Mars 2023

BLEFCO
Biologistes des Laboratoires d'Etude de la Fécondation et de la Conservation de l'Oeuf

Protection environnementale du laboratoire: Mythes et Réalités

Dr Xavier Pollet-Villard

nataliance
centre d'amp du Loiret

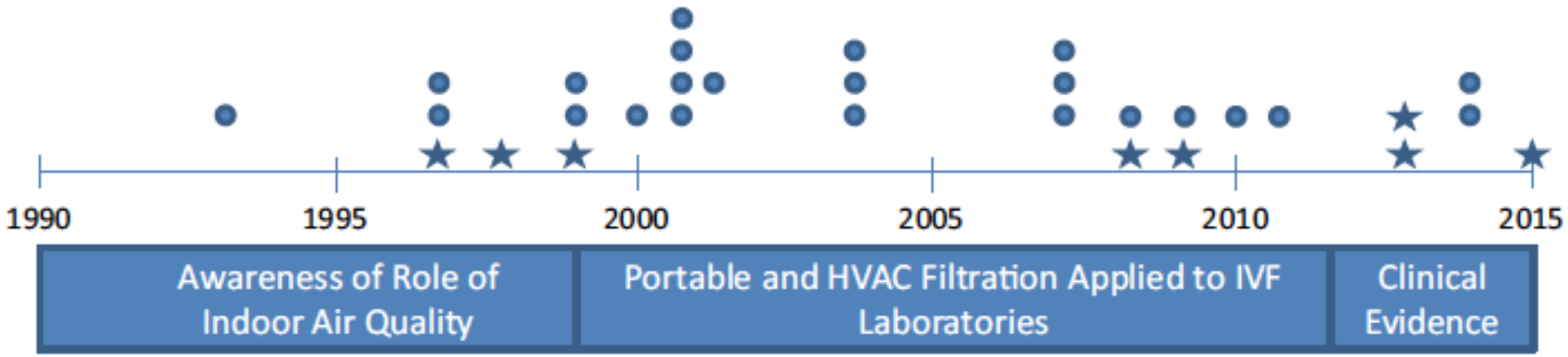
Journée des Techniciens et Biologistes en AMP

CONTEXTE

The Effects of Volatile Compounds (VC) on the Outcome of In Vitro Mouse Embryo Culture. [1]J. E. Johnson, [1]W. R. Boone and [2]R. S. Bernard, [1]Greenville Hospital System, Reproductive Endocrinology Associates, Greenville, SC, [2]Clemson University, Dept. of Animal, Dairy and Veterinary Sciences, Clemson, SC.

1993… 2017?

careful consideration must be given to the use of any VC-producing material in close proximity to human gametes and embryos.



Morbeck 2015

Dans le laboratoire

Tableau I : Cahier des charges relatif à l'environnement et la qualité de l'air dans le laboratoire de FIV (Tiré de [3])

Température	20 à 24°C
Humidité Relative	40 à 45 %
Renouvellement d'air	15/h dont 3/h en air frais
Surpression	> 38 Pa
Classe particulaire au repos	ISO7 ou meilleur
Classe particulaire en activité	ISO7 ou meilleur
Contamination microbiologique au repos	< 20 CFU/m^3 et < 2 spores/m^3
COV totaux	400 à 800 ppb et/ou < 500 µg/m^3
Aldéhydes totaux	< 5 µg/m^3

Dans les incubateurs

Temperature	Close to 37°C, stable
Relative Humidity	Max allowed
CO2/pH	CO2 according to target pH
Oxygen	5%, oxygen sequential?
CACs	As low as possible

Penser au temps de récupération après ouverture

METHODES DE PROTECTION: FILTRES PARTICULAIRES

Table 2.3 Coarse filter grading system as per the European Standard EN 779:2012

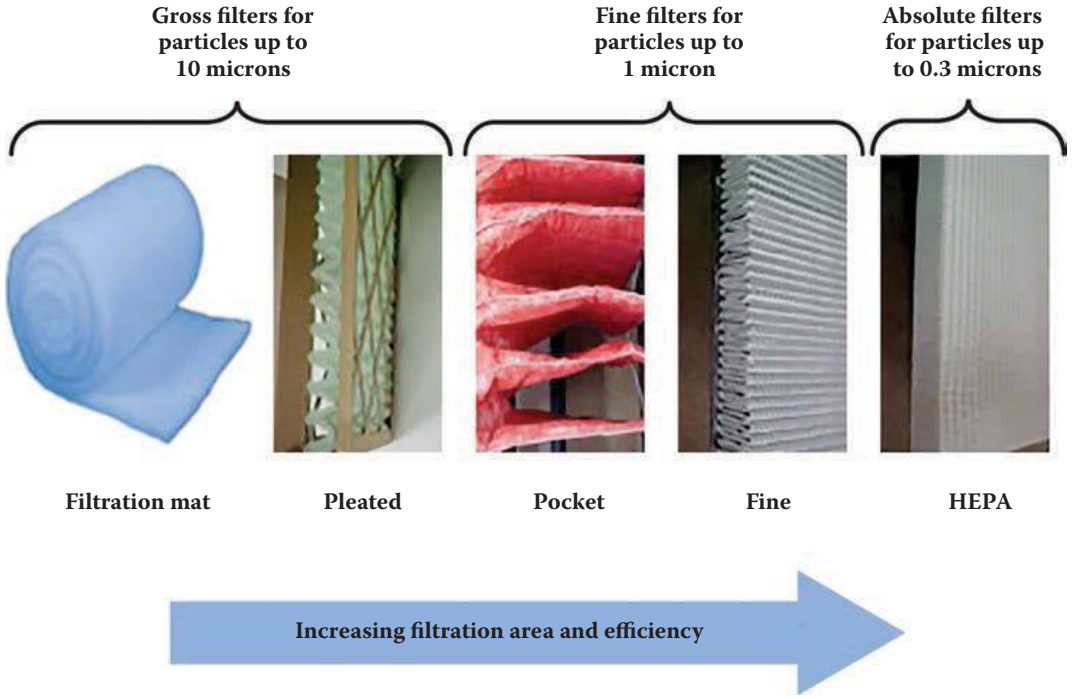
Coarse filters	
Grade	Gravimetric efficiency
G1	50 ≤ Am < 65%
G2	65 ≤ Am < 80%
G3	80 ≤ Am < 90%
G4	Am ≤ 90%

Note: Am: "Arrestance Moyenne" (average retention).

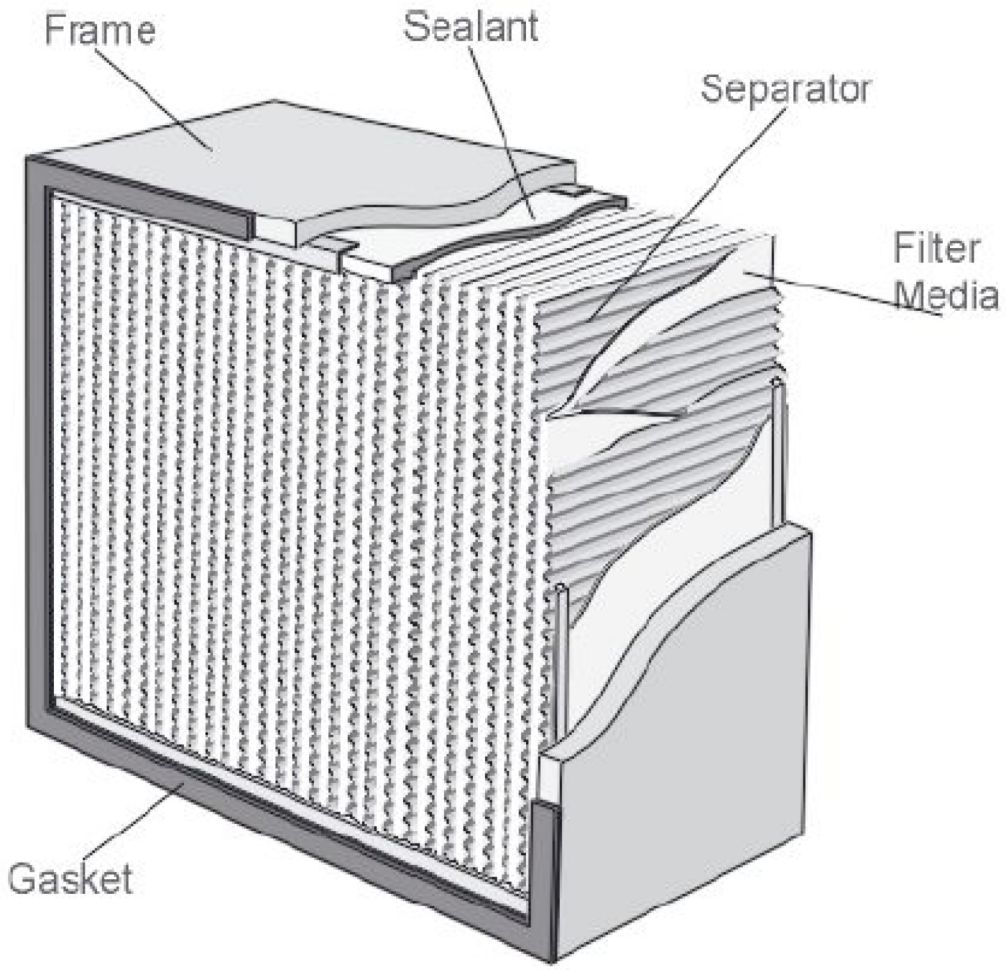
Table 2.4 Medium and fine filter grading system as per the European Standard EN 779:2012

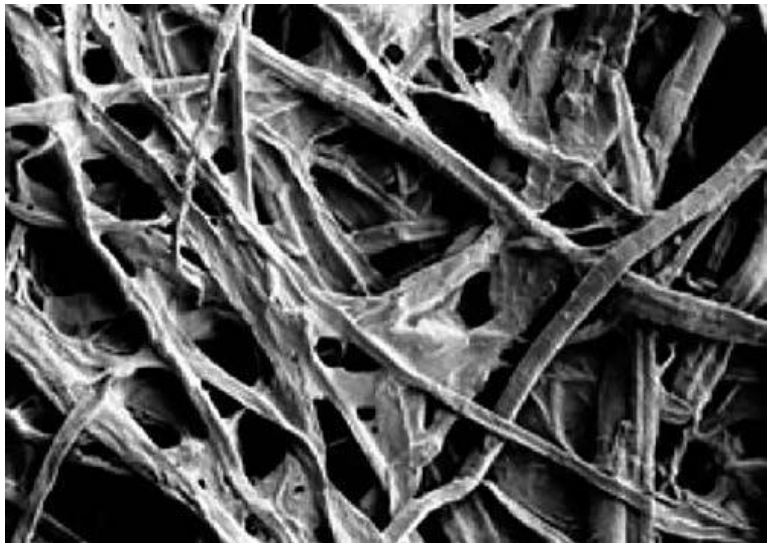
Medium and fine filters	
Grade	Spectral efficiency DEHS 0.4 μm
M5	40 ≤ Em < 60%
M6	60 ≤ Em < 80%
F7	80 ≤ Em < 90%
F8	90 ≤ Em < 95%
F9	Em ≤ 95%

Note: Em: "Efficacité Moyenne" (average efficiency).

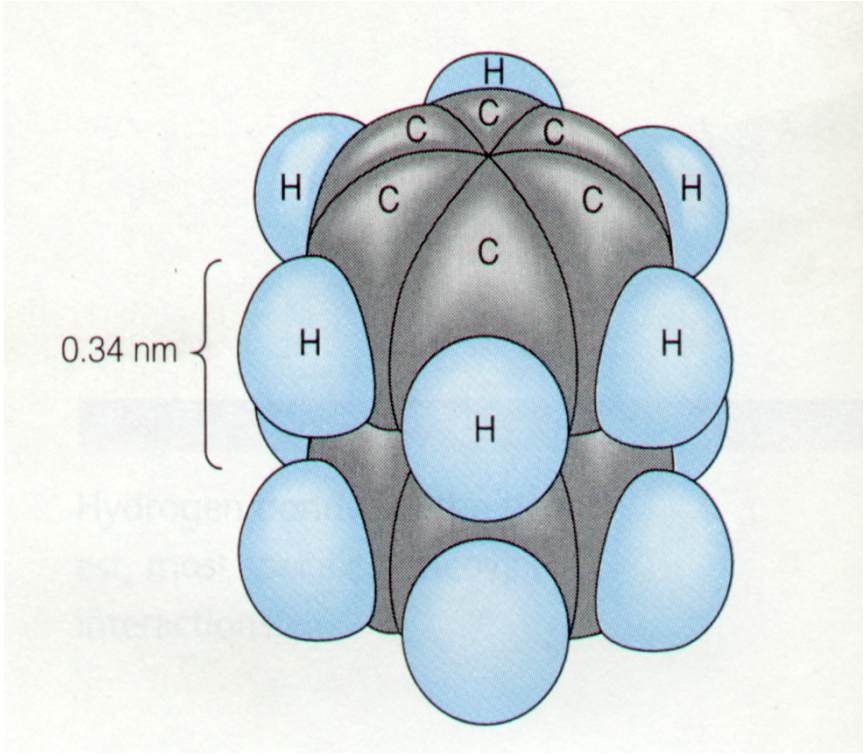


HEPA: Principes





METHODES DE PROTECTION: FILTRES CHIMIQUES

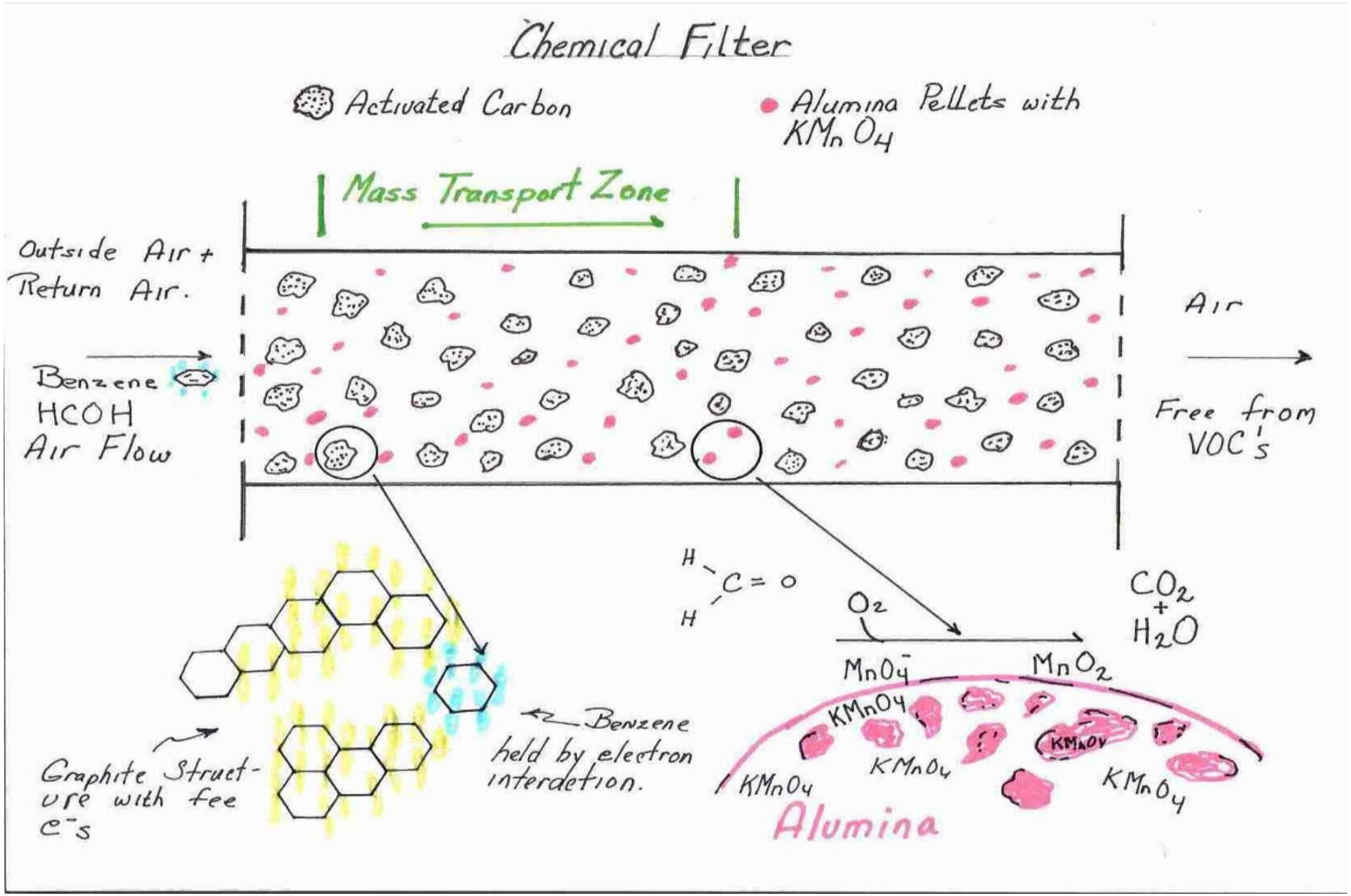


VOC

1,000 - 10,0000 x's

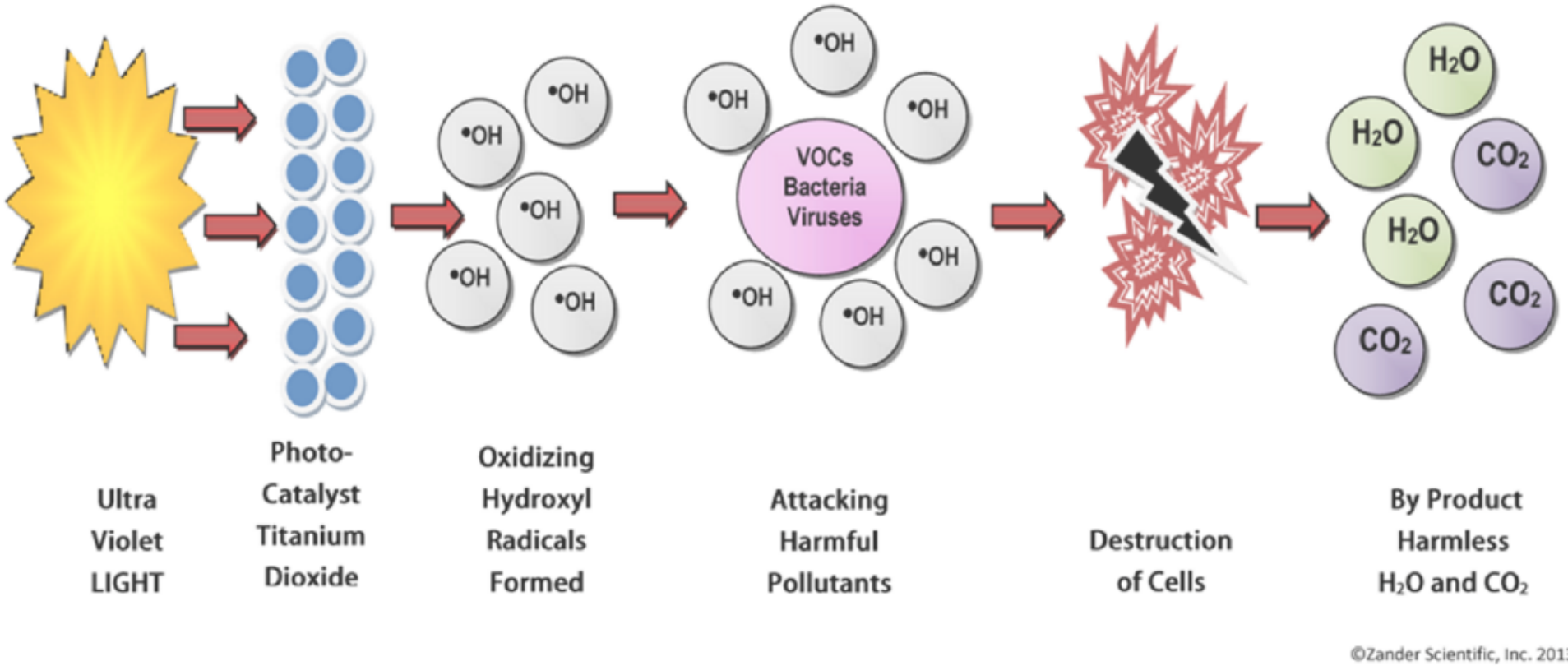
smaller than HEPA pore size

Alpha Environmental, Inc.



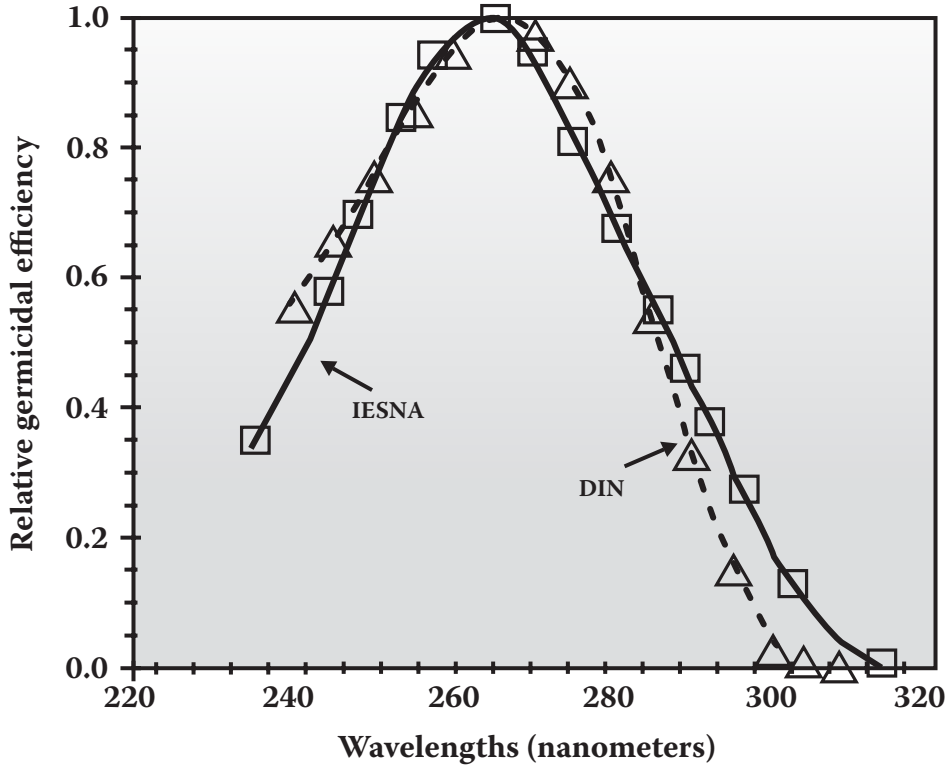
Antonia Gilligan

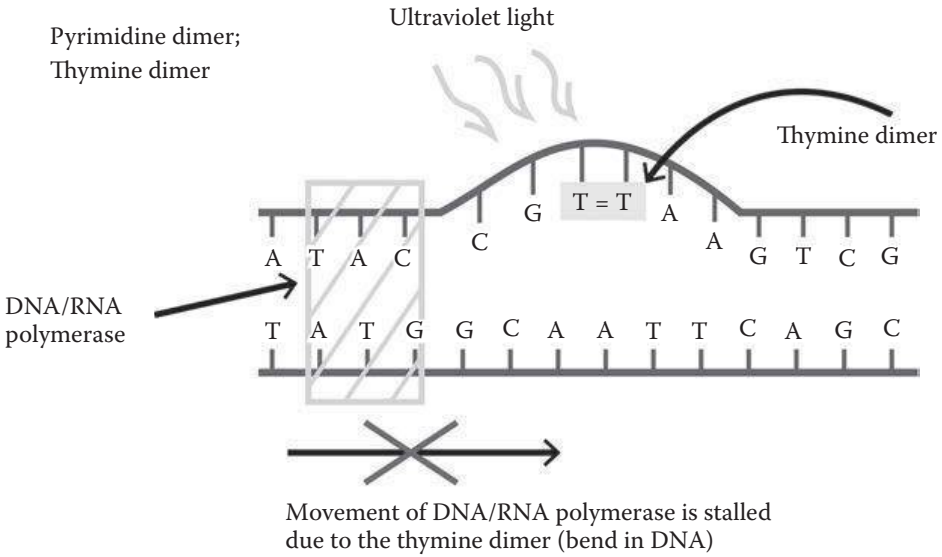
PHOTOCATALIC OXIDATION



FILTRATION COV et DOUBLE ACTION GERMICIDE (ROS +UVC)

UVC


1.0
0.8
0.6
0.4
0.2
0.0
Relative germicidal efficiency
220
240
260
280
300
320
Wavelengths (nanometers)
IESNA
DIN


Pyrimidine dimer;
Thymine dimer
Ultraviolet light
Thymine dimer
DNA/RNA
polymerase
A T A C
C G T = T A A G T C G
T A T G G C A A T T C A G C
Movement of DNA/RNA polymerase is stalled
due to the thymine dimer (bend in DNA)

Filtration HEPA

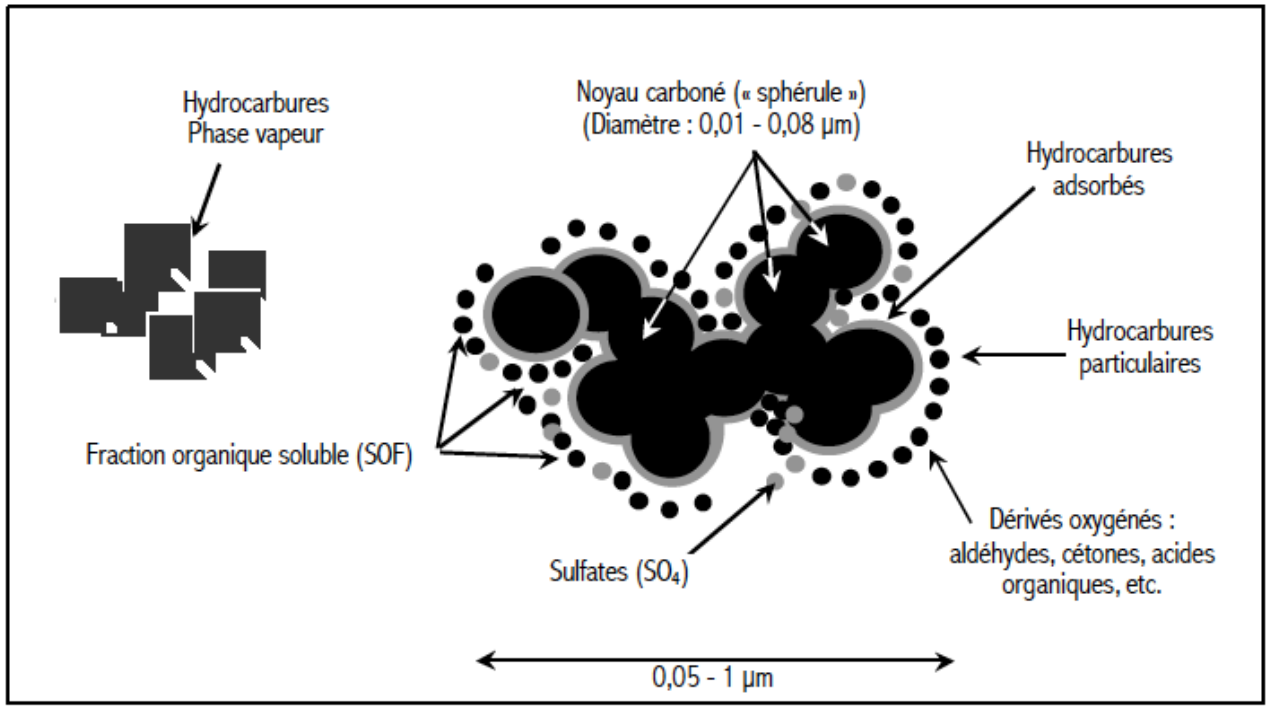
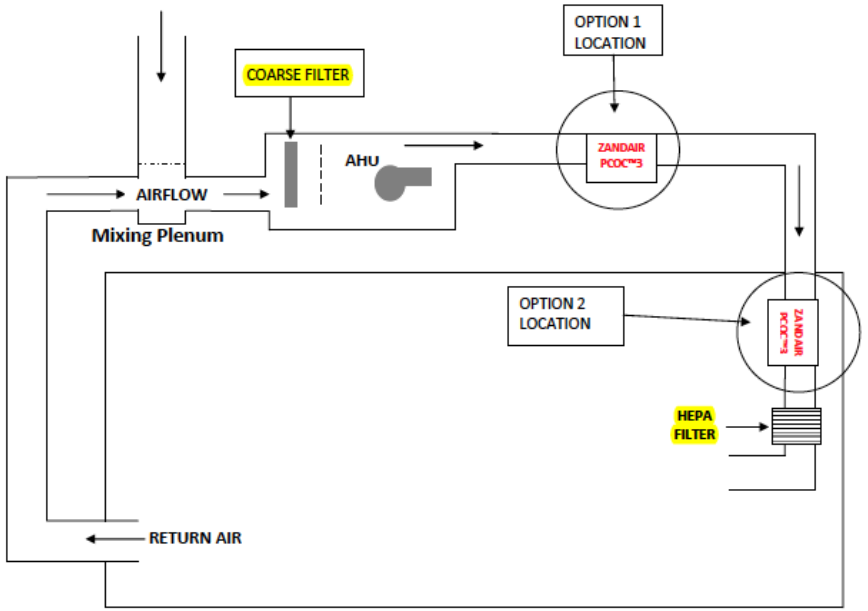
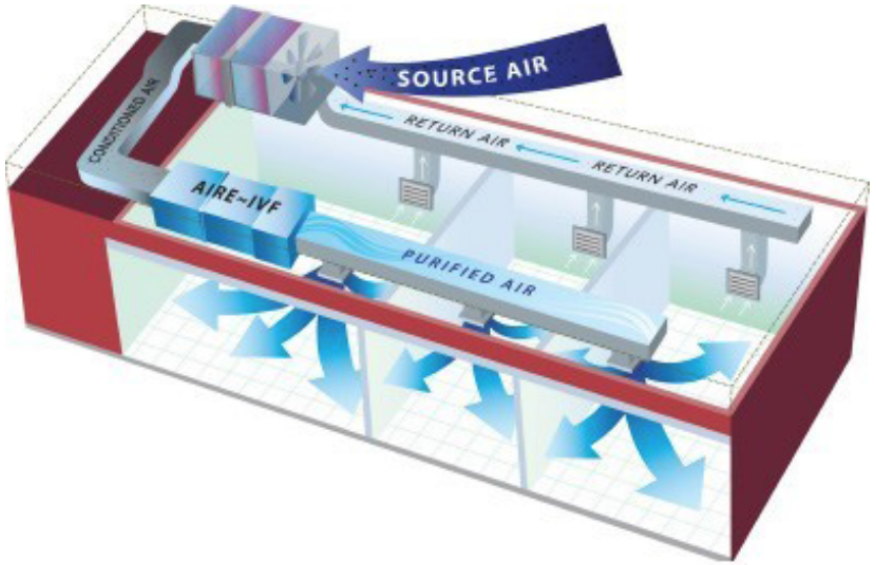


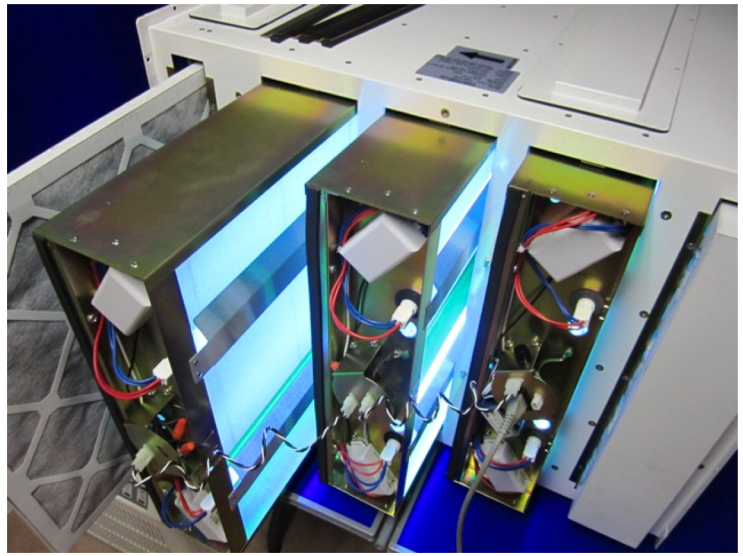
Figure 1 : Schéma des particules diesel

Adaptée de HEALTH EFFECTS INSTITUTE (HEI), 1995 *in* SOCIETE FRANÇAISE DE SANTE PUBLIQUE, 1996, p. 64.

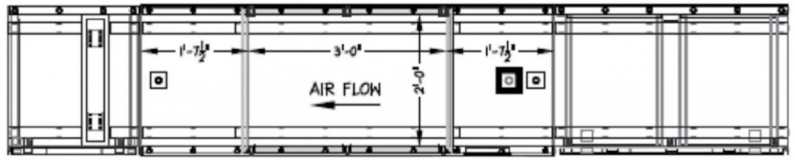
FILTRATION CENTRALISEE







Aire~IVF® 1000



FILTRATION MOBILE

Sources de pollutions dans le laboratoire

Which regulation and label is more ambitious?

- Lowest limit values:
  - EMICODE EC1 and EC1^{PLUS}, GUT, Natureplus, EU ecolabel, Indoor Air Comfort GOLD
- Medium range:
  - AFSSET, M1, some Blue Angel criteria, Austrian ecolabel, Danish label, Greenguard
- Less strict limit values:
  - AgBB, CDPH, FloorScore, BIFMA, Indoor Advantage, Indoor Air Comfort

Avant de commencer l'activité

'Burn-in'

A newly constructed or renovated laboratory should be given adequate time for off-gassing of construction materials. The period required for this will depend upon the location and materials used and might require several weeks; a minimum of 2–3 weeks should be allowed for this in the construction schedule. Verification should be established by specific VOC testing to provide comparison with a baseline. Bioassays such as human sperm survival test are not sufficient for this purpose.

'Deep clean'

A newly constructed or renovated laboratory must be subjected to an intensive cleaning before being validated for clinical use. Every surface, including all hard-to-reach corners, inside cupboards and drawers, and all equipment, is cleaned with products capable of removing all expected contaminants, and then cleaned again to ensure no trace of the cleaning agents remains.

CONSENSUS

THE IMPACT OF "BURNING IN" OF INCUBATORS BEFORE INITIATING ASSISTED REPRODUCTIVE CYCLES - A COMPARATIVE STUDY.

S. Singh,[a] P. Chakraborty,[b] S. K. Goswami,[a] R. Chattopadhyay,[a] B. Chakravarty.[a] [a]Assisted Reproduction, Institute of Reproductive Medicine, Kolkata, India; [b]Infertility, Institute of Reproductive Medicine, Kolkata, India.

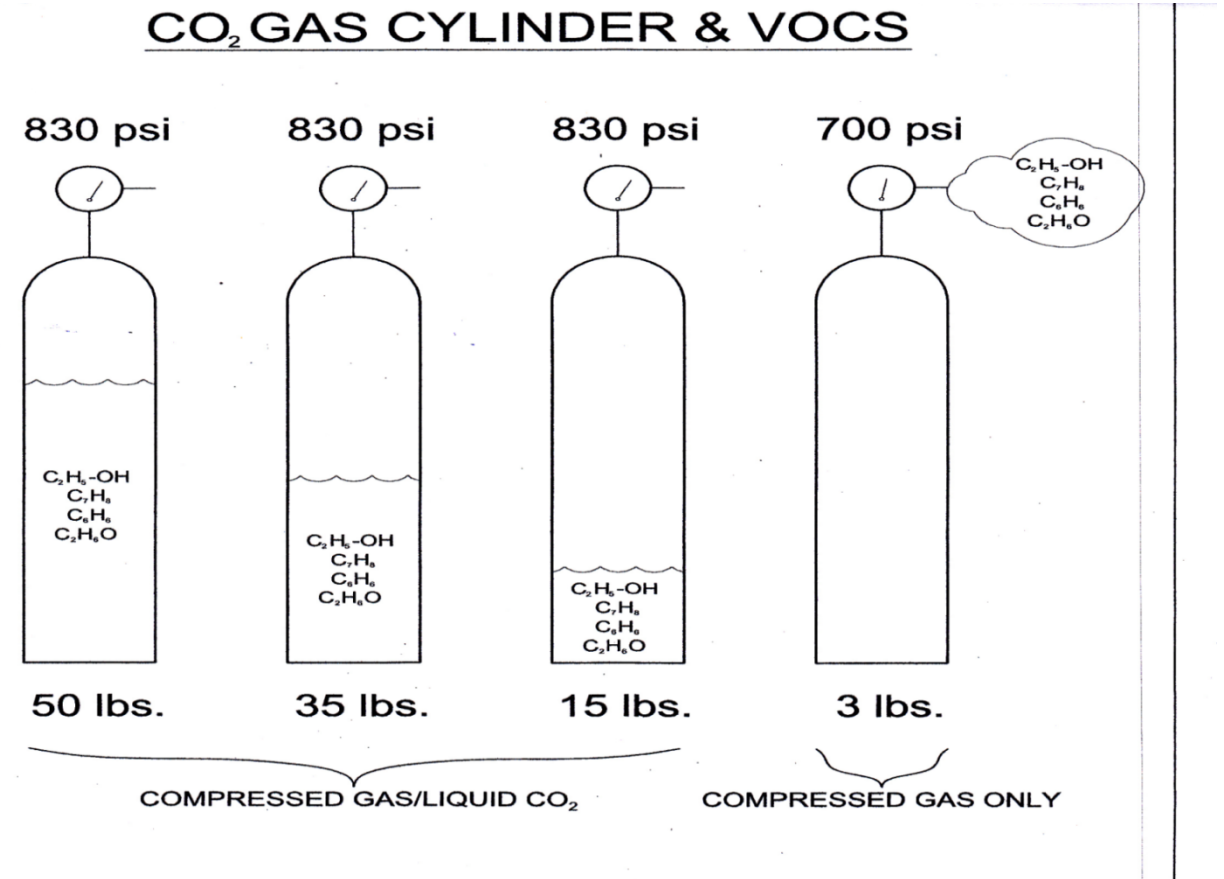
INCUBATEUR A « no burn-in » INCUBATEUR B « burn-in » 10 jours

	Incubateur A	Incubateur B	
% fécondation	69	72,06	NS
% clivage	66,47	94,63	p<0,01
% Fragmentation	71,04	18,06	p<0,001
% blastulation	22,09	61,77	p<0,01
% grossesse clinique	22,83	30,06	p<0,05

Etude observationnelle, prospective
600 cycles sur une période de 5 mois
1500 ovocytes/ incubateur

ASRM 2015

AEI11210-2-12 CO_2 May 2013 Pressure <828 psig		
CAS#	**Materials**	**µg/m^3**
75-07-0	Acetaldehyde	280.0
590-86-3	Isovaleraldehyde	60.0
100-52-7	Benzaldehyde	0.5
50-00-0	Formaldehyde	0.4
	Total Aldehydes in CO_2 supply	**340.9**



Gilligan

Table V. Compounds released from cell tissue culture grade petri dishes

Material	>50 ng/sample	⩽50 ng/sample	
Styrene	920.00	*n*-Pentane	50
Toluene	180.00	3-Methylpentane	50
Acetone	150.00	Nonanal	50
2-Butanone	130.00	Butanal	40
Acetaldehyde	100	3-Pentanone	40
n-Butane	100	n-Hexane	30
Benzaldehyde	100	Butene isomer	30
Hexanal	70	Benzene	23
Ethylbenzene	64.00	*n*-Octane	20
2-Hexanone	58.00	*n*-Nonane	20
		Decanal	20
		Cumene	10
		Propylbenzene	10
		Octanal	10
		m- & *p*-Xylenes	7.5
		o-Xylene	5.80

Cohen et al. 1997

Table 1. Fully loaded Miri with different Labels (ppb)

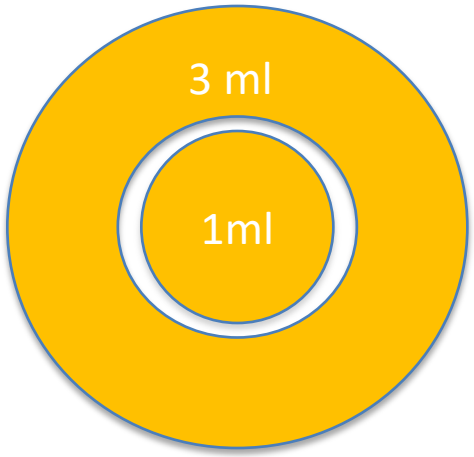
Sharpie extrafine point permanent markers	65
Sharpie fine point permanent markers	142
Wax pencil	58
Brady labXpert label	46
Brady harsh Environment labels	67

Yang et al. 2016

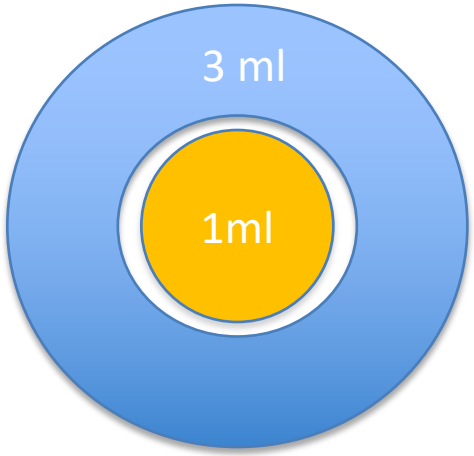
EFFET SIPHON
Un biais affectant les résultats des études de toxicité

Contaminants hydrosolubles (formaldéhyde)

EXP1



~~BLASTO~~



BLASTO

EXP2

BLASTO

~~BLASTO~~

HTF

EC1 (embryotoxique)

Miller et Fry, 2000

Contaminants lipophyles (ex: styrene, BTEX)

Table II. Development of One-Cell Mouse Embryos Cultured in Control or Adulterated Medium With or Without Oil Overlay and With or Without BSA Supplementation (Mean ± SD)*

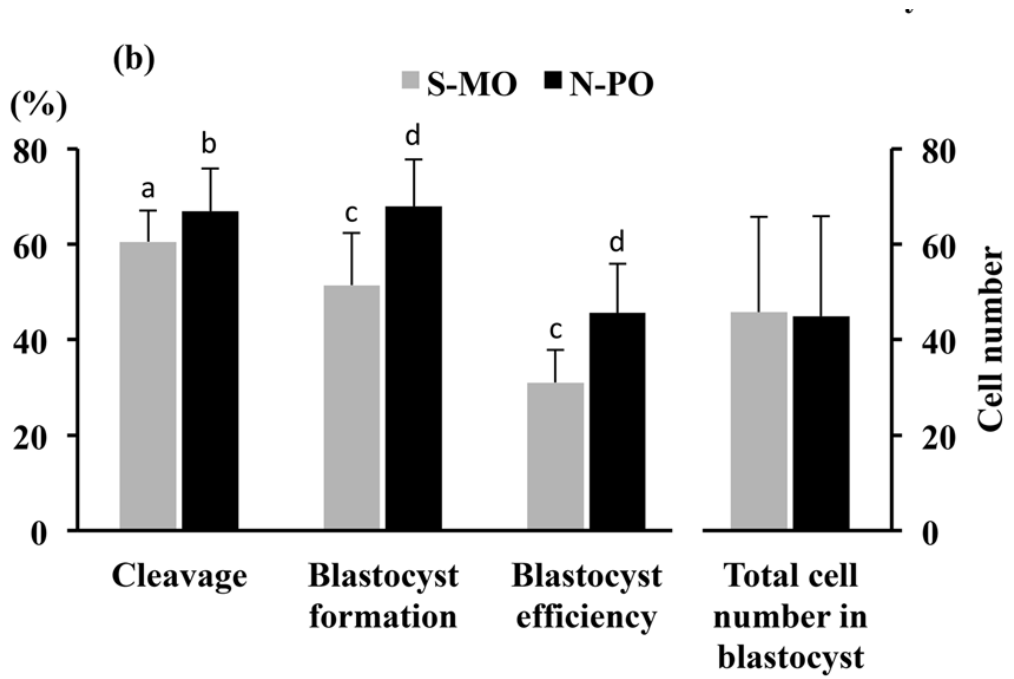
Medium	Oil overlay	BSA (%)	*n*	% blastocyst (96 hr)
Control	–	0	3	$31^{d} \pm 15$
Control	–	0.5	4	$83^{ab} \pm 7$
Control	+	0	8	$62^{bc} \pm 24$
Control	+	0.5	9	$90^{a} \pm 10$
Adulterated	–	0	3	0^{e}
Adulterated	–	0.5	4	0^{e}
Adulterated	+	0	8	$44^{cd} \pm 15$
Adulterated	+	0.5	9	$75^{ab} \pm 18$

* Means with different superscripts a–e are different ($P < 0.05$).

Bupivacaïne

Miller, Goldberg et Collins, 1994

Partition huile-milieux à J5



Compounds (mg/kg)	Sigma mineral oil	Nidoil paraffin oil	Fresh medium (non incubated)	Medium incubated under Sigma mineral oil	Medium incubated under Nidoil paraffin oil
Heptane	0.4 ± 0.01	6.2 ± 0.7	trace	trace	trace
Pentanal	0.3 ± 0.7	n.d.	n.d.	0.2 ± 0.1	n.d.
4-ethyl heptane	0.1 ± 0.01	n.d.	n.d.	n.d.	n.d.
4-methyl decane	0.05 ± 0.01	0.5 ± 0.02	n.d.	n.d.	n.d.
2-methyl decane	0.2 ± 0.02	n.d.	n.d.	n.d.	n.d.
3-methyl decane	0.1 ± 0.01	n.d.	n.d.	n.d.	n.d.
1,3-diethyl benzene	0.1 ± 0.1	n.d.	n.d.	0.1 ± 0.1	n.d.
4-methyl heptane	n.d.	3.9 ± 0.9	n.d.	n.d.	n.d.
Octane	n.d.	6.0 ± 0.2	n.d.	n.d.	1.8 ± 0.01
2-methyl octane	n.d.	3.2 ± 0.3	n.d.	n.d.	n.d.
3-methyl nonane	n.d.	0.4 ± 0.01	n.d.	n.d.	n.d.
Decane	n.d.	2.3 ± 0.1	n.d.	n.d.	0.7 ± 0.01
Dodecane	n.d.	1.4 ± 0.1	n.d.	n.d.	0.5 ± 0.01
Tetradecane	n.d.	3.3 ± 0.1	trace	n.d.	1.2 ± 0.03
Pentadecane	n.d.	0.6 ± 0.1	n.d.	n.d.	0.3 ± 0.1
Hexadecane	trace	4.2 ± 0.1	n.d.	n.d.	1.4 ± 0.05
Heptadecane	n.d.	0.9 ± 0.1	n.d.	n.d.	0.4 ± 0.03
Octadecane	n.d.	0.4 ± 0.3	trace	trace	0.2 ± 0.03

Pentanal log Kow = 1.31

1,3 DiethylBenzene log Kow= 4,44

Martinez et al, 2017

VOCs, Protéines, Huile

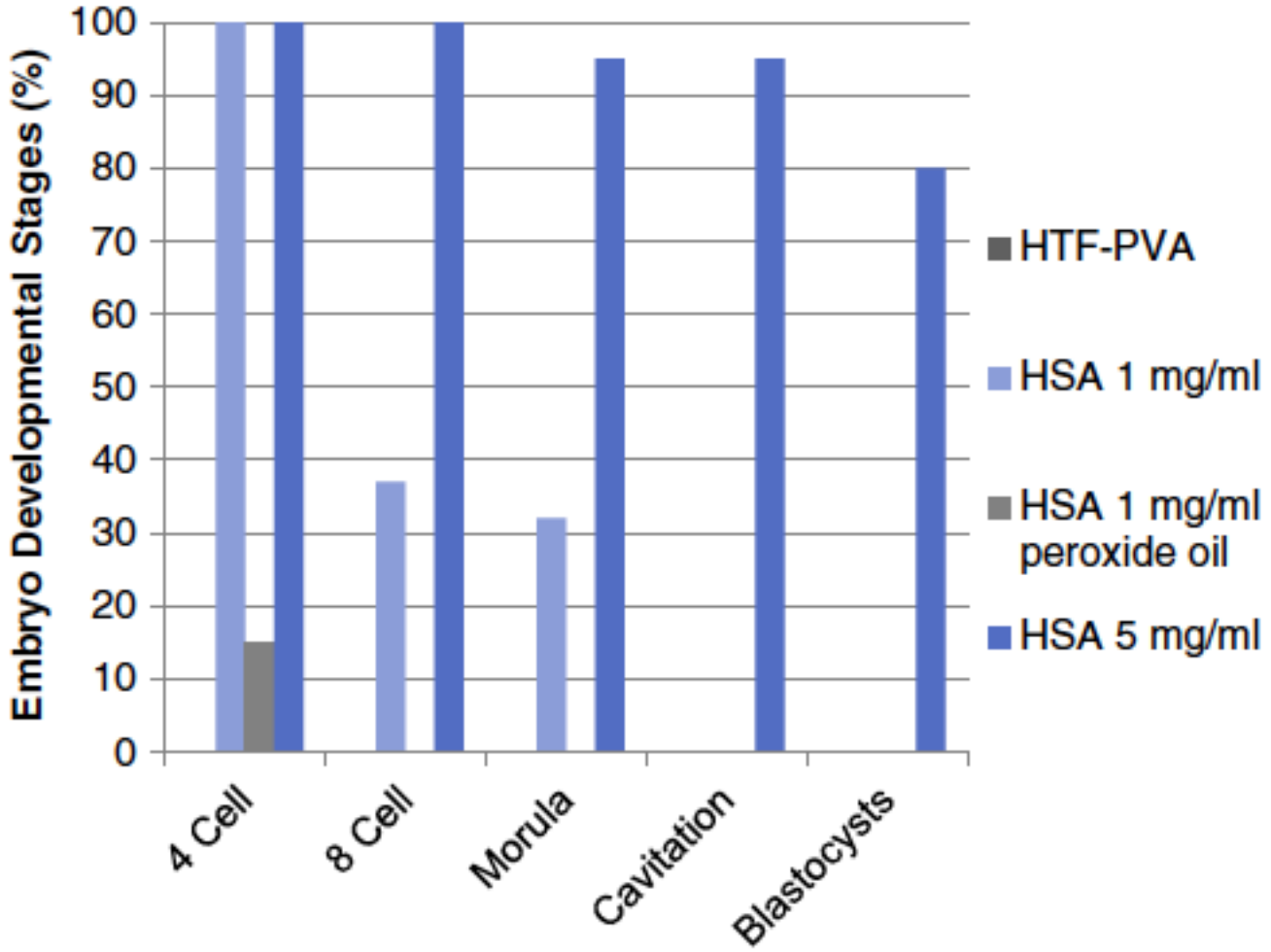


Fig. 2 Effect of acrolein in air (0.5 ppm for 24 h at the zygote stage) on mouse embryo development. HTF-PVA control is protein-free medium. *HSA* human serum albumin. Peroxide oil passed a standard one-cell mouse embryo assay [36]

Morbeck 2015

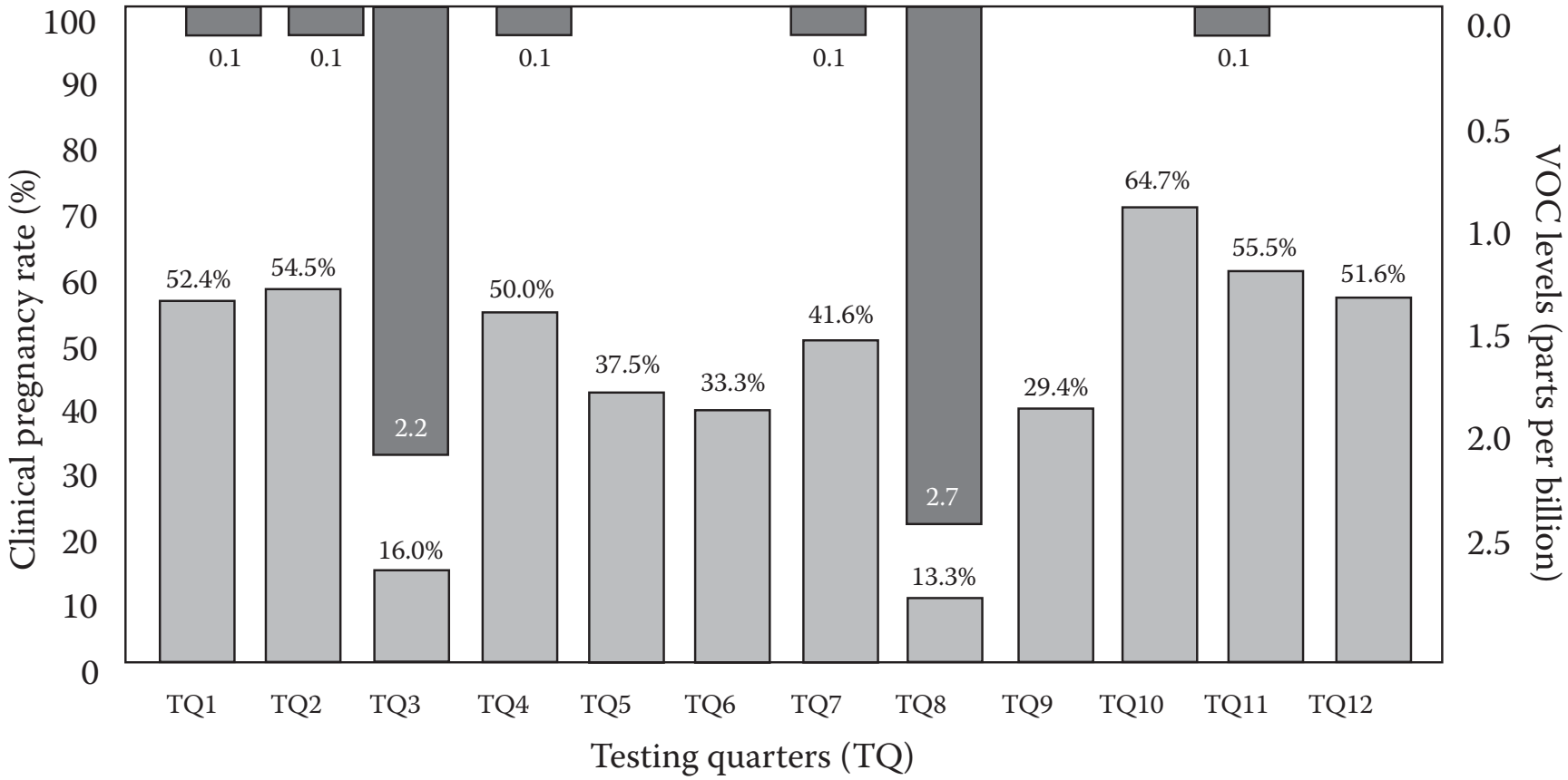
Espèces à risques et leur coefficient de partage *(partition coefficient)*

Compound	**Correlation (*Alpha)***	**HSDB and/or NIOSH[1]**	**Solubility K(O/W)[2]**
Formaldehyde	Yes	Carcinogenic Mutagenic	0.35
Acetaldehyde	Yes	Carcinogenic Mutagenic	0.45
Propionaldehyde	Yes	Carcinogenic Mutagenic	-0.24
Butyraldehyde	Yes	Carcinogenic Mutagenic	0.88
Benzaldehyde	Yes	Carcinogenic Mutagenic	1.48
n-Hexaldehyde	Yes	Carcinogenic Mutagenic	1.78
Acetonitrile	Yes (1 Lab high >700 µg/m3)	Possible source for slow CN^- release	-0.34
Acrolien	Yes (via TO-15) First case '96	Carcinogenic Mutagenic	-0.01

BTEX >2

Styrene >3

Pentanal: 1,31



Worrilow K, Clean Room Technologies in ART clinics, 2016

Modelling the Equilibrium Partitioning of Low Level Airborne Volatile Organic Compounds (VOCs) in Human *In Vitro* Fertilization (IVF) Laboratories

John T. Fox[a], Pan Ni[a], Alicia R. Urrutia[b], Huey T. Huynh[b], Kathryn C. Worrilow[b]

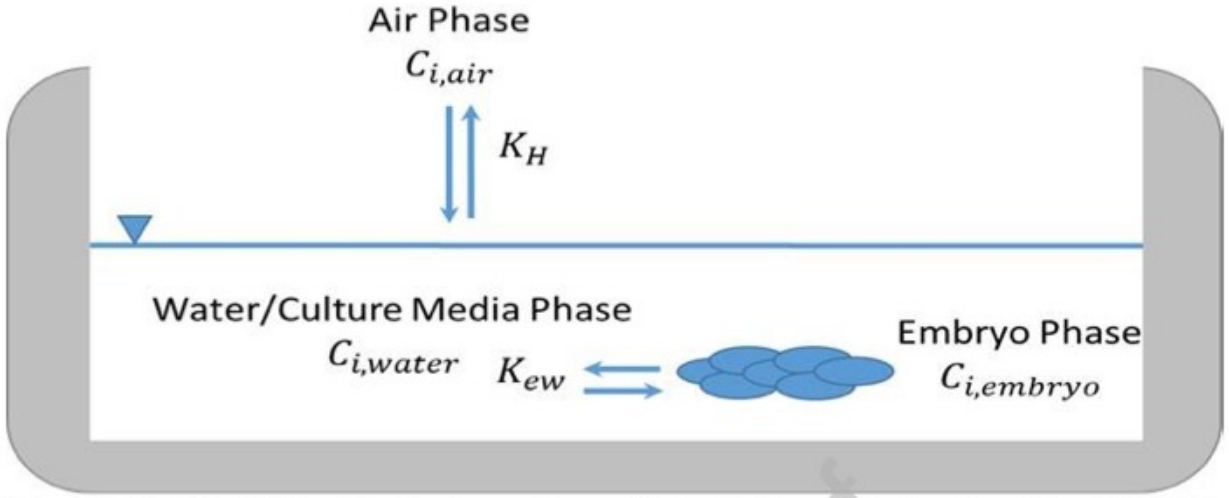
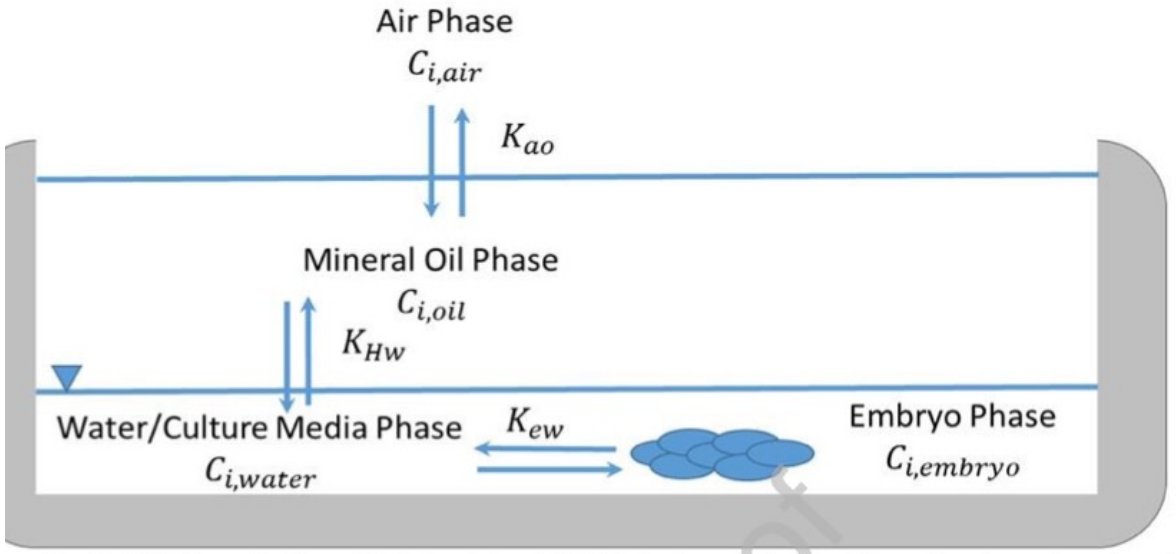


Figure 1. Air-Water/Culture Model, when culture media is mixed or exposed to air, ppb level VOCs in the air phase will partition into the water/culture media phase, governed by Henry's Law (K_H) and organic compounds now in the water/culture media phase are defined as the concentration, C_i where "i" is chemical in the culture media.



ıre 2. Air-Oil-Water-Embryo Model, ppb level VOCs in the air phase will partition into the mineral phase, governed by air-oil partitioning coefficient (K_{ao}). The organic compounds now in the mineral phase can now partition into the water/culture media phase, governed by hexdecane-water partitioning fficient (K_{Hw}). The VOCs in the water/culture media phase will partition onto/into the embryo erned by the water-embryo partitioning coefficient (K_{we}). Ci is concentration of "i" chemical in the specific phase.

VOCs à risque: Ethanol, Isopropanol, Aldéhydes, phenols, toluene…

Limites d’exposition et normes à respecter?

CHIMIQUE: (ISO-14644-8)

-TVOC < 100ppb <200ppb 0ppb ???

>0,5ppm = augmentation FCS très probable, dvpmt pré-implantatoire normal

>1ppm= altération développement embryonnaire (toxicité « visible »)

- ATTENTION AUX APPAREILS DE MESURE ET A LEUR SENSIBILITE DE DETECTION (PID=SURVEILLANCE)

- NE RENSEIGNE PAS SUR LE TYPE DE CONTAMINATION (GCMS ou HPLC)

- NE RENSEIGNE PAS SUR LES ALDEHYDES DE FAIBLE PM (non détectés)

NORME INTERNATIONALE

ISO 14644-8

Deuxième édition
2013-02-15

Salles propres et environnements maîtrisés apparentés —

Partie 8: Classification de la propreté chimique de l'air

Cleanrooms and associated controlled environments —

Part 8: Classification of air cleanliness by chemical concentration (ACC)

Tableau 1 — Classes ISO-ACC

Classe ISO-ACC	Concentration g/m³	Concentration µg/m³	Concentration ng/m³
0	10^{0}	10^{6} (1 000 000)	10^{9} (1 000 000 000)
–1	10^{-1}	10^{5} (100 000)	10^{8} (100 000 000)
–2	10^{-2}	10^{4} (10 000)	10^{7} (10 000 000)
–3	10^{-3}	10^{3} (1 000)	10^{6} (1 000 000)
–4	10^{-4}	10^{2} (100)	10^{5} (100 000)
–5	10^{-5}	10^{1} (10)	10^{4} (10 000)
–6	10^{-6}	10^{0} (1)	10^{3} (1 000)
–7	10^{-7}	10^{-1} (0,1)	10^{2} (100)
–8	10^{-8}	10^{-2} (0,01)	10^{1} (10)
–9	10^{-9}	10^{-3} (0,001)	10^{0} (1)
–10	10^{-10}	10^{-4} (0,000 1)	10^{-1} (0,1)
–11	10^{-11}	10^{-5} (0,000 01)	10^{-2} (0,01)
–12	10^{-12}	10^{-6} (0,000 001)	10^{-3} (0,001)

CHIMIQUE: (ISO-14644-8)

Toluene < 2,2 ppb (9µg/m3) (Worrilow, Huynh et al. 2001)
ISO-ACC -5 ou-6 (Toluène)?

Benzène <2ppb (7µg/m3) (Vàzquez et al. 2016)
ISO-ACC -5 ou -6 (Benzène)?

Acroléine <500 ppb
ISO-ACC -4 (Acroléine)?

Formaldéhyde <10µg/m3 (Khoudja, 2013)
ISO-ACC-5 ou -6 (Formaldéhyde)

Méthodes d’analyse et de prélèvement

TECHNIQUES DE DOSAGE: HPLC-GC/MS
Méthodes de prélèvements

Piégés sur des supports solides :

- **Prélèvement actif :** il est réalisé par aspiration à l'aide d'une pompe.
  Durée du prélèvement : 15 minutes à 8 heures.
- **Prélèvement passif :** il est réalisé sur des tubes passifs posés ou suspendus à l'endroit du prélèvement (par exemple sur un opérateur).
  Durée du prélèvement : 8 heures à 14 jours.

Prélevés en canister :

Le canister est un récipient de plusieurs litres en inox inerté mis sous dépression. Sa mise en œuvre s'effectue par simple ouverture du robinet. Ce type de prélèvement est intéressant car il peut être réalisé par n'importe quel opérateur directement sur site. Durée du prélèvement : 1 à 8 heures.

INERIS

Prélèvements Actifs

6h de prélèvement

24h de prélèvement

EPA TO11a et TO15a

Prélèvements Passifs

1 Kit Radiello® 165 :

- Cartouche Radiello® 165 dans son porte-tube de protection
- Corps diffusif bleu
- Etiquette d'identification
- Un support triangulaire
- Une pince de fixation
- Un porte-étiquette

1 Kit Radiello® 145 :

- Cartouche Radiello® 145 dans son porte-tube de protection
- Corps diffusif jaune
- Un support triangulaire
- Une pince de fixation
- Un porte-étiquette

1 Kit Radiello® 165 :

- Cartouche Radiello® 165 dans son porte-tube de protection
- Corps diffusif bleu
- Un support triangulaire
- Une pince de fixation
- Un porte-étiquette

1 Kit Radiello® 145 :

- Cartouche Radiello® 145 dans son porte-tube de protection étiqueté
- Corps diffusif jaune
- Un support triangulaire
- Une pince de fixation
- Un porte-étiquette

7 jours d'exposition pour atteindre les seuils de dosage équivalent à la méthode active

norme Européenne EN13528 2002 « Ambient Air Quality – Diffusive samplers for the determination of gases and vapours – requierements and test methods »

TECHNIQUES DE DOSAGE: GC/MS
Méthodes de Dosage: EPA TO15 (COV totaux)

Injection directe :

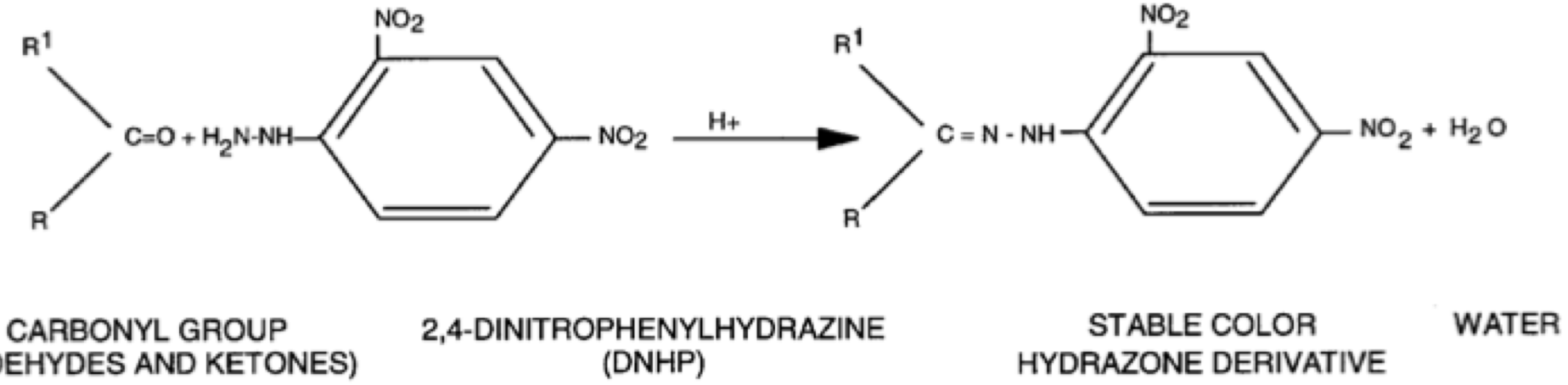
Une partie aliquote du contenu des canisters est prélevée par un système de pompe puis concentrée sur un tube afin de transférer les composés piégés sur les colonnes de chromatographie.
La quantification est effectuée à l'aide d'étalons gazeux.

Canisters

Système chromatographique avec canister

Seuil de détection inférieur au microg/m3

TECHNIQUES DE DOSAGE: HPLC
Méthodes de Dosage: EPA TO11a (Aldéhydes et cétones)



Détermination présence et concentration de chaque précipité spécifique par temps de rétention et hauteur du pic en HPLC

Seuil de détection inférieur au microg/m3

Mesure en fin de vie du filtre (4-6 mois)

Volatile Organics via US EPA TO-15

AEI18002-1 Lab Medbio Saran France 2/23/2018			**Hi tech**	**Std. Dev.**
CAS#/*RT*	**Compound**	**µg/m³**	**µg/m³**	
64-17-5	Ethanol	87.0	101.2	156.4
7.17	***2-Methylbutane***	***12.0***	0.9	5.8
108-88-3	Toluene	11.0	5.8	12
67-64-1	Acetone	9.2	35.7	46.5
5.02	***Isobutane***	***7.7***	8.3	30.5
75-05-8	Acetonitrile	5.3	7.1	12.7
17.15	***Hexamethylcyclotrisiloxane***	***5.0***	7.3	19.2
9.48	***unknown***	***4.2***		
5.53	***n-Butane***	***3.0***	3.6	4.7
115-07-1	Propene	2.6	10.8	22.8
75-71-8	Dichlorodifluoromethane (CFC 12)	2.3	2.2	1.2
75-69-4	Trichlorofluoromethane (CFC 11)	2.0	1	0.7
141-78-6	Ethyl Acetate	1.9	4.7	8.8
110-54-3	n-Hexane	1.7	1.6	6
142-82-5	n-Heptane	1.3	0.1	0.5
75-09-2	Methylene Chloride	0.8	0.9	3.9
71-43-2	Benzene	0.8	0.5	1.9
	Total VOC IVF Lab	**157.8**	**191.7**	

Mesure en fin de vie du filtre (4-6 mois)

Aldehydes via US EPA TO-11a:

AEI18002-10 IVF Lab Lab Medbio Dr. Pollet-Villard			Hi-tech	Std. Dev.
CAS#	**Compound**	**µg/m³**	**µg/m³**	
50-00-0	Formaldehyde	2.6	2.5	2.7
75-07-0	Acetaldehyde	2.6	2.1	2.4
66-25-1	n-Hexaldehyde	0.47	0.1	0.2
123-72-8	Butyraldehyde	0.26	0.2	0.2
	Total Aldehydes	**5.9**	**4.9**	

Table 6 – Measured aldehyde levels in modern IVF laboratories built using cleanroom concepts (data from Alpha Environmental Inc., Emerson, NJ, USA).

Compound	Mean µg/m^3	SD	95% upper confidence limit µg/m^3
Formaldehyde	2.8	3.2	9.3
Acetaldehyde	1.8	1.9	5.7
Propionaldehyde	0.6	0.7	2.0
Crotonaldehyde, Total	0.0	0.0	0.1
Butyraldehyde	0.1	0.2	0.5
Benzaldehyde	0.1	0.1	0.4
Isovaleraldehyde	0.0	0.0	0.0
Valeraldehyde	0.1	0.1	0.3
o-Tolualdehyde	0.0	0.0	0.0
m,p-Tolualdehyde	0.0	0.0	0.0
n-Hexaldehyde	0.2	0.2	0.7
2,5-Dimethylbenzaldehyde	0.0	0.0	0.1
Total aldehydes	5.8		

« Nouveaux » polluants

N02, SO2, O3, (PM)

Human Reproduction, Vol.34, No.3 pp. 441–451, 2019
Advanced Access publication on January 23, 2019 doi:10.1093/humrep/dey386

human reproduction ORIGINAL ARTICLE *Embryology*

Association between outdoor air pollution during *in vitro* culture and the outcomes of frozen–thawed embryo transfer

Xinli Wang[1], Jiali Cai[2,3,*], Lanlan Liu[2,3], Xiaoming Jiang[2], Ping Li[2], Aiguo Sha[2], and Jianzhi Ren[2]

Table IV Association between embryo parameters and quartiles of SO_2 and O_3.

	Q1 (2.97–9.27)	Q2 (9.28–13.50)	SO_2, μg/m³ Q3 (13.51–18.66)	Q4 (18.67–45.74)	*P* for trend
[a]Non-synchronized cleaving on Day 3 ($n = 79\,110$)	Ref	1.12 (1.06–1.18)	1.11 (1.05–1.17)	1.1 (1.02–1.19)	0.001
On-time eight-cell embryo on Day 3 ($n = 79\,110$)	Ref	0.92 (0.87–0.97)	0.94 (0.89–1)	0.92 (0.85–0.99)	0.01
[b]Fast-cleaving embryo on Day 3 ($n = 79\,110$)	Ref	1.11 (1.03–1.19)	1.12 (1.04–1.22)	1.24 (1.11–1.38)	0.001
[c]Slow-cleaving embryo on Day 3 ($n = 79\,110$)	Ref	1.02 (0.96–1.08)	0.98 (0.92–1.05)	0.94 (0.86–1.03)	0.383
Compact on Day 3 ($n = 79\,110$)	Ref	1.1 (0.95–1.26)	1.29 (1.11–1.51)	1.34 (1.09–1.66)	0.008
Fragmentation>20% ($n = 79\,110$)	Ref	1.08 (0.94–1.23)	1.87 (1.59–2.2)	2.73(2.28–3.28)	<0.001
Delayed blastocyst ($n = 27\,422$)	Ref	0.89 (0.82–0.98)	1.17 (1.07–1.27)	1.31 (1.20–1.43)	<0.001
	Q1 (26.88–66.12)	**Q2 (66.13–85.43)**	**O_3, μg/m³ Q3 (85.44–104.18)**	**Q4 (104.19–169.43)**	***P* for trend**
[a]Non-synchronized cleaving on Day 3 ($n = 79\,110$)	Ref	1.03 (0.98–1.09)	1.05 (1.00–1.11)	1.07 (1.00–1.14)	0.211
On-time eight-cell embryo on Day 3 ($n = 79\,110$)	Ref	1.01 (0.96–1.06)	1.03 (0.98–1.09)	1.09 (1.02–1.16)	0.067
[b]Fast-cleaving embryo on Day 3 ($n = 79\,110$)	Ref	1.04 (0.97–1.12)	1.12 (1.04–1.22)	1.13 (1.03–1.24)	0.016
[c]Slow-cleaving embryo on Day 3 ($n = 79\,110$)	Ref	0.97 (0.91–1.02)	0.90 (0.84–0.96)	0.85 (0.79–0.92)	<0.001
Compact on Day 3 ($n = 79\,110$)	Ref	1.17 (1.02–1.35)	1.1 (0.95–1.28)	1.12 (0.94–1.32)	0.191
Fragmentation >20% ($n = 79\,110$)	Ref	1.31 (1.14–1.51)	1.82 (1.56–2.13)	3.03(2.54–3.61)	<0.001
Delayed blastocyst ($n = 27\,422$)	Ref	1.04 (0.95–1.14)	1.16 (1.06–1.26)	1.34 (1.23–1.46)	<0.001

[a]Non-synchronized cleaving embryo was defined as embryo with even cell number at the time of observation.
[b]Fast-cleaving embryo was defined as embryo with more than eight cells at the time of observation.
[c]Slow-cleaving embryo was defined as embryo with less than eight cells at the time of observation.

Cohorte rétrospective, 11000 patients, 16000 transferts…
HEPA centralisé,
Tour CODA

Pas de filtration
intra ou extra-incubateur

Mais SO2 et Ozone Hydrophiles…

Effet indirect?:
Patients en périconceptionnel?
Dérivés secondaires?

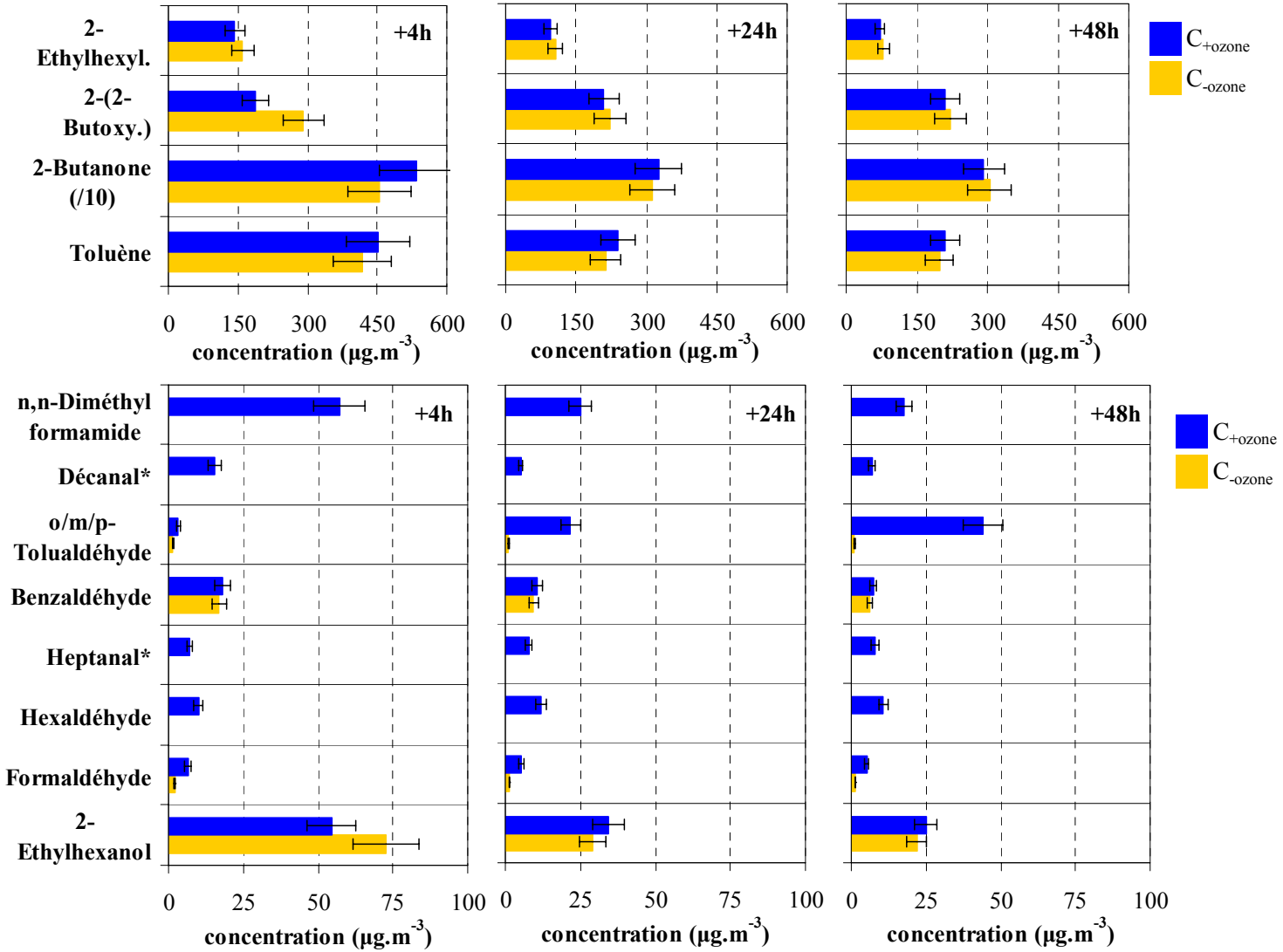


Figure III-19 : Emissions du sol PVC (*aldéhydes identifiés en GC/MS)

Critères d’alerte dans le laboratoire?

Human Reproduction, Vol.34, No.1 pp. 37–43, 2019
Advanced Access publication on December 4, 2018 doi:10.1093/humrep/dey349

human reproduction

ORIGINAL ARTICLE *Embryology*

Tracking quality: can embryology key performance indicators be used to identify clinically relevant shifts in pregnancy rate?

Elizabeth R. Hammond[1] and Dean E. Morbeck[1,2,*]

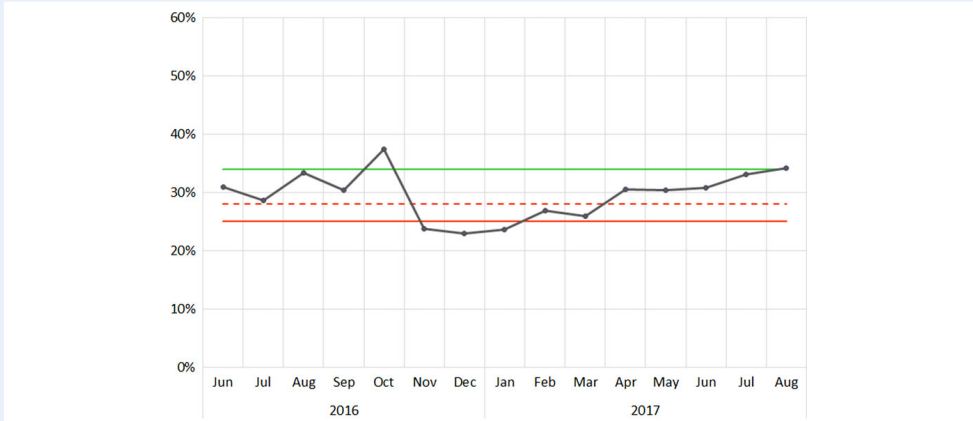


Figure 1 Shewhart control chart of monthly D5BUR from June 2016 to August 2017, expressed as the number of blastocysts transferred or frozen on Day 5/number of fertilised (2 pronucleate [PN]) oocytes. The control mean (green line) is 34%. The mean (± standard deviation) D5BUR from June 2016 to August 2017 was 30 ± 26%. The lower warning (red dashed line) and control (red line) limits were 28% (2-sigma) and 25% (3-sigma), respectively. The D5BUR decreased below the lower control limit (25%) and lower warning limit (28%) for a period of 5 months from November 2016 to March 2017 (25%). The D5BUR subsequently increased above the lower warning limit from April 2017.

RBM ONLINE

ELSEVIER

Review

The Vienna consensus: report of an expert meeting on the development of ART laboratory performance indicators

CrossMark

ESHRE Special Interest Group of Embryology and Alpha Scientists in Reproductive Medicine [a,b,*]

	Min	Bench
Taux de blastulation	>40%	>60%
Taux de blastocystes utilisables	>30%	>40%
Taux d'implantation (blasto)	>35%	>60%

Vers une définition TLI: tSB, tB, dB? Marqueurs précoces? IA?

Conclusions

Bien connaître et **choisir son système de culture**

Adapter ses procédures (dégazage des boîtes, utilisation+++ d'huile de culture)

Connaître son environnement, si possible en période « dégradée »
(au moins une analyse de qualité de l'air portant sur les COVT et Aldéhydes)

Adapter la protection (filtres, surpression, renouvellement d'air, contrôle d'accès)

Surveiller: challenge+++, couts+++ >**indicateurs seuls?**

Information des patients sur le risque « environnement et fertilité » **en amont de la tentative**

Mais en pratique?

Aldéhydes

FH0W8 : **Formaldéhyde sur Radiello 165**			
Formaldéhyde	µg/tube	*	1.5 ±0.26
Formaldéhyde (concentration)	µg/m³		1.5

Composés Volatils

N80BE : **Screening COV - Identification jusqu'à 10 composés majoritaires exprimé en équivalent toluène**		voir annexe
FH0WE : **TVOC (équivalent toluène) sur Radiello 145**		
Somme des solvants analysés	ng/tube	11000
TVOC (équivalent toluène) (concentration)	µg/m³	38

Hydrocarbures aromatiques monocycliqu

FH0VA : **Benzène sur Radiello 145**			
Benzène	ng/tube	*	770 ±139
Benzène (concentration)	µg/m³		2.7
FH0VD : **Ethylbenzène sur Radiello 145**			
Ethylbenzène	ng/tube		D, <50
Ethylbenzène (concentration)	µg/m³		<0.19
FH0VJ : **o-Xylène sur Radiello 145**			
o-Xylène	ng/tube		D, <50
o-Xylène (concentration)	µg/m³		<0.2
FH0VL : **Styrène sur Radiello 145**			
Styrène	ng/tube		140

Hydrocarbures aromatiques monocycliq

FH0VL : **Styrène sur Radiello 145**		
Styrène (concentration)	µg/m³	0.52
FH0VN : **Toluène sur Radiello 145**		
Toluène	ng/tube	110
Toluène (concentration)	µg/m³	0.35
Incertitude	%	15
FH0XL : **m+p-Xylène sur Radiello 145**		
m+p-Xylène	ng/tube	D, <100
m+p-Xylène (concentration)	µg/m³	<0.37

D : détecté / ND : non détecté

z2 ou (2) : zone de contrôle des supports

Composé	CAS	Résultat en ng équivalent toluène	Résultat en µg/m^3
Sevoflurane	**1000308-79-8**	2938.3	-
Tetradecane	**629-59-4**	968.8	-
2-Heptene, 3-methyl-	**3404-75-9**	844.7	-
3-Heptene, 3-methyl-	**7300-03-0**	623.3	-
1-Decene	**872-05-9**	439.3	-
3-Hexene, 2,3-dimethyl-	**7145-23-5**	431.3	-
4-Dodecene	**2030-84-4**	201.5	-
Benzene, hexyl-	**1077-16-3**	173.9	-
2-Dodecene, (Z)-	**7206-26-0**	159.4	-
2-Propanol, 1,1,1,3,3,3-hexafluoro-	**920-66-1**	155.1	-

Table 2 Summary of the air quality parameters measured at the location

Analyte	Formula	Average Reading	WHO-AQGL (2021) (per 24hrs)	LOD (mg/m^3)
Particulate Matter	PM 2.5 PM 10	0.001 0.001	0.015 0.045	0.001
Volatile organic compounds	VOC	130	300	1
Non-methane Hydrocarbons	NMHC	47.8	0.004	0.1
Formaldehyde	CH2O	0.22	0.04	0.01

Valeurs rendues en ppm