Odors & VOCs

Diagnosis and solutions

J.L.FANLO
École des mines d 'Alès
Laboratoire Génie de l 'Environnement Industriel
6, Avenue de Clavières
30319 ALES Cedex
Tel : 04 66 78 27 79
jean-louis.fanlo@mines-ales.fr
Staff and skills

**Staff**
- 6 researchers (4 HDR)
- 2 Technicians
- 1 Post-doctoral researcher

**Chemical / Sensorial analysis**

**Chemical engineering / Air treatment**

**Microbiology / Molecular biology**
Theme of thesis (1993-2013)

- Biological process: 15
- Physical process: 8
- Metrology: 8
- Impact evaluation—Odour/chemical relation: 5
Scientific position

**Scientific area**
- Air quality management: Odors and VOCs

**Research interests**
- Analytical methodologies (VOCs, odorous compounds and biological contaminants of the air)
- Odor impact assessment - “odor / chemistry” relationship
- Biological gas treatment - bioconversion of waste gases into valuable products

**Scopes**
- Industrial gaseous emissions
- Stuffy atmospheres (IAQ, industrial atmospheres)
Social pressure for improving the quality of environment

decrease of public acceptability concerning industrial activity

Sustainable industrial production: minimize the negative impacts
Context

Improvement of treatment system efficiency

Process / Industrial site

At-source action (process / site management)

Impact / Nuisance assessment

EMA / LGEI / Equipe Odeurs & COV
Actions

- **Improvement of treatment system performance**
  - Mechanisms understanding
  - Process combination
  - Customization of the process to fit the local settings

- **At source action - Process / Site management**
  - Diagnosis
  - Implementation of management tools

- **Impact assessment**
  - Nuisance: chemistry / odor / discomfort relationship
  - Health: microorganisms
Process efficiency improvement

- Microbial Resource Management (MRM) strategies for improving functional stability of biological processes (VEOLIA, EUROPE-ENVIRONNEMENT)

- Passive gas drainage and biofiltration system (greenhouse and odorous gases from lagoon effluents) (EHTP / ONEP Morocco)

- Biological conversion of VOCs to energy (VEOLIA / Univ. DUKE)
Institut Mines-Télécom

02/06/2015

EMA / LGEI / Équipe Odeurs & COV

Microbial Resource Management (MRM) strategies

Fundamental interest (understanding of biological mechanisms)

Practical interest (forecasting, diagnosis, monitoring)

Ecosystem function
(Removal efficiency)

Total, active and functional microbial communities
(abundance, diversity, structure)
Passive Biofiltration

Cleaned gaseous effluent

Biofilter (a few cm)

Lagoon (a few m)

Anaerobic sludge

Biofilm

Packing material

Gas-liquid transfer

Biodegradation

Gas flow with contaminants

CO₂, H₂O, by-products

Sulphide Oxidizing Bacteria

Methanotrophs

H₂S → H₂SO₄

CH₄ → CO₂, H₂O

Odor and CH₄ emissions control

Natural lagoon
Energy recovery vs treatment

Complex gaseous emissions

VOCs to energy

Treatment

Cleaned gas

Polluted gas (VOCs)

Absorption
(Water + organic phase)

Regenerated liquid phase (water + organic phase)

Biogas recovery

Liquid phase (water + organic phase + VOCs)

Reactor with methanogens

Nutriments

Complex gaseous emissions

VOCs to energy

Treatment

Cleaned gas

Polluted gas (VOCs)

Absorption
(Water + organic phase)

Regenerated liquid phase (water + organic phase)

Biogas recovery

Liquid phase (water + organic phase + VOCs)

Reactor with methanogens

Nutriments
« At-source" Action

Real-time monitoring of low concentrations of pollutants (ODEMS - AAP Eco Industries 2012)
ODEEMS Project (real-time monitoring system of odors emission and diffusion - AAP Eco Industries 2012)

- Implementation of an environmental management system correlated with real-time odor survey as a production tool
  1. Correlate odors with tracers,
  2. Develop and deploy a tridimensional network of sensors,
  3. Coupling of quantitative data obtained from the sensors' network and dispersion (impact of odor dispersion on the surrounding area) and reverse dispersion (trace the sources) modelling systems,
  4. Provide reliable spatial and temporal information down to the low ppbv level

Buff’Air: patented filter that “buffers” humidity changes
Dynamic air uptake thanks to a microfan
Nanoampere electronic circuitry
Electrochemical sensor

Impact Assessment

**Odor Annoyance**: chemistry / odor / discomfort relationship

Prediction system of the odor annoyance level and its economic consequences on a territory (EMA / OLENTICA)

**Healthy risks**: Bioaerosol emissions
Prediction system of the odor annoyance level and its economic consequences on a territory

- Provide and map the discomfort generated from odor exposure
- Concept:

  - Odor annoyance
  - Human vulnerability
  - Olfactory discomfort potential
  - Economic vulnerability

  Odorous compounds

  Complaints, behavior shifts

  Economic impact

  Olfactory discomfort

Source
Prediction system of the odor annoyance level and its economic consequences on a territory

- Integration of the function « annoyance » into a GIS database
Healthy Risks: bioaerosol emission from bioprocesses

- Risk assessment of bioaerosol exposure?
  - Determination of suitable collection methods and air sample analysis for viable microorganisms characterization
  - How to evaluate bioaerosol toxicity?

- Impact of bioprocess functioning on bioaerosol production?

- Understanding of cell desorption mechanisms? Implementation of a reliable strategy for optimal cell recovery from air particles?

Aerosol (solid or liquid particles)

Bioaerosol (particles of biological origin)

Microbial Aerosol (bacterial, fungal and viral particles)

Health impact
Thank you for your attention
Meet the industrial demand