

# BIOFILTRATION FOR INDUSTRIAL ODOUR CONTROL

## ODOUR POLLUTION

- Affects image
- Affects labour relations
- Affects productivity and health

### How is odour measured?

Odour is a complex phenomenon involving interaction of many compounds. The human nose is a very sensitive detector for certain compounds. Odour is evaluated in terms of odour units. A panel of trained persons smell the gas sample at various dilutions. They find out at what dilution the odour is barely perceptible.

A gas chromatograph may be set up measure odour is certain cases. When complex mixtures cause the odour, a reference compound may be selected as measure of odour. The degree of removal of a mutually agreed reference compound may be used for evidencing of process guarantees with regard to odour removal.

ASTM D1292 defines Odour Intensity index and specifies its method of evaluation

### Biofiltration:

- Absorption of volatile gas compounds in the filter material
- Microbial break down of the polluting components
- Complete destruction of compounds into harmless products such as carbon dioxide, mineral salts or acids and water.

### Biofiltration advantages:

- Cost-effective for dilute, large volume air streams
- Low O&M costs
- High odour removal efficiency >99%.

Alternative technologies for volatile organic compound and odour control

- thermal or catalytic incineration
- physical or chemical treatment
- UV irradiation
- Masking
- biological treatment

### Biofilter media:

- key component is a biofilter.
- Provides moisture, nutrients and support to micro-organisms
- Contacts volatile compounds with micro-organisms
- Need good mechanical strength and high porosity
- Should have long life and be environmentally friendly material
- Provided with buffers to neutralize acid products

### NIIST BIOFILTER TECHNOLOGY

NIIST determines the best emission control option before recommending a biofilter. Biofilters are designed on the basis of organic load. Often, there is almost no data volatile organic emissions load from a factory or process. NIIST uses its long experience in multi-sectoral expertise to estimate the emission loads by various innovative schemes.

| <b>Odour threshold</b> |  | (mg/m <sup>3</sup> )   |
|------------------------|--|------------------------|
| Ammonia                |  | 2.6 x 10 <sup>-2</sup> |
| Butyric acid           |  | 1 x 10 <sup>-4</sup>   |
| Chlorine               |  | 2.9 x 10 <sup>-2</sup> |
| Petrol (heavy)         |  | 150                    |
| Hydrogen sulphide      |  | 1.5 x 10 <sup>-3</sup> |
| Ethyl mercaptan        |  | 4 x 10 <sup>-5</sup>   |
| Vanillin               |  | 2 x 10 <sup>-7</sup>   |

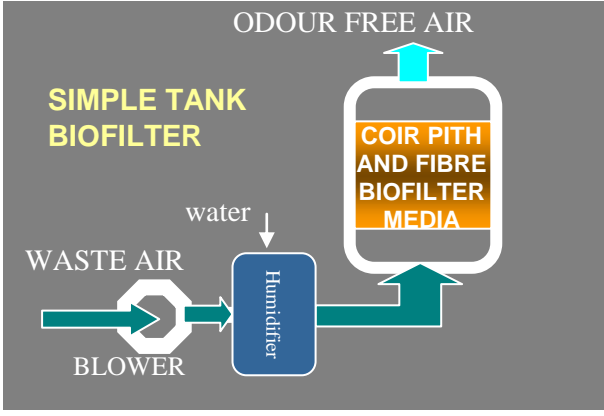
one gram of vanillin distributed uniformly in air up to a height of 100 m can be smelt 5 km away!

| <b>Industrial odour</b>  |  |
|--------------------------|--|
| Meat and fish processing | cystine -> H <sub>2</sub> S,                                   |
| Tanneries                | methyl mercaptan   |
| Cooking smells           | dimethyl disulphide, furan, pyridine                           |
| Fruit warehousing        | ethylene   |
| Sewage treatment         | H <sub>2</sub> S   |
| Refineries               | H <sub>2</sub> S, methyl mercaptan, acrolein, methionine, BTEX |

| <b>Cost comparison of odour control technologies</b>                    |      |
|---|------|
| Cost Rs per 1000m <sup>3</sup> air treated                              |      |
| Chlorine  | 70   |
| Ozone   | 70   |
| Activated carbon (including regeneration)                               | 25   |
| Biofiltration (total capital and operating costs including ventilation) | 10.5 |

**Micro-organisms in a biofilter**

bacteria : *thiobacillus, psuedomonas, actinomyceces globspor, microcococcus albus, micromonospora vulgaris, proteus vulgaris, bacillus cerus, streptomyces sp* : fungi such as *Pleurotus ostreatus, Trametes versicolor, Bjerkandera adusta, and Phanerochaete chrysosporium, pecillum,*



- NIIST designed biofilters:*
1. Akash Fishmeal Pvt Ltd. Kelus, Sindudurg District, Maharastra (Installed by Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)
  2. Collagen Marine Products, Palghat (Fish Meal) (Installed by Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)
  3. Nitta Gelatin India Ltd., Ossein plant, Koratty (Installed by Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)
  4. NPM Fish Products, Thrissur (Fish Meal)
  5. Miracle Polymers Ltd., Coimbatore (Reclaim rubber factory ventilation)
  6. Cochin International Airport Ltd. (Sewage treatment plant)
  7. Kochi Refineries Ltd. for bitumen off-gas treatment (pilot scale)
  8. Alembic Ltd., for erythromycin plant ETP
  9. JP Pharchem Ltd., Pencillin G plant
  10. Herald Marine Products Ltd. Palghat
  11. Orchid Pharma Ltd., pilot plant ETP

NIIST high-performance, low-cost BIOFILTER MEDIA (US Pat. 6,696,284) features

- very low pressure drop,
- high water holding capacity
- long life
- green eco-friendly material
- unique procedure for assured and fast biofilter start-up

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**Figure 1.** Gas biofilter installed on roof of a fish meal factory. The factory processes low priced sardines and achovy into fish meal protein, a component of animal feed and prawn feed.



**Figure 4.** Gas biofilter treating odour from a ossein factory that makes gelatine from animal bones. Sinews separated from bones are rendered to make meat meal pet food. Emissions from meat meal plant is treated in this biofilter.



**Figure 2.** Gas biofilter treating air from two plants making reclaim rubber from scrap tyres. Truck tyres are pulverized and devulcanized to make reclaim rubber sheets, a raw material for tyre manufacture. These factories use chemical devulcanization technology. Without control, odour nuisance can spread for several kilometers.



**Figure 5.** Large gas biofilter (60m x 14.5m x 1.2 m) in 4 independently operable units in fish meal plant at 400 tpd fishmeal plant; February 2016 (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)



**Figure 3.** Small Gas biofilter treating odour from tanks of a sewage treatment plant at Cochin International Airport



**Figure 6.** Gas biofilter for odour control in 180 tpd fishmeal plant at Palghat (2014).



Figure 7. Biofilter for odour from crushed bone processing at ossein unit for gelatin manufacture (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)



Figure 8. View of very large biofilter installation for municipal solid waste composting plant, Bengaluru (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)



Figure 9. Large biofilter treating exhaust ventilation air 256,000 m<sup>3</sup>/h from 500 tpd integrated solid waste management plant for BBMP, Kudlu, Bengaluru (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)



Figure 10 Biofilter for 300 tpd prawn feed factory, Odisha (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)



Figure 11. Quantitative measurement of odour in biofilter exhaust by dynamic olfactometry. (Licensee: Elixir Enviro Systems Pvt Ltd <https://elixirenviro.in/>)

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