



ABICH S.r.l.

Biological and Chemical Analysis
Toxicology, Research and Services

Company

FLAVOURART

Via Carmine snc
Oleggio (NO)

Comparative evaluation report between traditional and electronic cigarettes
about the release of airborne agents in a closed environment

May 2012

Ref.

REL/0489/12/ECOAMB/LUZ

CERTIFIED COMPANY
UNI EN ISO 9001:2008
Certificate N. 501004992

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R.E.A.: 189901
Cap. Soc. € 16.000,00 i.v.



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Summary

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- 2) Environment properties and survey procedures
- 3) Regulations and methods
- 4) Sampling points
- 5) Instruments
- 6) Results

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1.0 – Aim of the survey

The evaluation has been performed in order to compare the diffusion in a closed environment, without air exchange, of traditional cigarettes smoke compared to the electronic ones.

The experiment has been carried out in a standard room, composed by three connected spaces: dining, bathroom and lounge room.

The room have a total volume of about 60 m3.

2.0 – Environment properties and survey procedures

During the first experiment five volunteers smoked, in the room, some traditional cigarettes remaining inside the room for the time strictly necessary for the aim. The room remained closed, except for the time necessary to allow the subjects to enter and leave.

The experiment lasted five hours.

During the second experiment other five volunteers - different from the previous ones - smoked electronic cigarettes, always remaining inside the room just for the time necessary for the aim and using the room in the same manner as the first experiment.

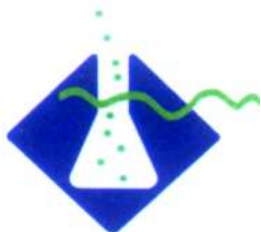
The experiment lasted five hours.

During both the experiments the maximum number of volunteers simultaneously in the room was three.

Between the two experiments have passed three days, during which the room has been ventilated for a long time.

The parameters tracked during the survey are:

- ✓ Carbon monoxide CO
- ✓ Nitrogen oxides NOx
- ✓ Acrolein
- ✓ Polycyclic Aromatic Hydrocarbons PAHs
- ✓ Volatile Organic Compounds VOC
- ✓ Total Organic Carbon TOC
- ✓ Nicotine
- ✓ Glycerine and propylene glycol (components of the electronic cigarettes fluids)



3.0 – Sampling methodicals

For the sampling have been used national and international methodicals

UNI EN 1076:1999	Absorbion tubes by pumping for the determination of gas and vapors Requirements and test methods
UNI EN 1232:1999	Atmosphere in the workplace. Pumps for personal sampling of chemical agents Requirements and test methods
UNI 14626/14211	Determination of CO and NOx
NIOSH 2018	Determination of Aldehydes – Acrolein -
NIOSH 5515 / EPA 8270	Determination of Polycyclic Aromatic Hydrocarbons – GC-MS method
NIOSH 2544 / EPA 8270	Determination of Nicotine
NIOSH 5523	Determination of Glycols
UNI EN 13649:2002	Determination of the mass concentration of each organic compound in gaseous form. Method by means of active carbons and desorption through the solvent
UNI-EN 12619 /13526	Determination of Total Organic Carbon (TOC) – continuous method with flame ionization detector FID

Note: the standard UNI 12619/13526 has been used simply to give a rough estimate of the release of organic substances in the environment.

4.0 – Sampling points

Given the small size of the room, the sampling point was unique and placed where the volunteers were.

**5.0 - Instruments**

To carry out the environmental sampling the following materials have been used:

Mobile sampler Mega System
Mobile sampler SKC mod. AIRCHECK
Analyzer TOC - PCF Elettronica mod.2001
Analyzer CO, NOx - MADUR
Aluminium membrane holder diameter 13 mm with 7 mm cone
Aluminium membrane holder diameter 37 mm with 14 mm cone
Solid Sorbent Tube SKC mod. XAD-2
Solid Sorbent Tube SKC mod. XAD-7
SKC Cartridge containing silica gel coated with 2,4-dinitrophenylhydrazine
Fiberglass filters and PTFE filters

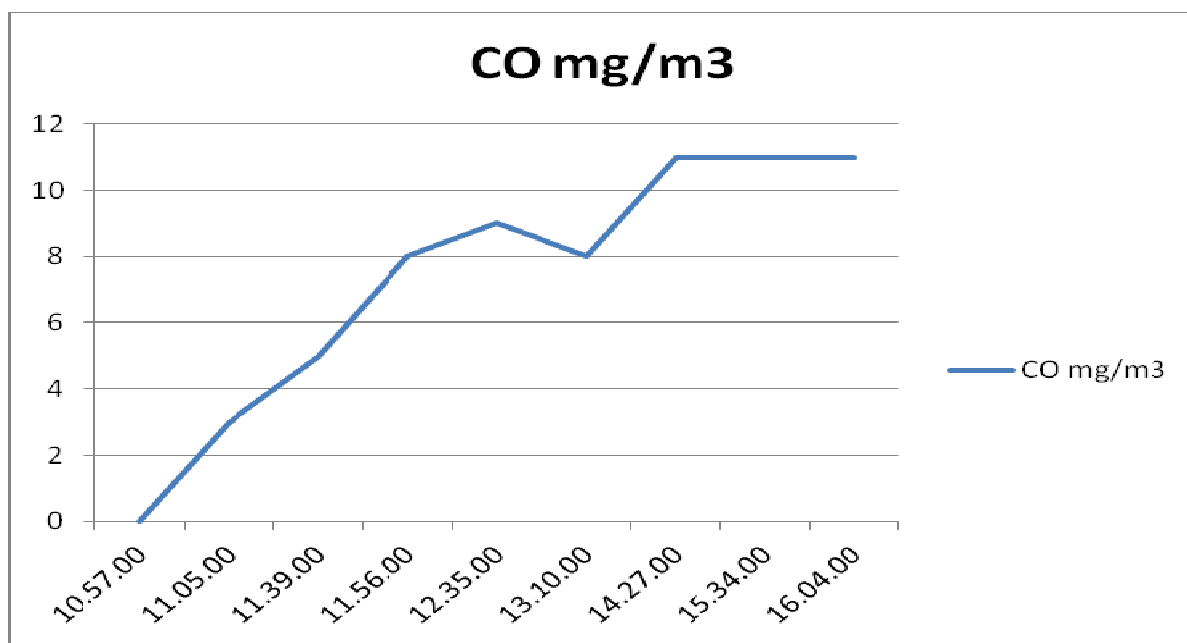


6.0 - RESULTS

CARBON MONOXIDE

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m ³ a 20°C e 0,101 MPa
Carbon monoxide	300	Continuous measurement	8,25



ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m ³ a 20°C e 0,101 MPa
Carbon monoxide	300	Continuous measurement	< 1

**NITROGEN MONOXIDE****TRADITIONAL CIGARETTE**

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nitrogen monoxide	300	Continuous measurement	< 1

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nitrogen monoxide	300	Continuous measurement	< 1

NITROGEN DIOXIDE**TRADITIONAL CIGARETTE**

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nitrogen dioxide	300	Continuous measurement	< 1

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nitrogen dioxide	300	Continuous measurement	< 1



NICOTINE

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nicotine	300	570,55	0,034

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Nicotine	300	573,55	< 0,001



GLYCERINE

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Glycerine	300	552,28	< 0,001

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Glycerine	300	552,11	0,072

PROPYLENE GLYCOL

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Propylene glycol	300	552,28	< 0,01

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Propylene glycol	300	552,11	< 0,01



ACROLEIN

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Acrolein	300	57,19	0,020

ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Acrolein	300	57,73	< 0,0016

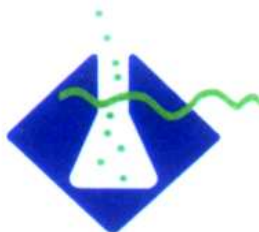


VOLATILE ORGANIC COMPOUNDS

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Methylethylketone	300	58,52	0,0042
Toluene	300	58,52	0,0017
o,m,p – xylene	300	58,52	0,0002
1-ethyl-2-methylbenzene	300	58,52	0,0049
1- ethyl -3- methylbenzene	300	58,52	0,0002
1,2,4-Trimethylbenzene	300	58,52	0,0003
Limonene	300	58,52	0,0125
Decane	300	58,52	0,0004
Menthene	300	58,52	0,0005
Undecane	300	58,52	0,0042
Dodecane	300	58,52	0,0037
Cedrene	300	58,52	0,0003
Longifolen	300	58,52	0,0183
Total u.s.	300	58,52	0,0147

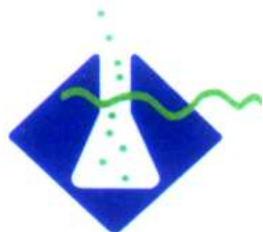
u.s. unidentifiable substance



ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m³ a 20°C e 0,101 MPa
Methylethylketone	300	58,51	0,0044
1- ethyl -3- methylbenzene	300	58,51	0,0034
BHT(Butylhydroxytoluene)	300	58,51	0,0004
Limonene	300	58,51	0,0001
Decane	300	58,51	0,0042
Terpene (u.s.)	300	58,51	0,0023
Undecane	300	58,51	0,0007
Dodecane	300	58,51	0,0003
Cedrene	300	58,51	0,0009
Longifolen	300	58,51	0,0303
Longicyclene	300	58,51	0,0022
Caryophillene	300	58,51	0,0010
Total u.s.	300	58,51	0,0126

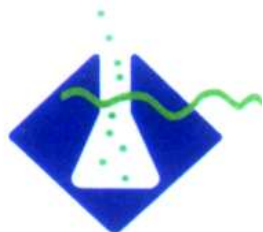
u.s. unidentifiable substance



AROMATIC POLYCYCLIC HYDROCARBONS

TRADITIONAL CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration $\mu\text{g}/\text{m}^3$ a 20°C e 0,101 MPa
Naphthalene	300	570,06	2,78
Acenaphthylene	300	570,06	< 0,02
Acenaphthene	300	570,06	0,19
Fluorene	300	570,06	0,47
Phenanthrene	300	570,06	0,37
Anthracene	300	570,06	< 0,04
Fluoranthene	300	570,06	0,13
Pyrene	300	570,06	< 0,01
Benzo(a)anthracene	300	570,06	< 0,16
Chrysene	300	570,06	5,46
Benzo(b)fluoranthene	300	570,06	< 0,33
Benzo(k)fluoranthene	300	570,06	< 0,74
Benzo(a)pyrene	300	570,06	< 0,62
Indeno(1,2,3-cd)pyrene	300	570,06	< 1,47
Dibenzo(a,h)anthracene	300	570,06	< 1,47
Benzo(g,h,i)perylene	300	570,06	< 1,60



ELECTRONIC CIGARETTE

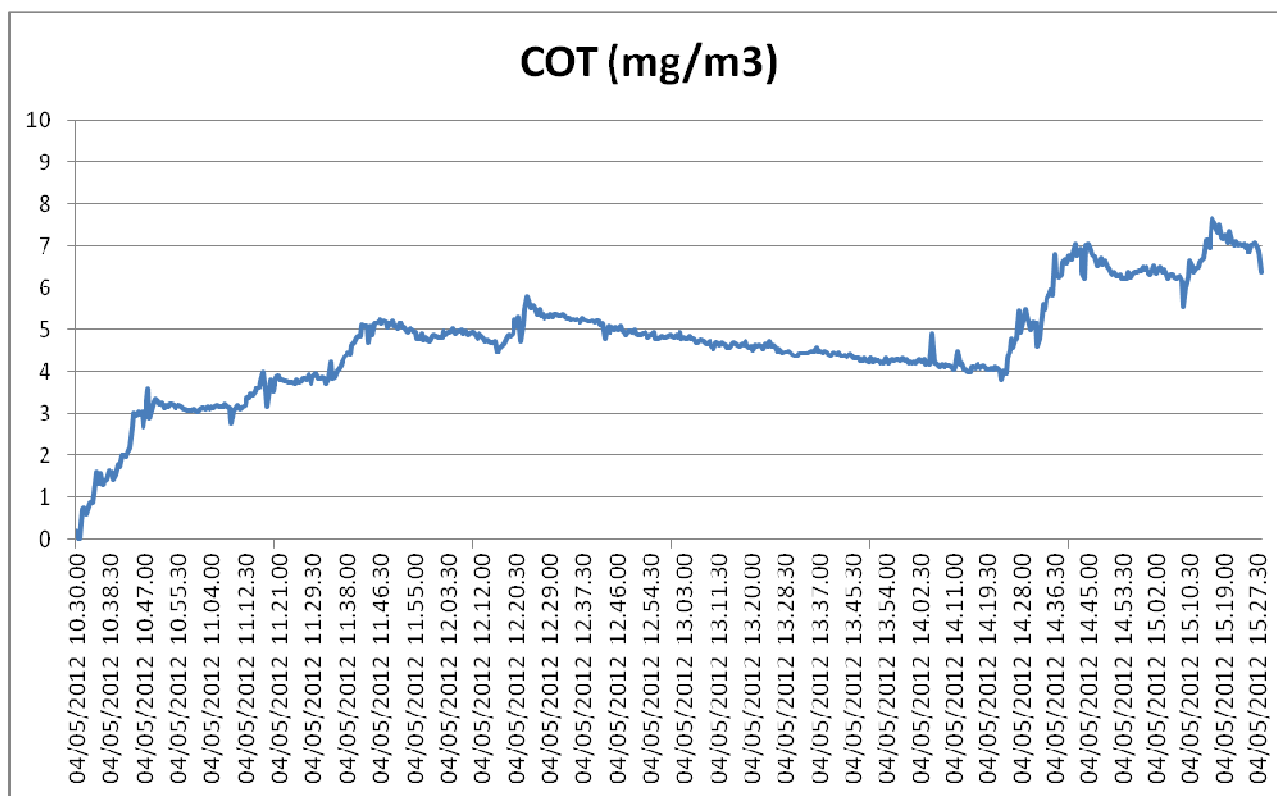
Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration $\mu\text{g}/\text{m}^3$ a 20°C e 0,101 MPa
Naphthalene	300	573,55	< 0,02
Acenaphthylene	300	573,55	< 0,02
Acenaphthene	300	573,55	< 0,03
Fluorene	300	573,55	< 0,06
Phenanthrene	300	573,55	< 0,08
Anthracene	300	573,55	< 0,04
Fluoranthene	300	573,55	< 0,02
Pyrene	300	573,55	< 0,01
Benzo(a)anthracene	300	573,55	< 0,16
Chrysene	300	573,55	< 0,14
Benzo(b)fluoranthene	300	573,55	< 0,33
Benzo(k)fluoranthene	300	573,55	< 0,74
Benzo(a)pyrene	300	573,55	< 0,62
Indeno(1,2,3-cd)pyrene	300	573,55	< 1,47
Dibenzo(a,h)anthracene	300	573,55	< 1,47
Benzo(g,h,i)perylene	300	573,55	< 1,60



TOTAL ORGANIC CARBON

TRADITIONAL CIGARETTE

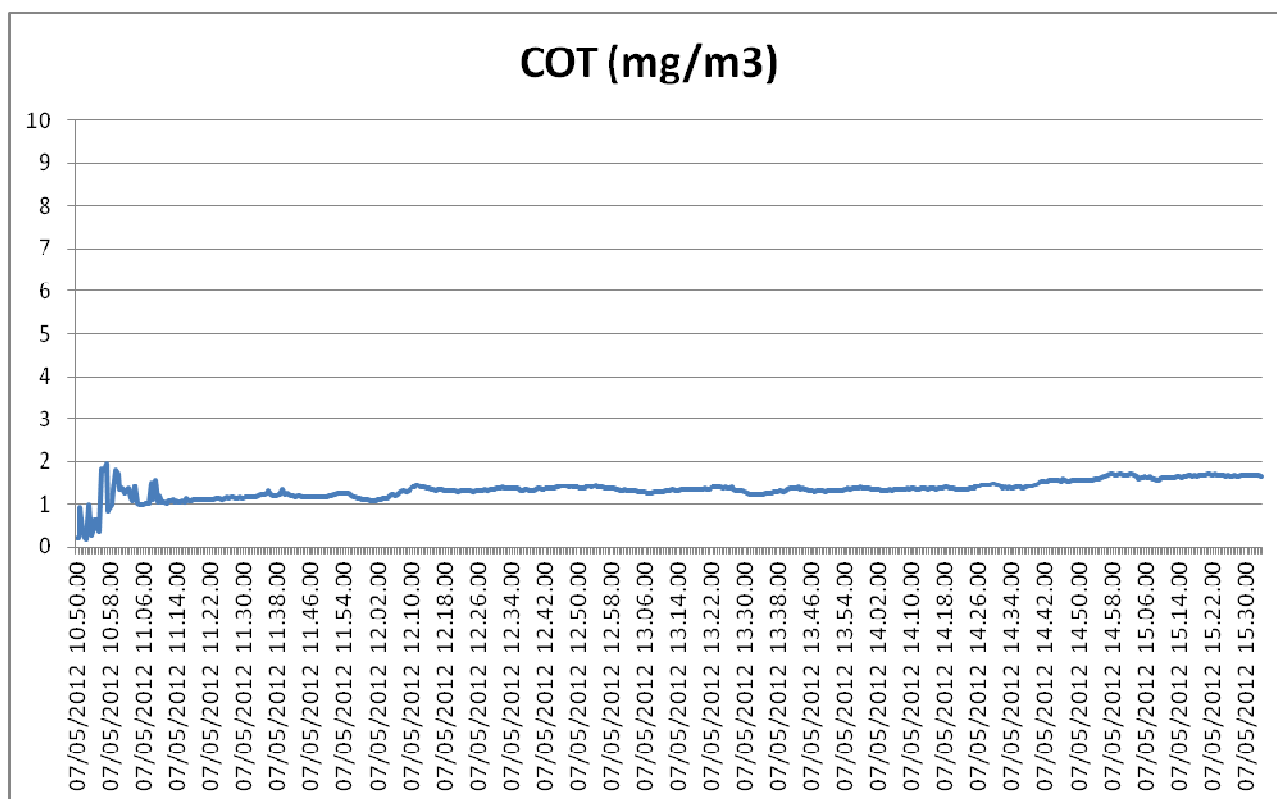
Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m ³ a 20°C e 0,101 MPa
TOC	298,5	Continuous measurement	4,67 (± 1,29)





ELECTRONIC CIGARETTE

Parameter	Sampling time Minutes	Sampled volume Liters 20°C 0,101 MPa	Mean concentration mg/m ³ a 20°C e 0,101 MPa
TOC	284	Continuous measurement	1,34 (± 0,22)



Verbania, 05/31/2012

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