Reduction of odour control electrical costs while increasing performance at wastewater treatment facilities using Photoionization Treatment technology

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The main odour control technologies that have been using in wastewater treatment facilities are:

- Biofilters,
- Carbon Filters,
- Scrubbers and
- Photoionization (PI)

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In choosing a suitable odour control technology, some key factors need to be evaluated:

- Required odour removal efficiency
- Equipment reliability
- Operator freedom from operational and maintenance attention
- **Initial investment and operating cost,**

  Need to do life cycle cost analysis

  - Including consumable and change out requirements
- Available space and environmental conditions
- Ability to handle variations in off-gas flow and loads at required efficiencies,
- Odour source, location, inlet air stream conditions…

Of course, removal of the odour should be the ultimate goal of any odour control system.

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Biofiltration Process

Some Advantages and Disadvantages of Biofiltration process

Advantages

- Reasonable odor removal possible (water soluble, biodegradable compounds)
- Low capital cost possible (if select proper filter media)
- Low operating cost can be achieved

Disadvantages

- Relatively very large footprint requirement
- Gas conditioning (Relative humidity and Temperature) may be required
- Potential for flow channeling
- Difficult to remove high concentration of organic sulfides and mercaptans
- Sensitivity of bacteria to inlet air conditions

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Activated carbon filtration

Advantages and Disadvantages of carbon filtration process:

Advantages

- Familiar product
- High efficiency can be achieved for a given time frame
- Can be ON/Off as required

- **Disadvantages GAC**
- Media replacement periodically and media cost
- Desorption may occur (break through …….)
- Caused by increase in RH &/or temperature,
- preferential gases, Odour compound limitations
- Flammability
- may pass through bacteria and molds

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Scrubber Process

Some Advantages and Disadvantages of scrubbers

Advantages

- Good efficiency can be achieved for a particular pollutant (not for odour)
- Low initial cost can be achieved
- Can On/Off the process whenever need
- provide cooling of hot off gases process

Disadvantages

- Secondary pollutants/ waste chemical handling/ disposal will be tough
- High odour removal may not be possible , depend on inlet odour chemistry
- Regular maintenance and Operator attention required
- Protection against freezing required

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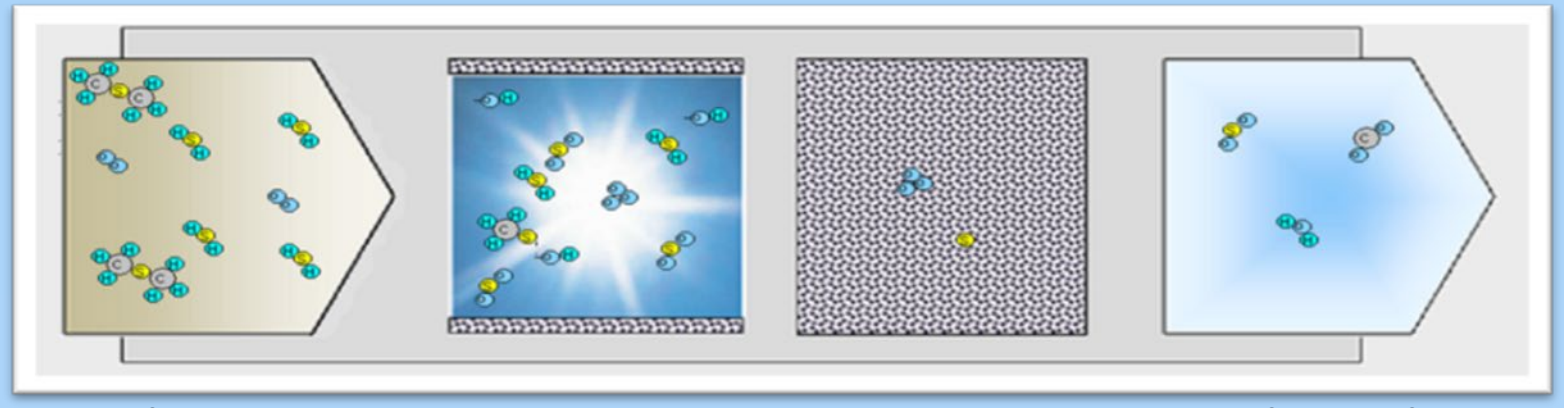
Photoionization technology

Photoionisation (PI) uses UV light and a catalyst to oxidize and break down odorous compounds. The UV light creates oxidizing agents (O^{-2}, OH^{-}, O_3 , activated O_2 and other free radicals) that begin to oxidize the odour causing compounds. Compounds that not treated here proceed to the catalyst, where they are trapped and broken down by various reactions, including catalysis.

The following drawing summarizes the process :



inlet of odorous air **UV section** **Catalyst** **Exit of odour free air**

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Photoionization technology

There are many advantages to this technology over traditional odour control methods, the main ones being :

- Superior performance
- Small footprint
- Effective handling of spikes
- Independent of temperature and relative humidity of the air stream
- Low energy – UV lamps and fan!
- Reduces or eliminates harmful bacteria, molds etc
- >5 deg C heat recovery!!!
- Starts to work instantly so can be turned On / Off any time

Disadvantages:

- Medium investment due to premium quality materials
- May not suitable for very high concentration of ammonia

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Comparison of Odour control methods

	Biological treatment		Activated carbon filtration		Chemical scrubber		Photoionization treatment	
Process Goal								
Odour elimination **- efficiency**	1	Treats odour rather than compounds but with only 80-90% efficiency	3	treats odour Efficiency > 99%	2	Treats rather single compounds , odour reduction is vary depend on mixture of pollutants	3	Treats odour, as a complex mixture of compounds. Efficiency > 99%
Disinfection **- Elimination of viruses, germs, spores.....**	0	Beds rather produce germs, spares, moulds....	0	No disinfection possible	1	Disinfection possible with certain chemicals	3	UV light disinfects the air
Treatment								
High Odour conc. **- e.g. several 100,000 OU/m3**	1	Applicable for low-medium conc,	1	High conc, may be treated but may require frequent carbon exchange	2	Applicable for high conc. of single compounds rather than odour load	3	Can handle high odour loading
Dynamic loading **-Varying loads**	1	Nature of biology makes Fast adaptions impossible	2	Work well , but may require frequent carbon exchange	2	Depends much on the efficiency of the applied control and dosing system	3	Work well on spikes through integrated catalyst buffer
Raw-gas requirements **- Temperature & Humidity**	1	100% humidity, mesophilic temp. required	2	Relative humidity should not exceed certain levels...	2	Depend on chemicals, certain environment required	3	No requirements

0- not favourable ------ 3- high favourable

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Comparison of Odour control methods

		Biological treatment		Activated carbon filtration		Chemical scrubber		Photoionization treatment
Technology								
Reliability **- How reliable the process**	2	Process requires electricity, water and biology neads....	3	Only electricity required	2	Process depends on chemicals, controls system....	3	Only electricity required
Availability **- Adaption time**	1	Long adaption time required (weeks)	3	No adaption necessary,	2	Adaption to some extent possible Correct mixer of chemicals...	3	No adaption necessary, 100% ready to start
Maintenance and operation demand	1	Biological needs constant maintenance and care need	2	Low operation and maintenance demand. However often exchange of carbon necessary	1	Very high control and maintenance demand	3	Apart from changing consumables, extremely low maintenance and operation demand

0- not favourable ------ 3- high favourable

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Comparison of Odour control methods

	Biological treatment		Activated carbon filtration		Chemical scrubber		Photoionization treatment	
Cost								
Investment	3	Low investment cost technology	3	Low investment cost technology	3	Low investment cost technology	2	Medium investment due to premium quality materials
Consumables	2	Filter media, water	2	Activated carbon required frequent in great amounts	2	Chemicals required frequently in high amount	2	UV lamps and Catalyst required /18 months
Operation	2	Back pressure increase with time causes high electricity demand	2	Only electricity required, High pressure loss increases electricity demand	1	Complex monitoring and dosing system, produced effluent causes additional costs	3	Only electricity required
personnel	2	Regular permanent maintenance required	1	Activated carbon must be exchange more frequently	1	Scrubbing system requires permanent monitoring or maintenance	3	Process does not requires permanent monitoring or maintenance
Total Cost **- Comparison of all relevant costs of the odour control projects**	2	Bed, humidification, fan and Huge foot print	2	Depending on application total costs comparable	2	Tanks, piping, pumps, fan, chemical storage... increase total cost	2	Depending on application total costs comparable.

0- not favourable ------ 3- high favourable

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Selection of Odour control technology

All the systems serve the same odour control function, but one have a lower initial/ capital cost, but the system life cycle cost shall be much more than other options

Capital and operational costs should be estimated when comparing the cost of the offered odour control systems

- In terms of performance, photoionization is the superior odour control technology with demonstrated performance from a variety of wastewater applications from North America and elsewhere

- The PI technology footprint is amongst the smallest in the industry

- PI unit's initial back pressure/ pressure loss is relatively low compare to Biofilter or Carbon filter. And pressure loss within the PI unit is almost constant through out the life, however the biofilter & carbon filter, back pressure increase with time, which imply for a constant off-gas flow rate, the fan energy cost will increase with time significantly.

Therefore the PI units's operation electrical cost is constant and low throughout the life-span

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Thank you

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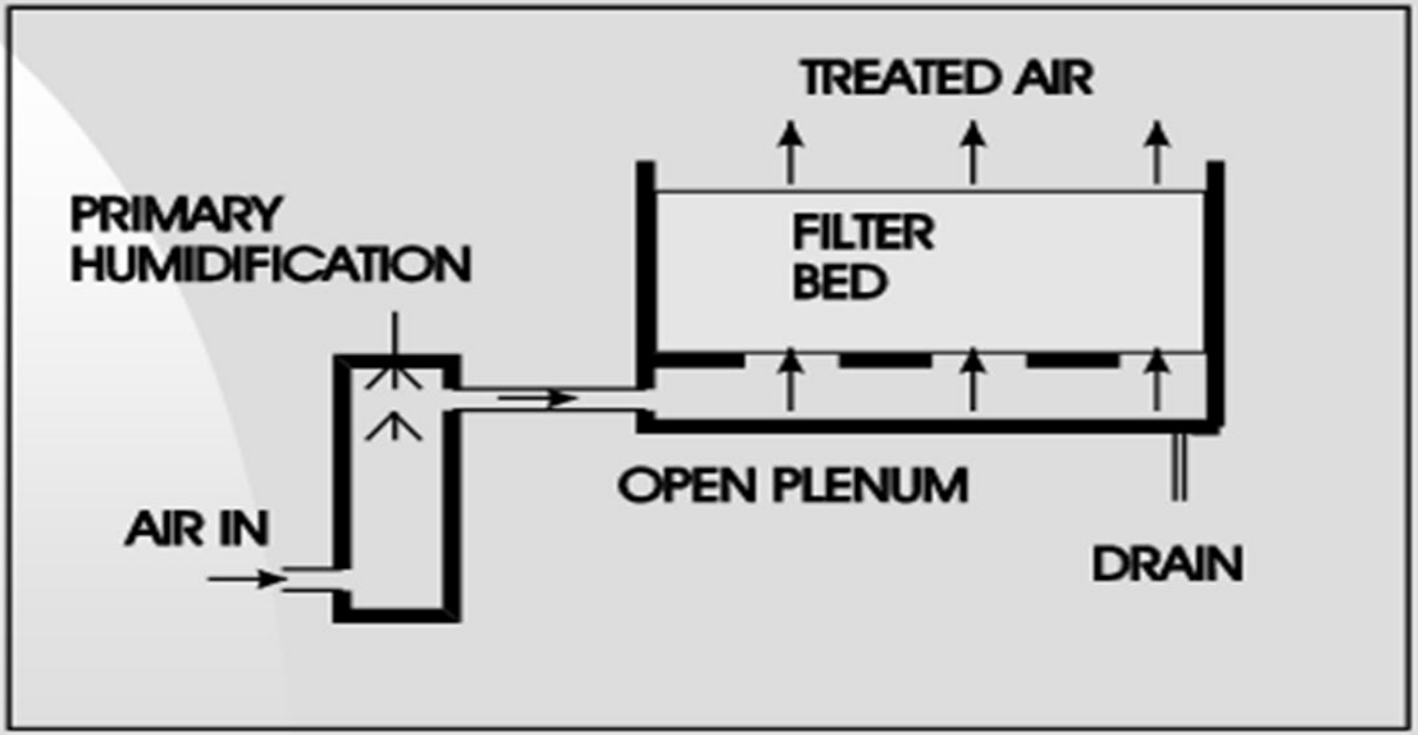
Simple Biofilter



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Over 150 References











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