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MEASURING EFFICIENCY OF TREATMENT FOR ODORS EMITTED BY A McDONALD'S RESTAURANT

Technical report

E0575P01T01 – RT36INTERZON/2011/CRO/1 – March 2011

EOG Olfactory Laboratory under Cofrac n°1-2035 accreditation
portee disponible sur www.cofrac.fr

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IDENTIFICATION

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CONTRIBUTION

REVISIONS

1	22/03/11	C.ROGNON		22/03/11	C.GRACIAN		22/03/11	C.ROGNON	
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1. INTRODUCTION

INTERZON designs ozone generators for professional and industrial uses.

In particular, INTERZON has developed ozone generators for the specific treatment of kitchen grease smoke in order to eliminate:

- Grease,
- Odors,
- Risks of the development of microorganisms.

The purpose of the present study is to verify the efficiency of the INTERZON device in terms of reducing odors for gaseous effluents emitted by a McDonald's restaurant.

2. METHODS

2.1 PLACE OF STUDY

The study was conducted in a McDonald's restaurant located at 9 rue du Marechal Foch - 78000 VERSAILLES (France) which is equipped with an air treatment device provided by the INTERZON company.

Figure 1 : Facade of McDonald's restaurant, 9 rue Foch in Versailles

2.2 PRINCIPLE OF THE STUDY

The study consisted of taking air samples above and below the air treatment device (*Figure 2*). These air samples were then analyzed by the EGIS Structure & Environnement olfactometric laboratory, certified by COFRAC to conduct olfactometric analyses. Odor concentrations expressed in ou_E/m^3 were compared to determine the reduction of odors through the treatment device.

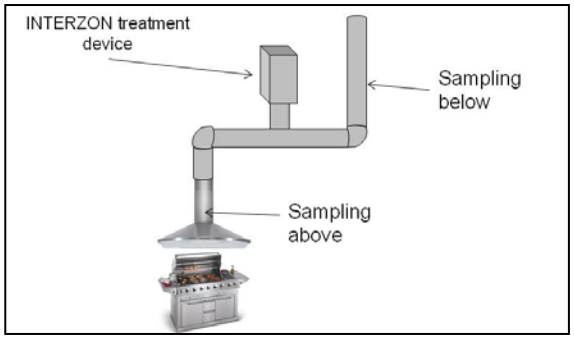

Figure 2 : Principle for conducting air sampling

Air sampling was conducted using two configurations:

1. INTERZON air treatment device stopped,
2. INTERZON air treatment device in operation.

2.3 MEASUREMENT POINTS

The restaurant has 4 hoods (2 for the Grilling sections and 2 or the Frying sections) connected by a system of conduits to a single and same aspiration module. Each aspiration hood is equipped with an INTERZON air treatment device.

For each configuration (INTERZON devices stopped and in operation), 3 air samples were analyzed (*Figure 3*):

- An average sample above the fryer, taken by mixing air from the exhaust duct of each of the 2 hoods located above the frying preparation sections.
- An average sample above the grill, taken by mixing air from the exhaust duct of each of the 2 hoods located above the 2 grilling sections.
- A total discharge sample taken from the roof of the restaurant.

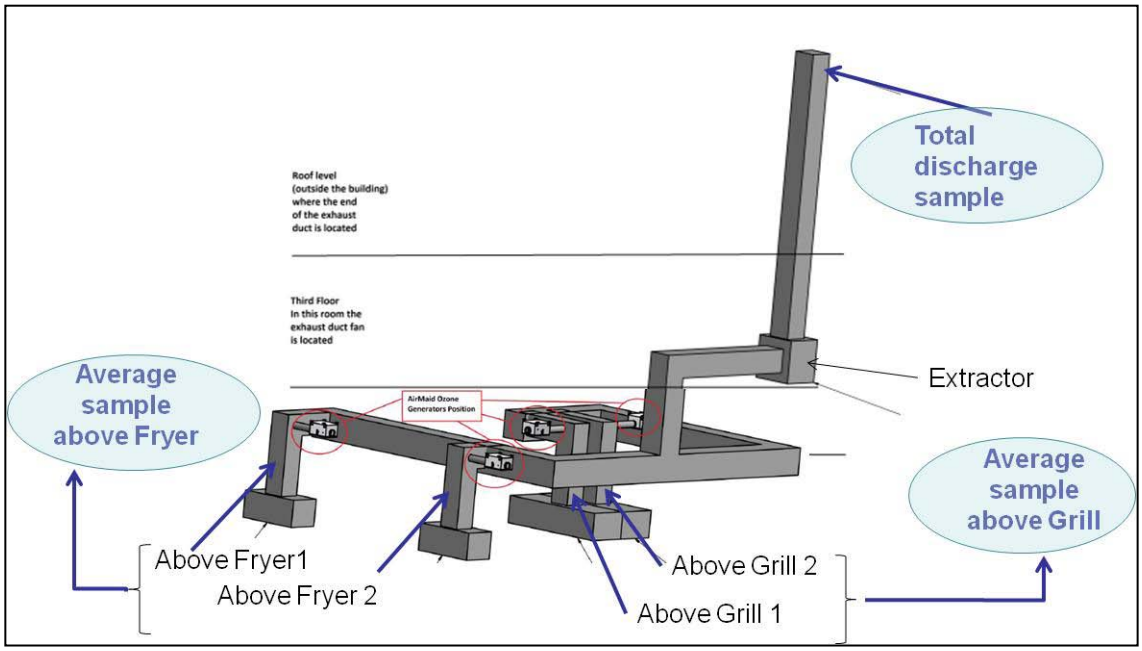

Figure 3 : Sampling points and air samples

Air samples were taken according to the AFNOR NF EN 13725 Standard, using a lung casing system to prevent any contact of the sampled air with the pumping device.

Air samples were then placed in completely sealed Nalophan bags, protected from sunlight.

2.4 CONDITIONS FOR SAMPLING

Wednesdays at noon is normally the busiest time for McDonald's restaurants.

To avoid incurring penalties due the emission of odors, air samples were taken on Wednesday, 23 February 2011 between 12:00 and 13:30.

The INTERZON air treatment devices were stopped at the closing of the restaurant, on the day before the sampling.

The 1st series of samples were then taken between 12:15 and 13:00 while the restaurant was in full activity, with no INTERZON treatment devices in operation.

At 13:00, the INTERZON treatment devices were restarted by the installer, with a stabilization period of 30 minutes.

The 2nd series of samples were taken between 13:00 and 14:15 while the restaurant was in full activity and with the INTERZON treatment devices in operation.

2.5 STANDARD OLFACTOMETRIC ANALYSES

The standardized olfactometric analyses of emissions (AFNOR NF EN 13725 standard) quantified the odor concentrations of each air sample taken at the site. The analysis was conducted with a panel of persons, trained and qualified in our olfactometry laboratory in Aix-en-Provence, according to the AFNOR NF EN 13725 standard (*Figure 4*).

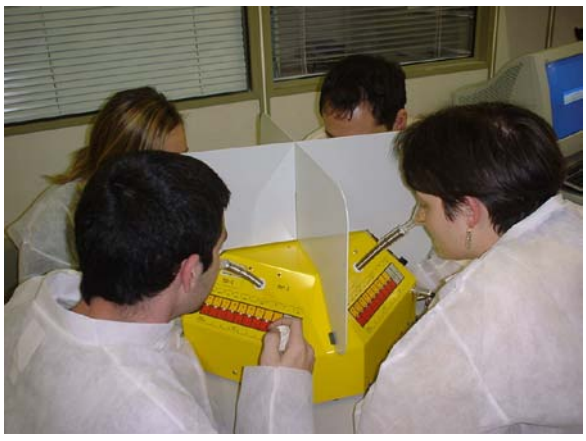

Figure 4 : Olfactometric working sessions according to the AFNOR NF EN 13725 standard

In order to provide the best possible service, Egis Environnement has established a quality procedure through **accreditation by COFRAC** (French Accreditation Committee) of its **olfactometry laboratory,** according to the NF EN 13725 technical standard and the NF EN ISO/CEI 17025 quality standard (Accreditation N°1-2035, with the accreditation content available at www.cofrac.fr).

This accreditation issued by a third party constitutes the formal acknowledgement that:

- The laboratory conducts its activity according to professional ethics and internationally accepted professional standards.
- The measurement method used is valid,
- The laboratory complies with the AFNOR NF EN 13725 standard and its field of application,
- The validation and compliance of the method have withstood the test of time,
- The competence of the technical staff is guaranteed,
- The results are validated through comparison tests between laboratories and within laboratories.

The detailed sampling and olfactometric analyses methods are presented in annex 1 of the report.

3. RESULT

Detailed results of the olfactometric analyses can be consulted in annex 2.

Statistical comparison test results are presented in annex 3.

Table 1 summarizes the odor concentrations measured on air samples taken at the smoke extraction system of the McDonald's restaurant in Versailles.

Odor concentrations are presented at the average value and confidence interval limits (minimum and maximum values) considering the uncertainty of the analysis.

INTERZON air treatment units	**Sampling point**	**Concentration of odors** (ou_E/m^3)		
		Minimum	**Average**	**Maximum**
Not in operation	Exhaust above Fryer	1390	**1 720**	2 140
	Exhaust above Grill	620	**770**	950
	General exhaust	1 650	**2 050**	2 550
In operation	Exhaust above Fryer	1 040	**1 290**	1 600
	Exhaust above Grill	930	**1 150**	1 425
	General exhaust	390	**480**	600

Table 1 : Odor concentrations measured at the smoke capture system of the Mc Donald's restaurant in Versailles

Odor concentrations measured in the fume capture system are between 500 and 2,100 ou_E/m^3. In the majority of cases, these odors persist only if emitted to the atmosphere near residential areas (urban environment) and may generate olfactive nuisances.

The comparison of individual responses (by each member of the panel) through statistical tests (comparison of deviations and the average) shows with an error risk of $\alpha = 5\%$:

- At the exhaust duct above the Fryer, odor concentrations did not vary between the first sampling series (INTERZON devices stopped) and the 2nd sampling series (INTERZON devices in operation). For the entire duration of the study, the concentration of odors from fumes extracted by the frying hoods remained stable at around 1,500 ou_E/m^3.
- At the exhaust duct above the Grill, the concentration of odors measured during the 2nd sampling series (INTERZON devices in operation) was higher than that measured during the 1st series (INTERZON devices stopped). It appears that there

was much more activity in this section during the 2nd sampling series, which provided an increase in the emission of odors through the grills (770 ou_E/m^3 for the first measurement series and 1,150 ou_E/m^3 for the 2nd).

- For the general discharge at the roof, the concentration of odors greatly varied between the 1st sampling series (INTERZON devices stopped) and the 2nd sampling series (INTERZON devices in operation). With 2,050 ou_E/m^3 for the 1st series as compared to 480 ou_E/m^3 for the 2nd series, the INTERZON devices provide a significant reduction of odor concentrations in the discharge exhaust to the atmosphere.

Figure 5 presents the measured odor concentrations.

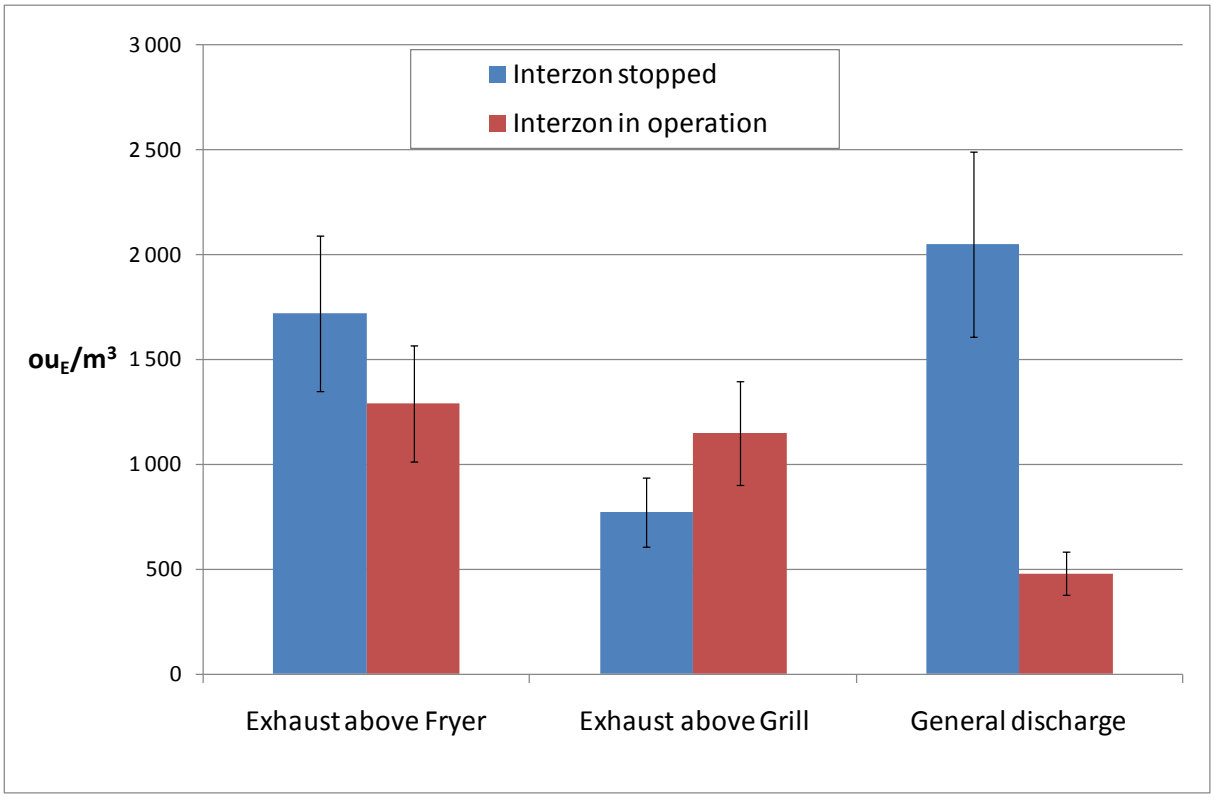

Figure 5 : Odor concentrations measured above and below the air treatment devices.

Odor concentrations measured above the air treatment devices did not vary much for the two operating configurations. We determined the treatment efficiency of the INTERZON devices by comparing the odor concentrations measured at the total discharge exhaust from the roof outlet. At 2,050 ou_E/m^3 while the INTERZON devices were stopped and 480 ou_E/m^3 while they were in operation, we concluded that the odors were reduced by 77%.

4. CONCLUSION

In order to verify the treatment efficiency for odors emitted by a McDonald's restaurant, olfactometric analyses were conducted.

During a full activity period of the restaurant (Wednesday between 12:00 and 13:30), two series of air samples were collected:

- At the exhaust of the « Frying » section aspiration hoods, above the INTERZON air treatment devices,
- At the exhaust of the « Grilling » section aspiration hoods, above the INTERZON air treatment devices,
- For the total discharge to the atmosphere, below the INTERZON air treatment devices.

The first sampling series was conducted while the INTERZON treatment devices were stopped for several hours.

The second sampling series was collected after the restarting of the INTERZON treatment devices and a stabilization period of 30 minutes.

The olfactometric analyses results show that odor concentrations, measured above the aspiration hood outlet, varied little for the entire duration of the study (1,500 ou_E/m^3 for the « Frying » section and between 770 and 1150 ou_E/m^3 for the « Grilling » section).

On the other hand, the operation of the INTERZON air treatment devices produced a clear reduction of odor concentrations for the total discharge at the roof: 480 ou_E/m^3 while the devices were in service, as compared to 2,050 ou_E/m^3 while they were stopped.

This shows that the INTERZON air treatment devices were able to **reduce odors** emitted by the McDonald's restaurant in Versailles-Foch by **77%**.

Annex 1 : Standardized olfactometric measurement methods

1) Sampling

Air sampling at the surface source (storage of blanks) was carried out using a ventilated flow chamber placed at the surface of the source to capture its emissions. These systems will delineate an emission zone and isolate it from uncontrolled external factors such as meteorological conditions. The sampling surface is therefore swept by an air current with controlled speed in order to simulate emissions for low wind conditions, which favor the perception of odors. The air to be analyzed is sampled in the air flow channeled by the chamber.

Air sampling from channeled sources (tank exhaust, production chimney) were carried out using a stainless steel sampling rod or a PTFE sampling line inserted into the air duct.

Air samples in the conveyor environment and the loading of casings were carried out using a sampling line.

Once the sampling device is installed at the source, sampling is carried out according to the AFNOR NF EN 13725 standard, with a lung casing system to prevent any contact between the sampled air and the pumping system (Photo 1). The air sampled is then stored in Nalophan bags inert for odors and sent to our laboratory in Aix-en-Provence.

Photo 1 : « Lung casing » type sampling system

2) Standardized olfactometric analysis accredited by COFRAC

The olfactometric analysis consists of determining the dilution factor to be applied to each of the samples to reduce their odor to the detection threshold level. By definition, the detection threshold corresponds to 1 Unit of European Odors per cubic meter of air (1 ou_E/m^3).

The concentration of odors in an odorous mixture (C_{od}) is obtained by multiplying the dilution factor (F) by the European Odor Unit (1 ou_E/m^3).

$$C_{od} = F \times 1\ ou_E/m^3$$

This measurement indicates the persistence of the odor, which refers to its property of being perceived at a more or less long distance from the source.

In accordance with the AFNOR NF EN 13725 standard, odorous air samples were analyzed in our Aix-en-Provence laboratory, within a maximum time of 30 hours after the sampling (Photo 2). Tests were conducted using a dynamic olfactometer and a panel composed of least 4 persons selected from the general population, according to the AFNOR NF EN 13725 standard and based on their individual sensitivity and variability. These tests were conducted under normal olfactometric conditions (CNO, 20°C and 1 atm) and odor concentrations were indicated under these conditions.

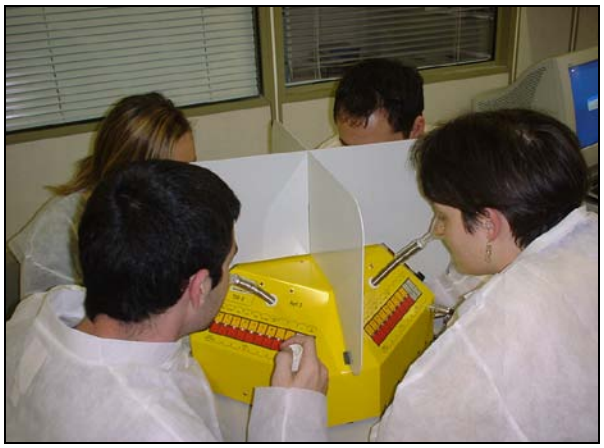

Photo 2: Olfactometric tests according to the AFNOR NF EN 13725 standard

3) An olfactometry laboratory accredited by COFRAC

EGIS Structures and Environnement (formerly GUIGUES Environnement) has the first French laboratory accredited by COFRAC (French Accreditation Committee) for olfactometric measurements, in accordance with the NF EN 13725 technical standard and the NF EN ISO/CEI 17025 quality standard (Accreditation N°1-2035, with the scope of accreditation provided at www.cofrac.fr).

This accreditation issued by a third party constitutes the formal acknowledgement that:

- The laboratory exercises its activity according to professional ethics and internationally accepted professional standards.
- The measurement method used is valid,
- The laboratory complies with the AFNOR NF EN 13725 standard and its field of application,
- The validation and compliance of the method have withstood the test of time,
- The competence of the technical staff is guaranteed,
- The results are validated through comparison tests between laboratories and within laboratories.

4) Calculation of odor flow rate

Surface sources :

A sweeping air speed of 65 meters per hour is regulated in the chamber, in a section equal to 0.075 m^2 which provides an air flow rate at the chamber outlet equal to 4.8 m^3/hr. The chamber surface is 0.35 m^2, and the air flow is 14 m^3/hr per square meter.

The odor flow rate at the chamber outlet is calculated by multiplying the concentration of odors by the chamber air flow rate.

The total emitted flow from the structure is therefore obtained by multiplying the odor flow rate at the chamber outlet by the total surface area of the structure being studied.

Channeled sources :

The odor flow rate is produced by the concentration of odors and the air flow rate from the source.

This air flow rate (in m^3/hr) is reduced to the Standard Olfactometry Conditions (CNO) defined by the AFNOR NF EN 13725 standard (temperature of 20°C and pressure of 1 atm) in order to calculate the flow rate of odors from the source:

$$Q_{air}\ (m^3/hr\ CNO) = Q_{air}\ (m^3/hr) \times \frac{(273+20°C)}{(273+T°effective)}$$

The air flow emitted by the production chimney was measured by EGIS Structures and Environnement at the sampling time of the odorous air. Measurements were conducted using a Pitot tube according to the applicable AFNOR NF X 10-112 standard.

The quantity of air emitted into the atmosphere at the bituminous tank exhaust during discharge is estimated from the quantity of matter discharged from the tank, with the air flow flushed from the exhaust equivalent to the quantity of matter entering the tank.

Annex 2 : Report of olfactometric results

EOG
Olfactometric laboratory

GUIGUES Environnement

March 2011

CLIENT:
GUIGUES ENVIRONNEMENT

70 rue Pierre DUHEM
Pole d'activite d'Aix-en-Provence
13 856 Aix-en-Provence Cedex 03

REPORT OF OLFACTOMETRIC RESULTS

CLIENT REFERENCE: INTERZON

LAO REFERENCE: LAO-En-6001-411 / 0

The results presented in this report only refer to the object being measured

Measurements conducted by:

OLFACTOMETRY LABORATORY

70 rue Pierre DUHEM
Pole d'activite d'Aix-en-Provence
13 856 Aix-en-Provence Cedex 03

cofrac ESSAIS

Cofrac Accreditation No. 1-2035

The COFRAC accreditation certifies the competence of the laboratory only for the measurements covered by the accreditation, indicated by the symbol *

1 IDENTIFICATION

Reference of the study concerned: INTERZON

Name of person requesting measurements: Geraldine DEIBER (GDE)

Registration number of the measurement request: LAO-En-6001-411

Total number of samples received: 6

Method used: Presentation of odorous substances to subjects using the YES / NO method in the NF EN 13725 standard

Number of passages: 3

Pre-dilution material used: --

Validity period for calibration of the pre-dilution material: --

Dilution material used: OLFACTOMETRE ECOMA 8502

Validity period for calibration of the olfactometer: February 2012

Dilution range initially determined: 4 – 65 536

Actual ambient conditions during measurements:

Expected temperature < 25°C	Maximum Temperature: 23.48°C +/- 0.21°C
Expected amplitude < 3°C	Minimum Temperature: 22.92°C +/- 0.21°C

Internal checking of measurement (butanol sample at 82 ppm): 4 096 ou_E/m^3
Expected value between 1 025 ou_E/m^3 and 4 100 ou_E/m^3.

Name of technician who conducted measurements: Aurore KONZ (AKO)

Observations or reservations: ……
……

	Name	Position	Date	Signature
Report validated by:	Christian COSTE	Laboratory head	03/03/11	
Report approved by:	Christian COSTE	Laboratory head	03/03/11	

2 QUALITY CRITERIA OF THE LABORATORY FOR THE REFERENCE MATERIAL (BUTANOL)

According to the requirements of the AFNOR NF 13725 standard, the laboratory verified its quality criteria (repeatability, precision, biases,…). The hypothesis states that the performance characteristics as determined on the reference materials are transferable to other odors.

The repeatability limit is calculated using t = 2.2622 for the Student distribution at (n-1) degrees of freedom with a confidence level of 95 %.

The olfactometric measurement decision limit is the lowest concentration which can be determined as different from a zero sample, with a confidence level of 95%.

The results of compliance checks of the laboratory are as follows:

	Requirement of AFNOR NF EN 13725 Standard	**Values measured in the olfactometry laboratory**
Repeatability limit (r)	< 0.477	0.471
Accuracy (A)	< 0.217	0.106
Standard deviation (s_r)	None	0.1473
Laboratory bias (ξ_w)	None	- 0.0003
Decision limit of the laboratory	None	50 ou_E/m^3

3 PRESENTATION OF SAMPLES RECEIVED IN THE LABORATORY

Sample reference	Date and time of sampling	Identification of the source	Type of sampling	Operating condition of the source during sampling	Pre-dilution during sampling	Date and time of receipt of samples in the laboratory	Presence of humidity and/or particles in the sample through visual inspection (Yes / No)	Date and time of olfactometric measurements	Time between sampling and measurement	Compliance of report to NF EN 13725 standard in terms of time between sampling and measurement (Yes / No)
11PAL0093	23/02/2011 from 13:00 to 13:10	General exhaust (Air treatment devices stopped)	Sampling rod (Piquage)*	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 14:50 to 15:00	25 hours 50 min	Yes
11PAL0094	23/02/2011 from 12:25 to 12:40	Fryer hood exhaust (Air treatment devices stopped)	Sampling rod (Piquage)	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 14:30 to 14:40	26 hours 00 min	Yes
11PAL0095	23/02/2011 from 12:40 to 12:55	Grilling hood exhaust (Air treatment devices stopped)	Sampling rod (Piquage)	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 14:40 to 14:50	25 hours 55 min	Yes
11PAL0096	23/02/2011 from 14:00 to 14:15	General exhaust (Air treatment devices in operation)	Sampling rod (Piquage)	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 16:05 to 16:15	26 hours 00 min	Yes
11PAL0097	23/02/2011 from 13:55 to 14:00	Grilling hood exhaust (Air treatment devices in operation)	Sampling rod (Piquage)	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 15:30 to 15:40	25 hours 40 min	Yes
11PAL0098	23/02/2011 from 13:45 to	Fryer hood exhaust (Air	Sampling rod (Piquage)	Normal	No	24/02/2011 at 11:45	No	24/02/2011 from 15:20 to	25 hours 40 min	Yes

	13:50	treatment devices in operation)						15:30		

Samples were collected by EGIS Structures et Environnement. All comments regarding the sampling presented in this table are transcribed from sampling files filled up by EGIS Structures et Environnement.

(*Air samplings in channeled sources are conducted through a stainless steel sampling rod or a PTFE sampling line inserted in the air duct)

4 LABORATORY RESULTS

Laboratory results are based on an eventual pre-dilution to be carried out by EGIS Structures et Environnement during sampling. Only the pre-dilutions conducted by the laboratory will be considered.

Reference samples analyzed	Panel member	Z_{ITE} individual (in ou_E/m^3) 1st series	ΔZ	Z_{ITE} individual (in ou_E/m^3) 2nd series	ΔZ	Z_{ITE} individual (in ou_E/m^3) 3rd series	ΔZ
11PAL0093	ESIM	2 896	1.4	2 896	1.4	1 448	-1.4
	AKO	2 896	1.4	2 896	1.4	2 896	1.4
	AFAC	1 448	-1.4	1 448	-1.4	1 448	-1.4
	JGHO	1 448	-1.4	2 896	1.4	1 448	-1.4
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**2 048**	
11PAL0094	ESIM	724	-2.4	724	-2.4	1 448	-1.2
	AKO	2 896	1.7	2 896	1.7	2 896	1.7
	AFAC	1 448	-1.2	1 448	-1.2	724	-2.4
	JGHO	2 896	1.7	2 896	1.7	2 896	1.7
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**1 722**	
11PAL0095	ESIM	724	-1.1	362	-2.1	724	-1.1
	AKO	1 448	1.9	1 448	1.9	724	-1.1
	AFAC	362	-2.1	724	-1.1	724	-1.1
	JGHO	724	-1.1	1 448	1.9	724	-1.1
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**767**	
11PAL0096	ESIM	1 448	3.0	724	1.5	362	-1.3
	AKO	362	-1.3	362	-1.3	181	-2.7
	AFAC	362	-1.3	724	1.5	362	-1.3
	JGHO	362	-1.3	724	1.5	724	1.5
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**483**	

Reference samples analyzed	Panel member	Z_{ITE} individual (in ou_E/m^3) 1st series	ΔZ	Z_{ITE} individual (in ou_E/m^3) 2nd series	ΔZ	Z_{ITE} individual (in ou_E/m^3) 3rd series	ΔZ
11PAL0097	ESIM	1 448	1.3	1 448	1.3	724	-1.6
	AKO	724	-1.6	724	-1.6	1 448	1.3
	AFAC	724	-1.6	1 448	1.3	724	-1.6
	JGHO	2 896	2.5	1 448	1.3	1 448	1.3
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**1 149**	
11PAL0098	ESIM	1 448	1.1	362	-3.6	724	-1.8
	AKO	5 793	4.5	2 896	2.2	1 448	1.1
	AFAC	724	-1.8	724	-1.8	724	-1.8
	JGHO	2 896	2.2	1 448	1.1	1 448	1.1
$\bar{Z}_{ITE}$ or average odor level of sample (in ou_E/m^3) *						**1 290**	

5 UNCERTAINTIES

The confidence interval of 95% to estimate the concentration values of odors is defined as follows:

$$\overline{y_w} - t.\frac{s_r}{\sqrt{n}} \leq C_{od} \leq \overline{y_w} + t.\frac{s_r}{\sqrt{n}}$$

Where:

s_r is the repeatability standard deviation (fidelity) of the laboratory
C_{od} = Average of Z_{ite}
t is the Student factor at 95 % for (n -1) degrees of freedom
$\overline{y_w}$ is the average of test results
n is the number of test results for the source studied

In case pre-dilution is conducted by the laboratory, uncertainties associated with the different pre-dilution stages of the equipment (α_1 and α_2 provided by the pre-dilutor manufacturer during annual calibration) are considered in the calculation of lower and upper limits of the concentration of odors. In case of successive pre-dilutions, the total uncertainty regarding the pre-dilution made by the laboratory is obtained by adding the uncertainties of each of the pre-dilutions.

$$\alpha = (\alpha_1 \times n_1) + (\alpha_2 \times n_2)$$

Where:

α is the total uncertainty for the pre-dilution conducted by the laboratory
α_1 is the uncertainty in stage 1 of the pre-dilution in equipment
α_2 is the uncertainty in stage 2 of the pre-dilution in equipment
n = number of times where the corresponding dilution was applied

Confidence interval at 95% to estimate the concentration value of odors in case of pre-dilution conducted by the laboratory is therefore defined as follows:

$$(\overline{y_w} - t.\frac{s_r}{\sqrt{n}}) - \left[(\overline{y_w} - t.\frac{s_r}{\sqrt{n}}) \times \alpha\right] \leq C_{od} \leq (\overline{y_w} + t.\frac{s_r}{\sqrt{n}}) + \left[(\overline{y_w} - t.\frac{s_r}{\sqrt{n}}) \times \alpha\right]$$

Where:

α is the total uncertainty for the pre-dilution conducted by the laboratory
s_r is the repeatability (fidelity) standard deviation of the laboratory
C_{od} = Average of Z_{ite}
t is the Student factor at 95 % for (n -1) degrees of freedom
$\overline{y_w}$ is the average of test results
n is the number of test results for the source studied

Reference samples analyzed	Identification of the source	Number of jury members selected for calculation	Pre-dilution conducted by the laboratory (YES / NO)	Uncertainty of pre-dilution conducted by laboratory (α)	**Lower limit (in ou_E/m^3)**	**c_{od} (in ou_E/m^3)**	**Upper limit (in ou_E/m^3)**
11PAL0093	General exhaust (Air treatment devices stopped)	4	NO	/	**1 651**	* **2 048**	**2 541**
11PAL0094	Fryer hood exhaust (Air treatment devices stopped)	4	NO	/	**1 388**	* **1 722**	**2 136**
11PAL0095	Grilling hood exhaust (Air treatment devices stopped)	4	NO	/	**618**	* **767**	**951**
11PAL0096	System exhaust (Air treatment devices in operation)	4	NO	/	**389**	* **483**	**599**
11PAL0097	Grilling hood exhaust (Air treatment devices in operation)	4	NO	/	**926**	* **1 149**	**1 425**
11PAL0098	Fryer hood exhaust (Air treatment devices in operation)	4	NO	/	**1 040**	* **1 290**	**1 600**

Annex 3 : Statistical comparisons of olfactometric analyses results

Individual results of olfactometric tests

Tests	General Discharge, INTERZON off	Above Fryer, INTERZON off	Above Grill, INTERZON off	General Discharge, INTERZON on	Above Fryer, INTERZON on	Above Grill, INTERZON on
1	2896	724	724	1448	1448	1448
2	2896	2896	1448	362	5793	724
3	1448	1448	362	362	724	724
4	1448	2896	724	362	2896	2896
5	2896	724	362	724	362	1448
6	2896	2896	1448	362	2896	724
7	1448	1448	724	724	724	1448
8	2896	2896	1448	724	1448	1448
9	1448	1448	724	362	724	724
10	2896	2896	724	181	1448	1448
11	1448	724	724	362	724	724
12	1448	2896	724	724	1448	1448
Average	**2048**	**1722**	**767**	**483**	**1290**	**1149**

Statistical comparisons

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Amont Frites sans et avec INTERZON

Résultats de calcul:

Première variable : Amont Frites INTERZON Arret
Moyenne de Amont Frites INTERZON Arret = 1970
Variance de Amont Frites INTERZON Arret = 890113

Seconde variable : Amont Frites INTERZON marche
Moyenne de Amont Frites INTERZON marche = 1687
Variance de Amont Frites INTERZON marche = 2136149
Risque pris en rejetant l'hypothèse 'variances égales'= 7.181 %

Risque sur la variance (en %) = 5

En rejetant l'hypothèse 'les variances de Amont Frites INTERZON Arret et Amont Frites INTERZON marche sont égales', on prend un risque de 7.181 %. D'après le risque admissible, on peut considérer que les variances ne sont pas significativement différentes.

En rejetant l'hypothèse 'La différence entre les moyennes de Amont Frites INTERZON Arret et Amont Frites INTERZON marche est égale à 0.000', on prend un risque de 56.193%.

En rejetant l'hypothèse 'La différence entre les moyennes de Amont Frites INTERZON Arret et Amont Frites INTERZON marche est égale à 0.000', on prend un risque de 56.193%.

Conclusion

Les variances de 'Amont Frites INTERZON Arret' et 'Amont Frites INTERZON marche' ne sont pas significativement différentes et la différence entre leurs moyennes n'est pas significativement différente de 0.000

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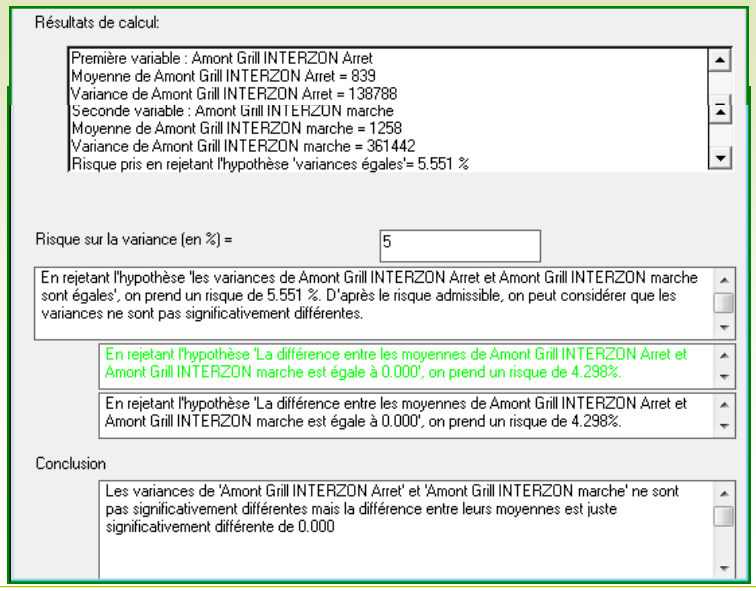
Amont Grill
sans et avec INTERZON



egis environnement

Sortie Générale sans et avec INTERZON

Résultats de calcul:

Première variable : Rejet général INTERZON Arret
Moyenne de Rejet général INTERZON Arret = 2162
Variance de Rejet général INTERZON Arret = 525359
Seconde variable : Rejet général INTERZON marche
Moyenne de Rejet général INTERZON marche = 552
Variance de Rejet général INTERZON marche = 106679
Risque pris en rejetant l'hypothèse 'variances égales'= 0.519 %

Risque sur la variance (en %) = 5

En rejetant l'hypothèse 'les variances de Rejet général INTERZON Arret et Rejet général INTERZON marche sont égales', on prend un risque de 0.519 %. D'après le risque admissible, on peut considérer que les variances sont significativement différentes.

En rejetant l'hypothèse 'La différence entre les moyennes de Rejet général INTERZON Arret et Rejet général INTERZON marche est égale à 0.000', on prend un risque de 0.000%.

En rejetant l'hypothèse 'La différence entre les moyennes de Rejet général INTERZON Arret et Rejet général INTERZON marche est égale à 0.000', on prend un risque de 0.000%.

Conclusion

Les variances de 'Rejet général INTERZON Arret' et 'Rejet général INTERZON marche' sont significativement différentes et la différence entre leurs moyennes est très significativement différente de 0.000