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Hydrogen Sulphide, Generation & Control

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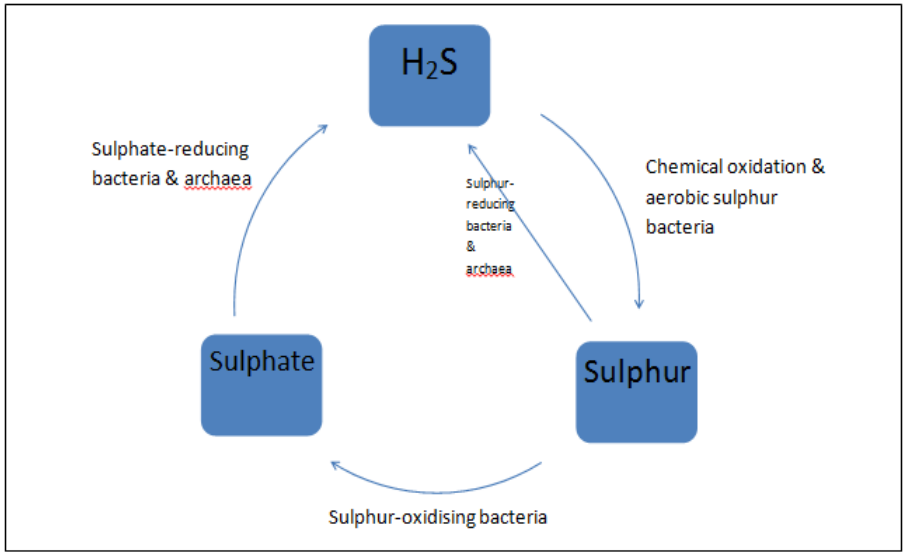
- Hydrogen sulphide (H_2S) is a very toxic, flammable gas.
- It can rapidly cause asphyxiation, unconsciousness and death.
- What about the cumulative impact of lower concentrations?
- It is important to be aware of its potential presence, to manage workplace activities that can lead to H_2S generation and to control occupational exposure.

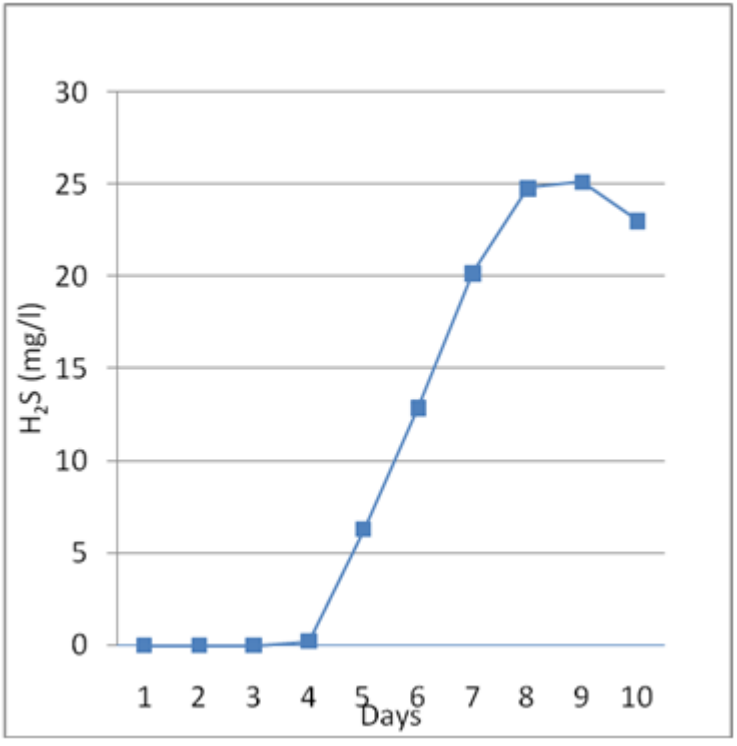
- Hydrogen sulphide can be a by-product of some microbiological processes, such as those involving sulphate-reducing bacteria (SRB) and other sulphide generating micro-organisms.
- Understanding the mechanisms would allow a better understanding on workplace exposure control
- Ignorance of such mechanism can result in uncontrolled & sudden releases.

- Hydrogen sulphide actually occupies a pivotal position in the global sulphur cycle and hence is essential in maintaining the functioning of the biosphere.
- There are many types of micro-organisms that are capable of producing or utilising hydrogen sulphide.



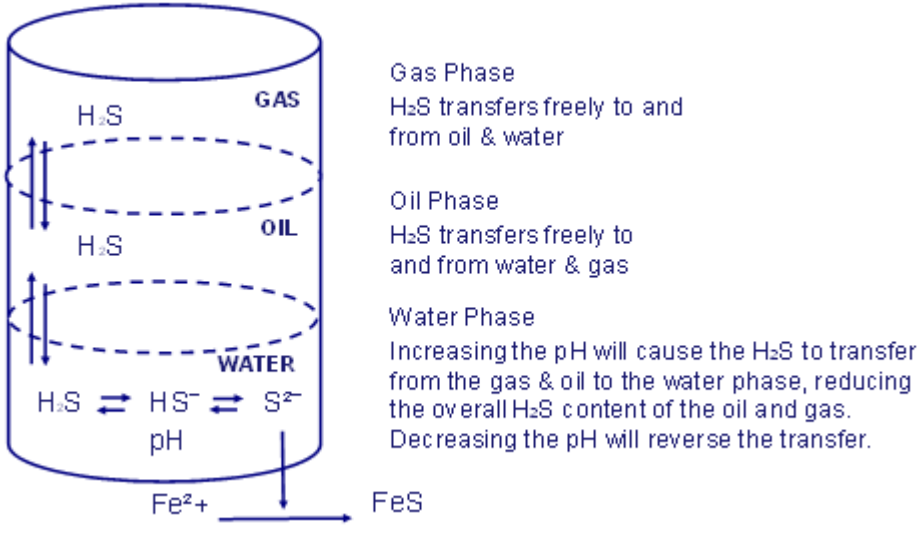
- SRP activity flourishes where there is a supply of suitable electron donors and sulphate is available. The result will be hydrogen sulphide production.
- Seawater and mixtures of seawater can be particularly good sources (including produced water with elevated oil in water)
- If all the sulphate available in seawater were reduced by SRP this would give rise to 900 mg/l H_2S.
- In reality, however, this is unlikely to happen since an equivalent supply of electron donor would also be required.
- SRP require anaerobic conditions in order to metabolise
- Suitable conditions may arise unexpectedly owing to the activity of aerobic bacteria which effectively consume dissolved oxygen resulting in the formation of anaerobic conditions.

Generation of H_2S by SRP in a mixture of produced water and seawater at 45°C.



- PH
- Solubility
- Abiotic scavenging
- Biotic scavenging
- Partitioning of hydrogen sulphide between oil, water and gas phases

- **Movement fundamentally influenced by the pH of anv associated water**



Gas Phase
H_2S transfers freely to and from oil & water

Oil Phase
H_2S transfers freely to and from water & gas

Water Phase
Increasing the pH will cause the H_2S to transfer from the gas & oil to the water phase, reducing the overall H_2S content of the oil and gas. Decreasing the pH will reverse the transfer.

- Hazard Identification
- Exposure Scenarios
- Predictive Exposure Modelling
- Risk Control Strategy
- Utilisation of Research Outcomes to develop guidance

- **Acute Exposure through area classification using fixed detection.**
- **Monitoring SRP and microbial activity**
- **Predictive generation step monitoring**

- **Casual Chain developed through better understanding**
- **Controlled breaking of the chain as a control mechanism**
- **Rate controlling steps in generation understood and then controlled.**
- **Health related verification through monitoring and surveillance. There is a lack of good science for low level exposures.**

- ACGIH – 1ppm (2010) down from 20ppm (1946)
- HSE – 5ppm
- ACGIH Science based justification for 1ppm TLV
- Setting of limits for ACGIH & HSE not necessarily same target organ basis

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SUMMARY – GENERATION PATHWAYS CONTROLLED BY ROBUST CHEMISTRY WILL ENSURE CONTROL

Questions Please