Sewage Septicity and Odour Control: An Introduction

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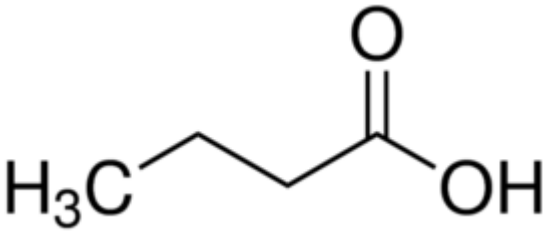
Sewage Septicity

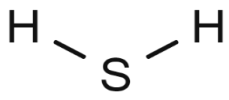
- In the absence of DO and Nitrates, Sulfate acts as Electron Receptor for SRB's and H_2S forms (rotten egg smel) under low pH.
- Anaerobic bacteria ferment organic materials to organic acids :

Acetic , Propionic, Butyric or butanoic acid (what gives vomit a distinctive odor) and Valeric or pentanoic acid (unpleasant odor).

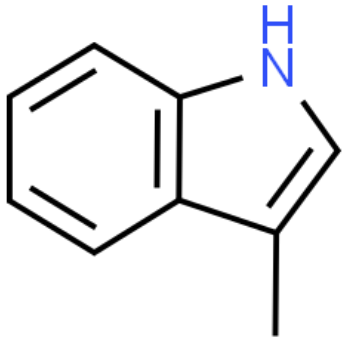
What's That Smell?



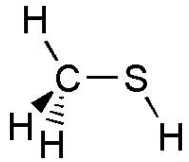
Butyric or Butanoic acid: The molecule that is being the Smell of vomit and rancid Butter.



Hydrogen Sulphide: has a characteristic **rotten egg smell** which can be detected at very low levels.

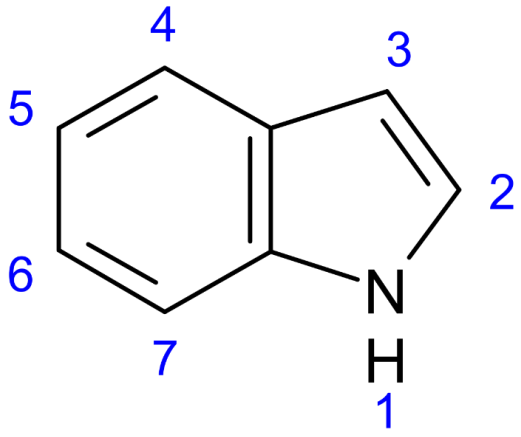


Skatole: Occurring in high concentrations, it is the primary **odour** of faeces. In low concentrations, it has a flowery **smell.**



Methanethiol

DiMethyl Sulfide (DMS)



Indole: **Indole** is a solid at room temperature. It occurs naturally in human faeces and has an intense fecal **odour**. At very low concentrations, however, it has a flowery **smell**.

Odor and pH

- Sewage by its nature and composition has an unpleasant odour, which is made obnoxious when it becomes anaerobic and septic. **Sludges** are more likely to become septic because the numbers of micro-organisms and the available substrates per unit volume are greater. Odours derived from septic sewage or sludge are classified as **acidic**, which include organic sulphides and hydrogen sulphide (H2S), with odour thresholds within the range 0.5 to 4 ppb, and volatile, organic, fatty-acids, such as acetic, propionic and butyric.

- If sewage or sludge becomes **alkaline**, the odours produced, which include ammonia and amines together with other volatile organic compounds such as skatole and indole, have much higher odour threshold concentrations than acidic sulphides but are more persistent. Septic sewage does not normally smell of the alkaline-related odours because the pH value is likely to be less than 7, due to the formation of fatty acids. Measures to control septicity and prevent odour nuisance must **avoid increasing the pH value above about 8.5** or the problem will not be resolved, as malodorous alkaline odours would prevail.

Other Odor Causing Molecules (Mercaptans)

- CH_2=CH-CH_2-SH : Strong garlic taste
- CH_3-$(CH2)_3$-CH_2-SH : Rotten taste
- C_6H5CH_2-SH : Intensely unpleasant
- CH_3-CH=CH-CH_2-SH : The stink of the weasel
- CH_3-S-CH_3 : Rotten vegetable taste (DMS)
- CH_3-CH_2-SH_3 : The rotten taste of cabbage (also "stench gas“ additive to LPG)

Odor Control Technologies - I

- **Wet air scrubbing** is the most flexible and reliable technology for vapor-phase wastewater odor control. This technology can be used to treat virtually any water-soluble contaminant. In addition to hydrogen sulfide and "organic" odors, wet scrubbing is very effective for ammonia removal. A knowledge of culprit chemistry is essential to adjust the pH of the solution.

Odor Control Technologies - II

- **Calcium Nitrate** Solution eliminates the odor, corrosion, and safety problems associated with hydrogen sulfide by achieving sewage odor control naturally. This unique, proven product also treats other common sewage odors, including odorous sulfur compounds such as mercaptans and organic sulfides.

Odor Control Technologies - III

- H_2S is transformed to HS^{-1} at higher pH
- Therefore, the addition of **alkalies** such as NaOH to sewage to prevent acidic bacterial action is an also known control measure. However, the pH should not be increased above 8.5 as alkaline odours will prevail.

Odour Control Technologies IV - Ozone Scrubbing

- Chemical scrubbing using ozone as the **oxidant** is an effective choice for high intensity odors and high air volumes where the amount of space for a treatment system is limited.

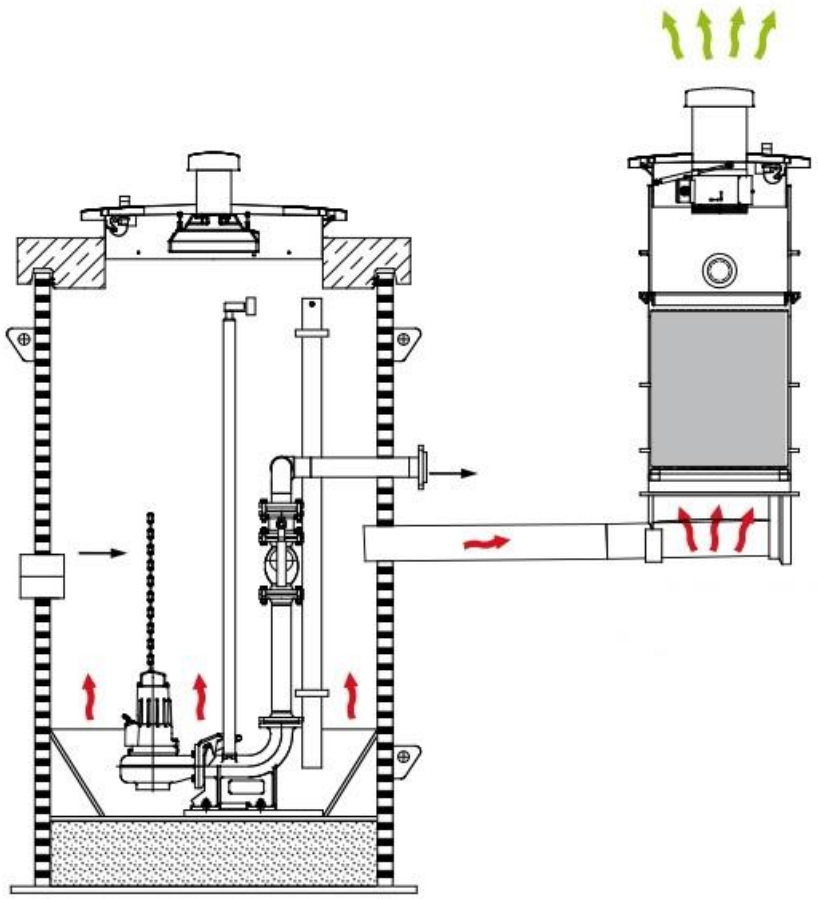
Odor Control Technologies V - Iron salts

- iron salts added to sewage or sludge will react with sulphides to form insoluble iron sulphide and will catalyse the rate of oxidation of sulphide. The amount required will depend on the pH value of the sewage or sludge; the dose rate will be high (about four times the stoichiometric amount) if the pH value is below 6.5.

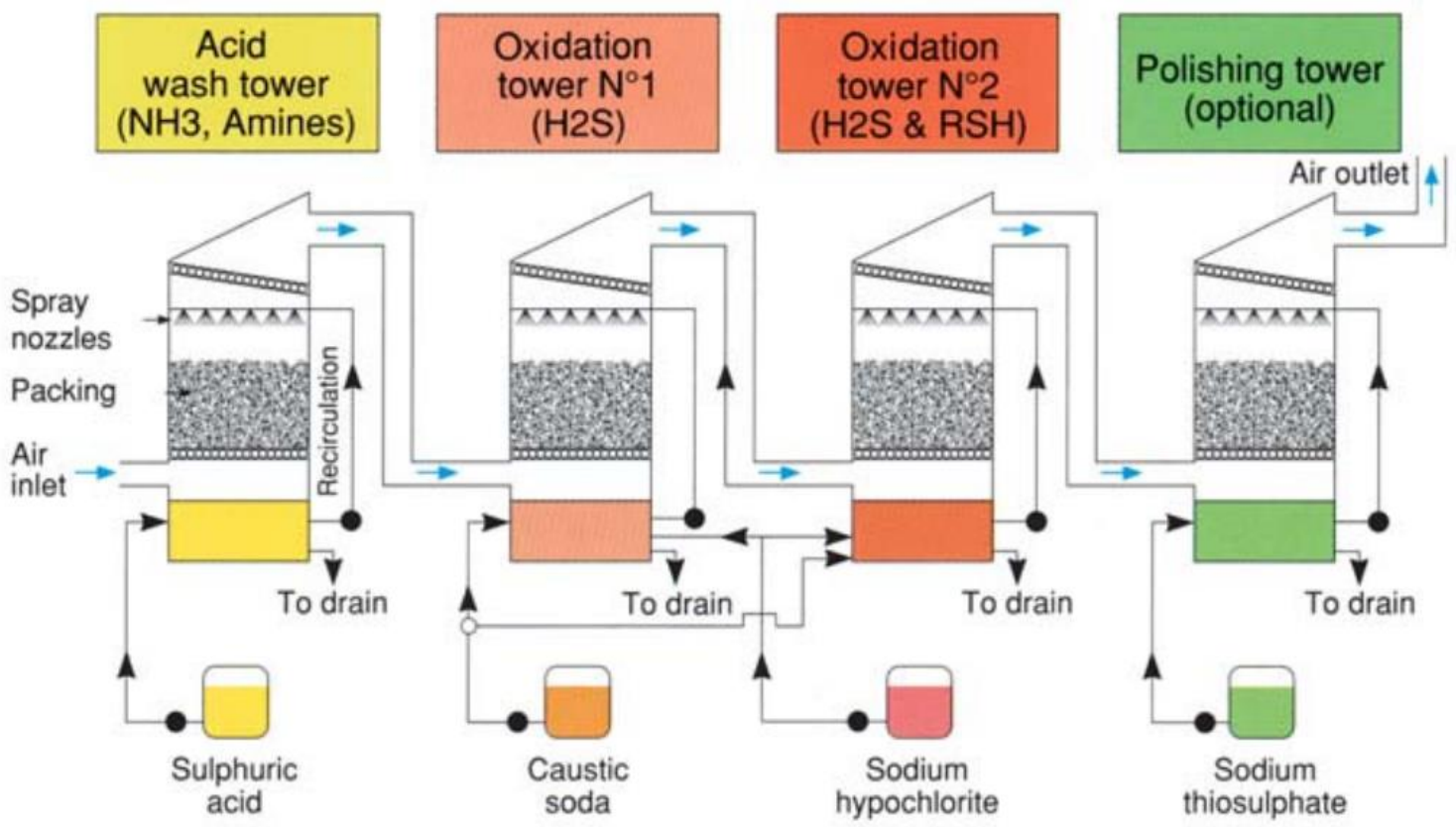
Manholes with AC Filters

Granular Active carbon adsorbs odour molecules.

Pump Station with Odour Control Using Fan and GAC



For Highly Concentrated Odorous Gas Effluents: Alizair (Veolia)



Air Biofilters

- Air biofilters. These are towers or other containers packed with chipped wood or similar media, kept moist with water so that biofilm of aerobic bacteria and fungi develop, which biologically oxidize the ammonia, hydrogen sulfide, etc. to water and soluble, non-odorous compounds. The air being vented is drawn upwards through the media, which is kept moist by a downward trickle flow of water and dissolved nutrients (to maintain the biofilm). The main disadvantages of air biofilters is that they only become fully effective once the biofilm has become established on the media and they must be kept moist and aerobic at all times by maintaining a flow of air through them. In cold climates, the biofilters may need to be insulated/heated depending upon the temperature of the air being vented through them.

Odour Control Chemical Engineering

- For active odour control, it is necessary to set up a network of **atomizing** nozzles around the main odour-producing parts of the site, which are fed under pressure with a dilute, aqueous solution of an effective odour control chemical formulation. The smaller the atomized droplet size, the larger the surface area to droplet volume, therefore the more effective the droplets are at capturing/neutralizing odours. High-pressure (60 to 70 bar) atomizing systems are more effective than low-pressure atomizing systems (5 to 15 bar), since these high-pressure systems produce smaller droplets, typically 10 to 15 microns in diameter, than the lower-pressure systems, which produce droplets typically 20 to 50 microns in diameter.

Odour Control Chemistry

- In addition to a pleasant perfume and essential oils, an odour control product should contain a number of other chemical compounds including:

  - Non-ionic and cationic **surfactants** to solubilize the perfumes and essential oils in the formulation, and to solubilize volatile organic compounds released into air.
  - Organic **acids** to neutralize ammonia and other ammoniacal compounds.
  - Specific **esters** of long-chain fatty acids that react with and neutralize hydrogen sulfides and other volatile sulfides.

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Questions?
Remarks?

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