673	m/s

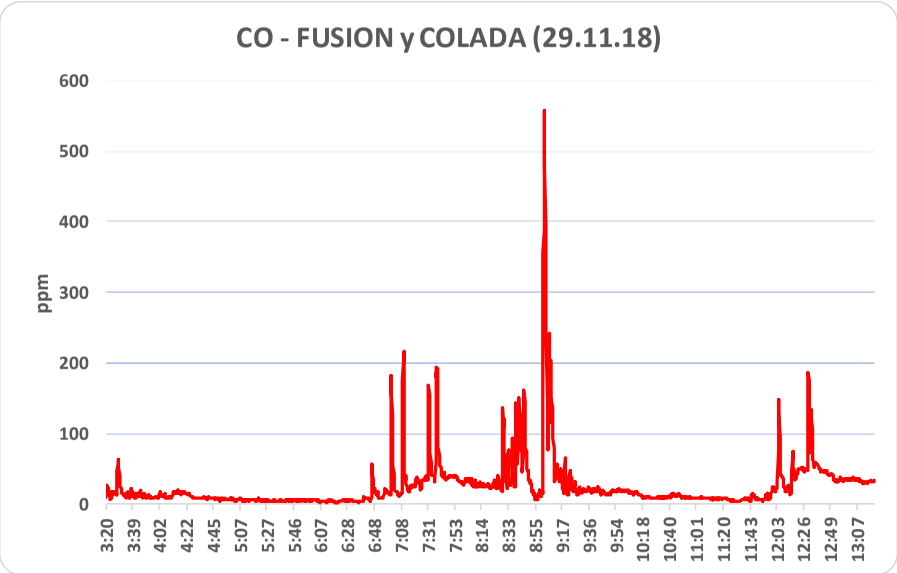
HUMEDAD DE LOS GASES							
Peso vapor agua condensado (G):	,8 g.	nº	Solución	Extremo	Peso inicial	Peso final	Diferencia
Fracción húmeda en volumen (Fh):	0,008	1	H_2O	R	542,1	542,3	0,2
Fracción gas seco (Fs):	0,992	2	H_2O	R	504,1	504,2	0,1
Humedad de los gases:	0,8%	3	Vacío	G-S	414,2	414,2	0,0
		4	Gel sílice	R	774,9	775,4	0,5

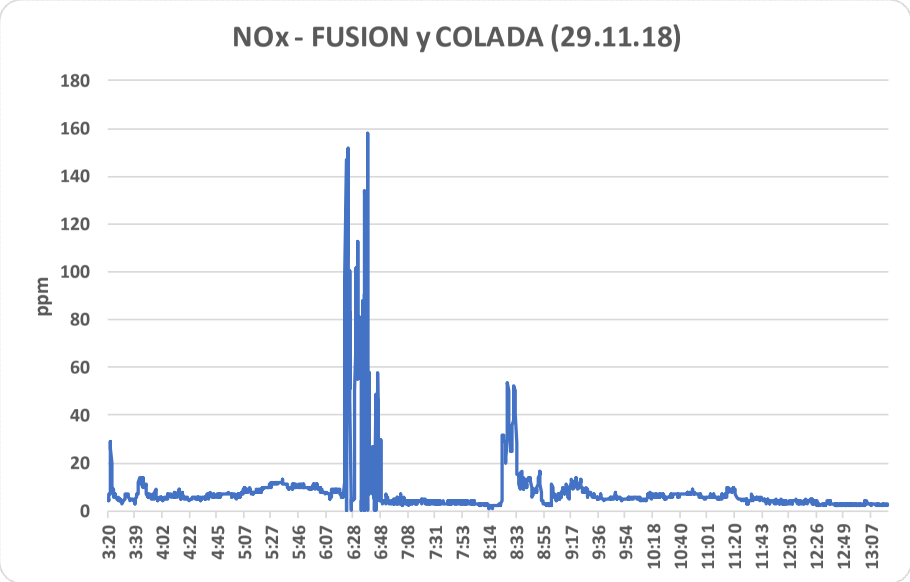
COMPOSICIÓN DE LOS GASES	
CO_2 (%)	1,07
O_2 (%)	20,91
CO (%)	<0,1

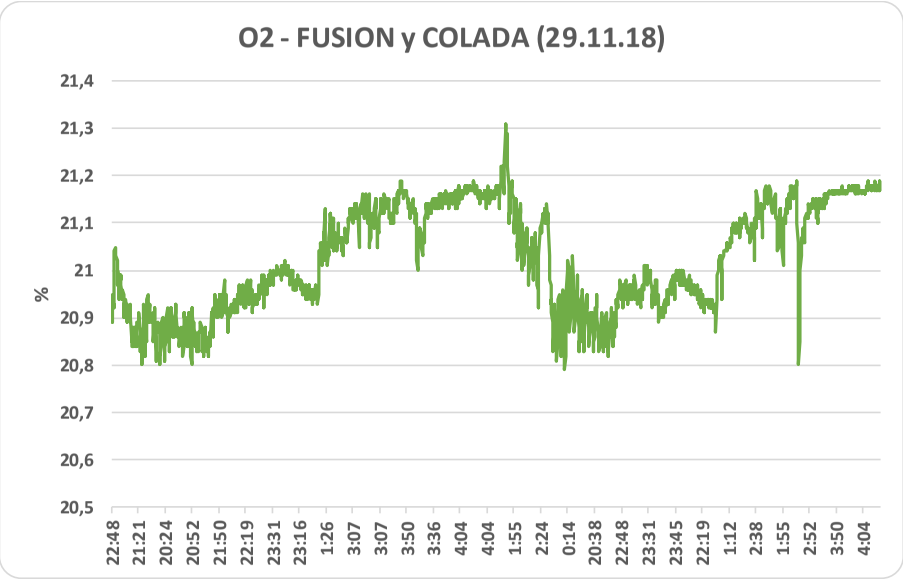
PESO MOLECULAR DE LOS GASES		
P.m seco (Ms):	29,01	g/mol
P.m húmedo (Mh):	28,92	g/mol
Densidad gases:	1,2950	g/l

CAUDAL HORARIO DE GASES		
Medidas interiores del conducto circular	1,700	m. diámetro
Sección interior del conducto (Si):	2,2698	m^2.
Caudal hora efectivo (Q):	134.559	m^3/h.
Caudal hora cond. normales. Base húmeda (Qcnh):	109.452	m^3N/h.
Caudal hora cond. normales. Base seca (Qcns):	108.627	m^3N/h.

Tª media contador:	20,8 ºC	Tª media contador:		294 ºK
Aspiración:	5 l/min.			
Volumen aspirado:	144 litros	Corrección:		litros/hora
Volumen aspirado (C.N):	133,5 litros	Corrección:	0,000	litros en el muestreo.
Volumen de la muestra en condiciones del contador (Vm):			0,1435	m^3.
Volumen de la muestra en condiciones normales (Vcn)(corregido):			0,1335	m^3N.
Presión media en el contador (Pm):			761	mmHg.


CO - FUSION y COLADA (29.11.18)
ppm
600
500
400
300
200
100
0
3:20
3:39
4:02
4:22
4:45
5:07
5:27
5:46
6:07
6:28
6:48
7:08
7:31
7:53
8:14
8:33
8:55
9:17
9:36
9:54
10:18
10:40
11:01
11:20
11:43
12:03
12:26
12:49
13:07


NOx - FUSION y COLADA (29.11.18)
ppm
180
160
140
120
100
80
60
40
20
0
3:20
3:39
4:02
4:22
4:45
5:07
5:27
5:46
6:07
6:28
6:48
7:08
7:31
7:53
8:14
8:33
8:55
9:17
9:36
9:54
10:18
10:40
11:01
11:20
11:43
12:03
12:26
12:49
13:07


O2 - FUSION y COLADA (29.11.18)
%
21,4
21,3
21,2
21,1
21
20,9
20,8
20,7
20,6
20,5
22:48
21:21
20:24
20:52
21:50
22:19
23:31
23:16
1:26
3:07
3:07
3:50
3:36
4:04
4:04
1:55
2:24
0:14
20:38
22:48
23:31
23:45
22:19
1:12
2:38
1:55
2:52
3:50
4:04

Lugar de medida:	**Chimenea de salida de gases de Colada**
Contaminantes a medir:	**COV´s** **CO** **NO_x** **O_2** **Caudal** **Humedad**
Fecha de medida:	**29.11.18**
Fecha de envío de muestras al laboratorio:	**04.12.18**
Fecha de análisis químicos:	**Del 04.12.18 al 11.12.18**
Realizado por:	**R. Sainz y A. Ibarra**

COLADA							
Fecha	Muestra	Horario de medida	Parametro	microgramos	volumen (m3N)		microgramos/m3N
29.11.18	Muestra 1	6:55 - 7:10	Benceno	8	0,01337		598,35
			Estireno	1	0,01337		74,79
			Tolueno	16,4	0,01337		1.226,63
			Isopropanol	4	0,01337	<	299,18
			n-Pentano	4	0,01337	<	299,18
	Muestra 2	7:15 - 7:30	Benceno	26,8	0,01337		2.004,49
			Estireno	1	0,01337	<	74,79
			Tolueno	27,6	0,01337		2.064,32
			Isopropanol	4	0,01337	<	299,18
			n-Pentano	4	0,01337	<	299,18
	Muestra 3	7:35 - 7:50	Benceno	17,2	0,01447		1.188,67
			Estireno	1	0,01447	<	69,11
			Tolueno	36	0,01447		2.487,91
			Isopropanol	4	0,01447	<	276,43
			n-Pentano	4	0,01447	<	276,43
	Muestra 4	7:55 - 8:10	Benceno	16	0,01178		1.358,23
			Estireno	4,4	0,01178		373,51
			Tolueno	39,2	0,01178		3.327,67
			Isopropanol	4	0,01178	<	339,56
			n-Pentano	4	0,01178	<	339,56
	Muestra 5	11:56 - 12:11	Benceno	20,8	0,01183		1.758,24
			Estireno	1	0,01183	<	84,53
			Tolueno	22,4	0,01183		1.893,49
			Isopropanol	4	0,01183	<	338,12
			n-Pentano	4	0,01183	<	338,12
	Muestra 6	12:15 - 12:30	Benceno	46	0,01366		3.367,50
			Estireno	7,2	0,01366		527,09
			Tolueno	52,8	0,01366		3.865,30
			Isopropanol	4	0,01366	<	292,83
			n-Pentano	4	0,01366	<	292,83
	Muestra 7	12:35 - 12:50	Benceno	26,4	0,01181		2.235,39
			Estireno	6,8	0,01181		575,78
			Tolueno	58,8	0,01181		4.978,83
			Isopropanol	4	0,01181	<	338,70
			n-Pentano	4	0,01181	<	338,70
	Muestra 8	12:55 - 13:10	Benceno	16,4	0,01228		1.335,50
			Estireno	5,6	0,01228		456,03
			Tolueno	40,4	0,01228		3.289,90
			Isopropanol	4	0,01228	<	325,73
			n-Pentano	4	0,01228	<	325,73

EMPRESA: FUNSAN
FOCO: CHIMENEA DE HORNOS (EN COLADA)

FECHA: 29.11.18
Expediente nº: TEC-18.90-002

Horario de muestreo:	12:45 a 13:00 h.				Nº de bridas	2
Presión atmosférica:	761	mmHg.	1.015	mbar	Puntos de muestreo:	8
Presión en conducto:	-0,60	"H_2O			Tª media de los gases (Ts):	36 ºC
					Tiempo de muestreo:	1.800 s

DATOS DE MUESTREO

		BRIDA 1		BRIDA 2					
Punto de muestreo	Distancia (cm)	Presión (DP) "H2O	Velocidad (m/s)	Presión (DP) "H2O	Velocidad (m/s)				
1	5,4	1,15	18,7	1,80	23,4				
2	17,9	1,50	21,4	1,90	24,1				
3	33,0	1,50	21,4	1,70	22,8				
4	54,9	1,35	20,3	1,40	20,7				
5	115,1	1,20	19,1	1,30	19,9				
6	137,0	1,40	20,7	1,20	19,1				
7	152,2	1,50	21,4	1,30	19,9				
8	164,6	1,80	23,4	1,50	21,4				

VELOCIDAD DE LOS GASES		
Media de las raices cuadradas de las DP:	1,2085	"CdA
Presión absoluta en el conducto (Ps):	759,88	mmHg
Factor de corrección del tubo de pitot (Cp):	0,8334	
Velocidad de los gases (V):	21,1121	m/s

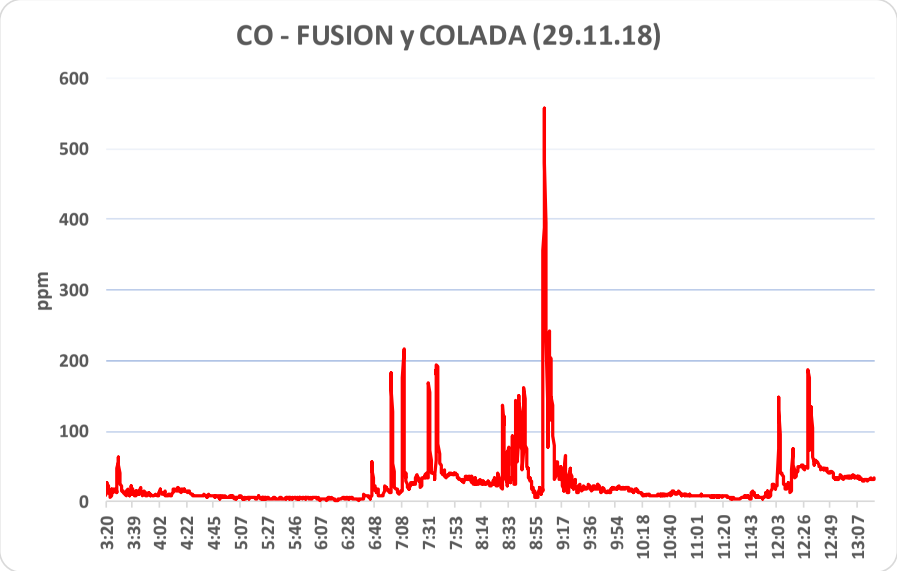
HUMEDAD DE LOS GASES							
Peso vapor agua condensado (G):	1,0 g.	nº	Solución	Extremo	Peso inicial	Peso final	Diferencia
Fracción húmeda en volumen (Fh):	0,007	1	H_2O	R	542,3	542,9	0,6
Fracción gas seco (Fs):	0,993	2	H_2O	R	504,2	504,3	0,1
Humedad de los gases:	0,7%	3	Vacío	G-S	414,2	414,2	0,0
		4	Gel sílice	R	775,4	775,7	0,3

COMPOSICIÓN DE LOS GASES		
CO_2 (%)		<0,1
O_2 (%)	21,17	
CO (%)		<0,1

PESO MOLECULAR DE LOS GASES		
P.m seco (Ms):	28,85	g/mol
P.m húmedo (Mh):	28,77	g/mol
Densidad gases:	1,2878	g/l

CAUDAL HORARIO DE GASES		
Medidas interiores del conducto circular	1,700	m. diámetro
Sección interior del conducto (Si):	2,2698	m^2.
Caudal hora efectivo (Q):	172.514	m^3/h.
Caudal hora cond. normales. Base húmeda (Qcnh):	152.274	m^3N/h.
Caudal hora cond. normales. Base seca (Qcns):	151.186	m^3N/h.

Tª media contador:	20,2 ºC	Tª media contador:		293 ºK
Aspiración:	6 l/min.			
Volumen aspirado:	189 litros	Corrección:		litros/hora
Volumen aspirado (C.N):	176,2 litros	Corrección:	0,000	litros en el muestreo.
Volumen de la muestra en condiciones del contador (Vm):			0,1890	m^3.
Volumen de la muestra en condiciones normales (Vcn)(corregido):			0,1762	m^3N.
Presión media en el contador (Pm):			761	mmHg.


CO - FUSION y COLADA (29.11.18)
ppm
600
500
400
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4:22
4:45
5:07
5:27
5:46
6:07
6:28
6:48
7:08
7:31
7:53
8:14
8:33
8:55
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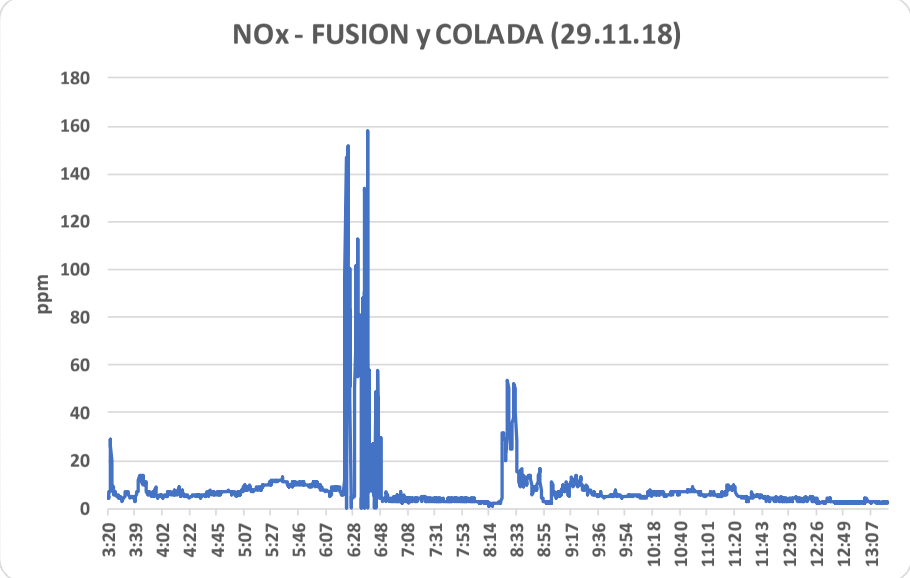
11:20
11:43
12:03
12:26
12:49
13:07


NOx - FUSION y COLADA (29.11.18)
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160
140
120
100
80
60
40
20
0
3:20
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4:02
4:22
4:45
5:07
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6:07
6:28
6:48
7:08
7:31
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8:14
8:33
8:55
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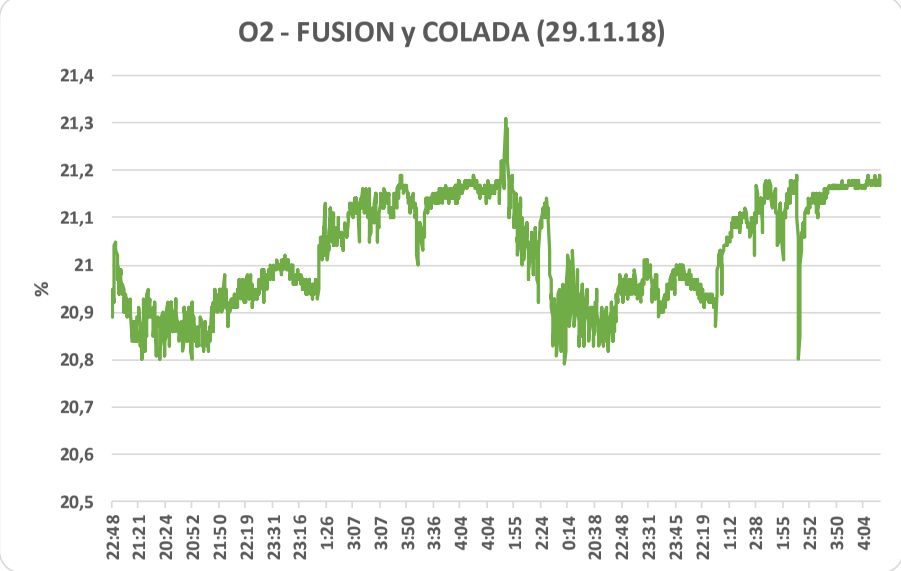
O2 - FUSION y COLADA (29.11.18)
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3:50
4:04

ANEXO II.- RESULTADOS ANALITICOS

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

Informe de análisis

DATOS GENERALES

FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

GOBIERNO VASCO EUSKO JAURLARITZA
DONOSTIA SAN SEBASTIAN, 1
01010-Vitoria-Gasteiz

REFERENCIA CLIENTE

GOBIERNO VASCO EUSKO JAURLARITZA 04.12.18

ANÁLISIS Nº	DENOMINACIÓN MUESTRA	DESCRIPCIÓN MUESTRA	FECHA DE TOMA	FECHA RECEPCIÓN
4699391	TEC-18.90-002 Foco Fusion colada Muestra 1F de 8	conteniendo resultado muestreo de atmósfera	**29/11/2018	5/12/2018
4699392	TEC-18.90-002 Foco Fusion colada Muestra 2F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699393	TEC-18.90-002 Foco Fusion colada Muestra 3F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699394	TEC-18.90-002 Foco Fusion colada Muestra 4F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699395	TEC-18.90-002 Foco Fusion colada Muestra 5F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699396	TEC-18.90-002 Foco Fusion colada Muestra 6F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699397	TEC-18.90-002 Foco Fusion colada Muestra 7F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699398	TEC-18.90-002 Foco Fusion colada Muestra 8F de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699399	TEC-18.90-002 Foco Fusion colada Muestra 1C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699400	TEC-18.90-002 Foco Fusion colada Muestra 2C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699401	TEC-18.90-002 Foco Fusion colada Muestra 3C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699402	TEC-18.90-002 Foco Fusion colada Muestra 4C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699403	TEC-18.90-002 Foco Fusion colada Muestra 5C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699404	TEC-18.90-002 Foco Fusion colada Muestra 6C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699405	TEC-18.90-002 Foco Fusion colada Muestra 7C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018
4699406	TEC-18.90-002 Foco Fusion colada Muestra 8C de 8	Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera		4/12/2018

** * INFORMACIÓN SUMINISTRADA POR EL CLIENTE

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699391
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 1F de 8
DESCRIPCIÓN MUESTRA: conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 5/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	20.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	45.2	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	10.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

*** INFORMACIÓN SUMINISTRADA POR EL CLIENTE**

FECHA DE TOMA: 29/11/2018

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699392
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 2F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	22.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	49.6	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699393
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 3F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	22.4	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	50.0	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº:
ANÁLISIS Nº: 4699394
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 4F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:

Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	16.8	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	35.6	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699395
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 5F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	12.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	2.4	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	38.0	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699396
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 6F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	11.2	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	37.6	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699397
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 7F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	24.4	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	4.4	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	61.2	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699398
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 8F de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	26.8	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	7.6	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	65.2	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	23.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES
INFORME Nº:
ANÁLISIS Nº: 4699399
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 1C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:

Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	8.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	16.4	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

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LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699400
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 2C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	26.8	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	27.6	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

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Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699401
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 3C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	17.2	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	36.0	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

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LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699402
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 4C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	16.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	4.4	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	39.2	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

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ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699403
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 5C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	20.8	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	< 1.0	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	22.4	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699404
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 6C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	46.0	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	7.2	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	52.8	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699405
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 7C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	26.4	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	6.8	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	58.8	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho

ENAC
ENSAYOS
Nº109/LE285

LABAQUA

* Las actividades marcadas no están amparadas por la acreditación de ENAC.

DATOS GENERALES

INFORME Nº:
ANÁLISIS Nº: 4699406
MUESTRA REMITIDA POR: GOBIERNO VASCO EUSKO JAURLARITZA
DOMICILIO: DONOSTIA SAN SEBASTIAN, 1
POBLACION: 01010-Vitoria-Gasteiz
DENOMINACIÓN MUESTRA: TEC-18.90-002 Foco Fusion colada Muestra 8C de 8
DESCRIPCIÓN MUESTRA: Tubo de Carbón 400/200(1), conteniendo resultado muestreo de atmósfera
FECHA RECEPCIÓN: 4/12/2018
FECHA FINALIZACIÓN Y EMISIÓN: 11/12/2018

Análisis realizado por LABAQUA. Ensayos cubiertos por la acreditación ENAC nº 109/LE285; C/ Dracma,16-18- Pol. Ind. Las Atalayas 03114 ALICANTE - Tel. 965 10 60 70 - Fax 965 10 60 80:
Fecha inicio análisis 5/12/2018.

PARÁMETROS	MÉTODOS	RESULTADOS	UNIDADES
BTEXs			
Benceno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	16.4	µg/cartucho
* Estireno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	5.6	µg/cartucho
Tolueno	A-BV-PE-0041- UNE-EN-13649 / UNE-EN-14662	40.4	µg/cartucho
Alcoholes			
* Isopropanol	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho
Gas en bolsa			
* n-Pentano	MAD-C-PE-0093 VO en C.A.	< 4.0	µg/cartucho