



Bio aerosols testing facilities at CEB



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Gram +

Gram -

DNA Virus

RNA Virus

Toxin

Biosimulants

Bacillus globigii



single circular DNA (4100 genes)
 sporulated (protective endospore)
 aerobic organism
 rod-shaped bacteria (1,4µm - 1µm)
 = Bacillus Subtilis Var Niger = Bacillus atrophaeus
 other simulants = Bacillus thuringiensis (BT)

E.Coli



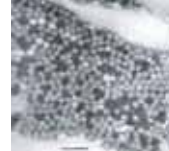
single circular DNA
 (4400 genes-sequenced in 1997)
 Gram negative bacterium
 rod-shaped bacteria (2µm - 0,5µm)
 aerobic or anaerobic respiration

CpGV



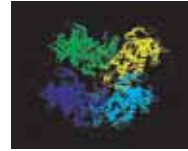
Cydia pomonella Granulovirus
 Caterpillar virus used as bioinsecticide
 Circular DNA (123500 Bp)
 Occlusion bodies called granules
 (length from 400 to 600nm)
 simulant for Poxvirus biothreat agents

MS2



3600 kDa RNA virus
 spheric (24 - 26 nm)
 3569 RNA Bp (sequenced in 1972)
 Good simulant for arenavirus (Ex : Junin)
 alphavirus (Ex : VEE) and flavivirus

Ovalbumin



44,3 kDa protein
 Isolated from chicken white egg (60,3%)
 Commercially available at different
 purification grade (2 and 7)
 Good simulant for toxins
 (30 to 150 kDa polypeptides)

Metrology

Culture (ACPLA)

Concentration



Biocollectors

Impactors (liquid, agar,...)
 filters, cyclones,
 Cascade impactors
 total number >100 systems

Granulometry



Granulometers

Aerodynamic diameter,
 optical diameter,
 Electrical mobility (SMPS)
 total number > 50 systems

Suspension

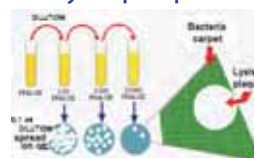
Cytometry, Fluorescence
 MEB/MET observation
 Chromatography
 total number >10 systems

DNA content



Filtration on membranes
 + extrac/purif + Real Time qPCR (LC480)
 Home made Kits (except RT-qPCR for MS2)
 Bg /E.Coli = 10 copies/ assay (5-25 µl)
 MS2 = 10³ copies/ assay (5-25 µl)
 CpGV = 10 copies/ assay (5-25 µl)

Lysis plaque



Direct Impaction
 on E.Coli culture
 or biocollect spreading
 very small LOD :
 => 1 pfu / L of air
 => 10³ pfu/mL

Protein content



LOD : ova = 0,1 ng/ml ;
 Bg & BT = 50-100 spores/ml ;
 E coli = 5e3-1e4 cfu/ml ;
 MS2 = 5e4-1e5 phages/ml ;
 CpGV = 5e4-1e5 granules/ml.

+ Mass spectrometry

Generators

<10 µm primary aerosol



Colison, MiniNeb, TSI,
 synaptex, VOAG,
 Atomisor DTF, etc...

=> Isolated organisms
 + Powder dispersion
 (Topas SAG, RGB 1000,...)

>10 µm primary aerosol



STAG, Mecanical /
 pneumatic atomisors ,
 Spinning-disk TSI, ...

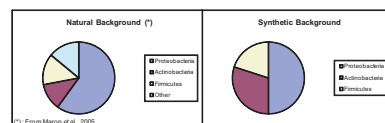
=> Aggregates
 => > 50 generators

Bio-Background

Natural Background Vs Synthetic Bio Background



Reproducible tool for biodegradation materials evaluation
 10 bacterial species mix
 Main airborne phyla represented
 (Proteobacteria, Firmicutes, Actinobacteria)



Physical and biological investigation (CEB and other french military fields)
 More than 5000 samples analysed between 2001 and 2009
 From 0 to 100 ACPLA (mean = 1,3 ACPLA, mean summer > 4 ACPLA)
 Intraday 2log variations
 Physical particle concentration >1000 x Biological particles (no correlation)

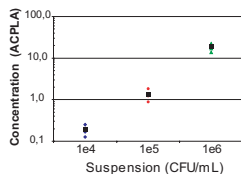
Bio-Dim Testing facilities

Wind Tunnels

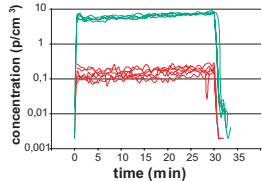


Systems outside from the tunnel (upper tunnel)
 or inside (large capacity tunnel on the left)
 # from 1 m/s to 10 m/s
 # filtered air or natural bio-background or synthetic
 bio-background
 # 3 wind tunnels dedicated to BSL1 simulant/ agent
 (400, 4000 and 40000 m³/h)
 # 1 mixed wind tunnel / chamber system
 under acquisition

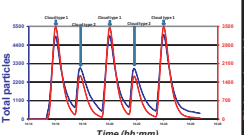
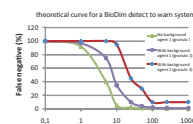
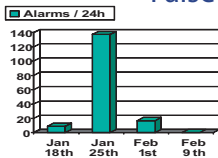
Sensibility



Response time



False Positive / Negative rates



false positive => long term studies
 => needs for synthetic background
 representative of long term exposition

Sensibility ? with or without background ?
 Function of the agent, the granulometry, etc... ?
 => need for sensibility vs false negative rates

False negative <<> Statistics
 => needs for automated and
 reproducible set up

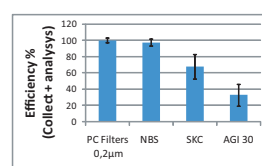
Biocollector Testing facilities

Chambers



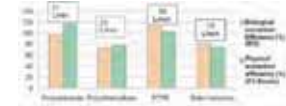
from 1m³ to 1400 m³ class 1 compatible chambers
 # filtered air or natural bio-background or synthetic
 bio-background
 # 1 hour stable bio-aerosols (BGs)
 # capability for vehicle or shelter testing
 # multiple system comparison (same aerosol)

Absolute yields



Relative biocollection rates possible
 Absolute => Polycarbonate (PC) Membranes
 filtration metrology under validation (BG = OK)

Filters extraction efficiency



Operational Testing Facilities

Outdoor testing Field



Stand off detection

