Creating Value From Sour Hydrocarbons Bi-products – Sulphur

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Introduction

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FACT 1

EASY OIL & GAS IS OVER, ALMOST EVERYWHERE

FACT 2

40% OF NATURAL GAS RESERVES ARE SOUR*

SOUR HYDROCARBON DEFINITION

OIL OR GAS CONTAINING
HYDROGEN SULFIDE (H_2S)
AND / OR
CARBON DIOXIDE (CO_2)

ALSO CALLED “ACID”

Examples of Sour Fields in the Arab Region

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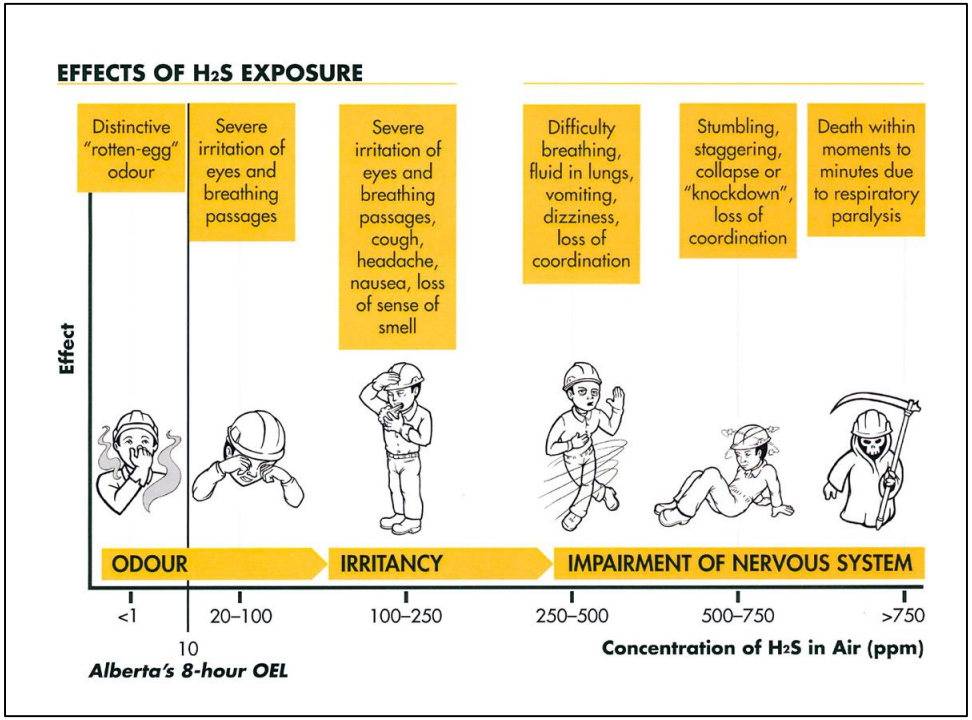
- Harweel, Yibal Khuff and Greater Birba (Oman)
- North Field LNG (Qatar)
- Jurassic Sour Gas Fields (Kuwait)
- Wasit, Kidan and Karan (Saudi Arabia)
- Shah, Bab and Ghasha (UAE)

Hydrogen Sulphide (H_2S) Characteristics

- ‘Sour Gas’ is commonly present in natural gas and oil formations
- At low concentrations, it smells like rotten eggs
- EXTREMELY dangerous as it is heavier than air, impairs our ability to smell/detect with increasing concentration, and exposure to >500 ppm can be fatal!
- With respect to safety and product specifications, it must be removed from natural gas and petroleum products
- Thus, how do we safely rid ourselves of H_2S and make another potentially valuable product?



Reference: Info-graphic taken from H2S – The Killer from the Alberta Government

Sulphur Recovery – Claus Process

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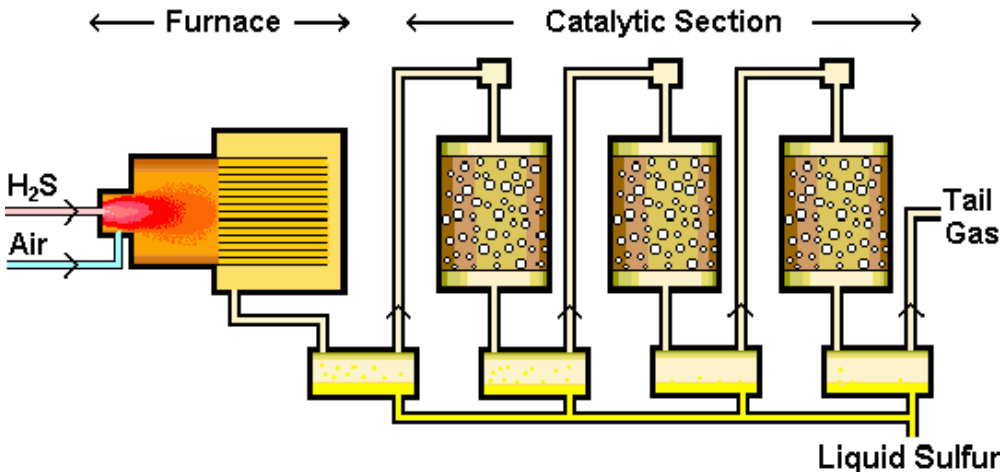
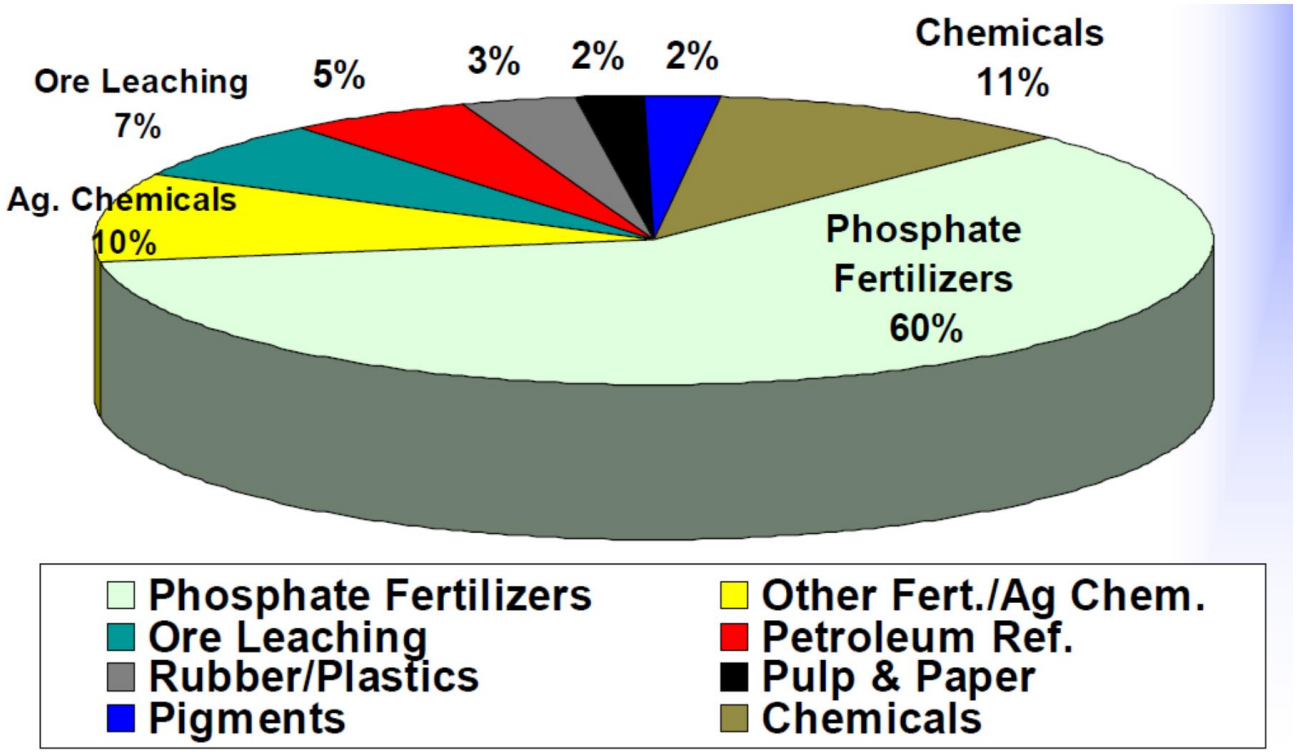
- Two-step reaction scheme overall
- A portion of the total H_2S is burned in the Reaction Furnace to form SO_2 (Sulphur Dioxide)
- Then, the H_2S and SO_2 react, at an optimal 2:1 ratio, to form elemental Sulphur (S_x) across the Claus Reactors
- After each catalytic stage, liquid sulphur is recovered in the Claus Condensers
- The remaining unreacted H_2S and SO_2 then proceed to the next stage, where the equilibrium-limited Claus reaction continues in the presence of Claus catalyst



Sulphur Valorization – Sulphur Utilization

About 90% of sulphur produced or extracted is used to make sulphur dioxide, which is then converted to sulfuric acid. The majority of the acid is used in the production of phosphate fertilizers, which is a crucial component of the food and beverage industry



Source: *Utilization of Sulfur Wastes from Sour Gas and Crude Oil Production,* Krishnan and Freeman, Integrated Environmental Solutions

Sulphur Valorization – Sulphur Dioxide (SO_2)

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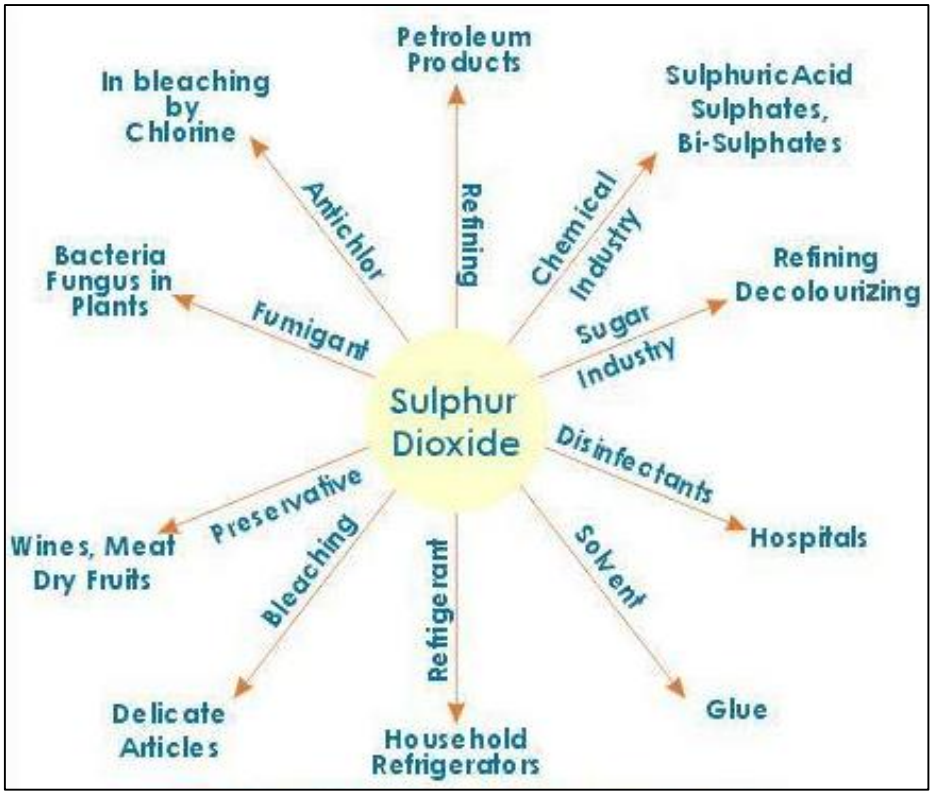
Sulphur Dioxide is a colorless, water-soluble gas, with a strong odor



Source: https://www.askiitians.com/iit-jee-s-and-p-block-elements/sulphur-dioxide/

Sulphur Valorization – Sulphuric Acid (H_2SO_4)

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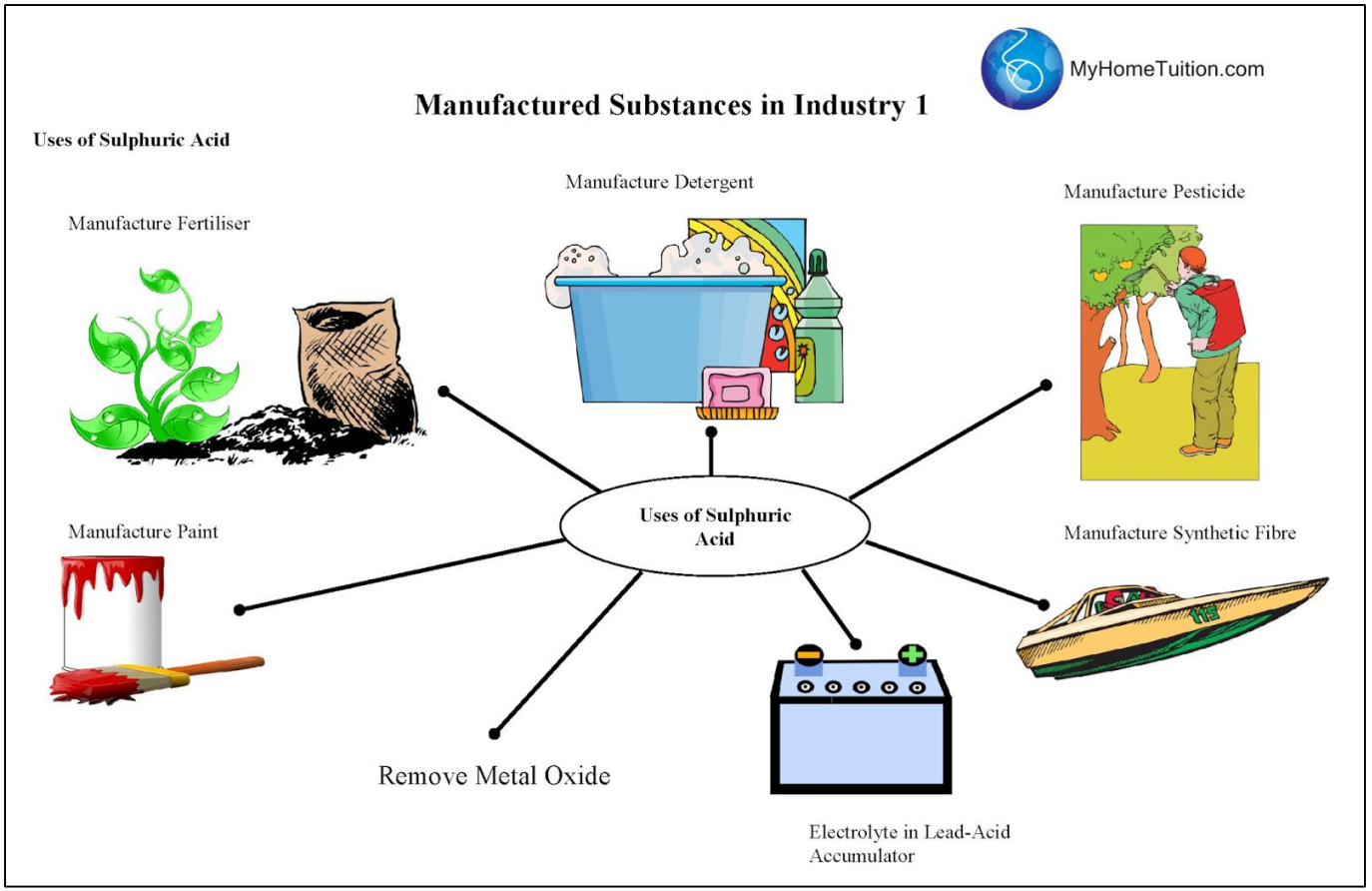
Over 90% of Sulphur consumption is as Sulphuric Acid



Case Study: Sulphur-Extended Asphalt (SEA)

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- Replacement for cement in binding asphalt or bitumen
- SEA has been used in dense-graded mixtures with sulphur/asphalt binder mass ratios from 20/80 to 40/60, and at times even up to 50/50
- Careful design of the mix, based on asphalt specs and temperature of the mix
- Role of Sulphur: Crystallizes in mixture when cooled (solid, stiffer filler)

Example:

- Shell's **Thiopave** technology, for enhanced road construction
- Quick-melting pellets + organic compaction agent (wax)

Sulphur Valorization – Challenges

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COST

Sweetening oil and gas can be costly, due to many processes required

SAFETY

Sulphur and its derivatives can be hazardous if not handled right

MARKET

Risk of over-supply of Sulphur, compared to demand growth

Many companies and research institutions are working to address those challenges

Sulphur Valorization – Food for Thought

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Global sulphur supply outlook, 2011 -2017

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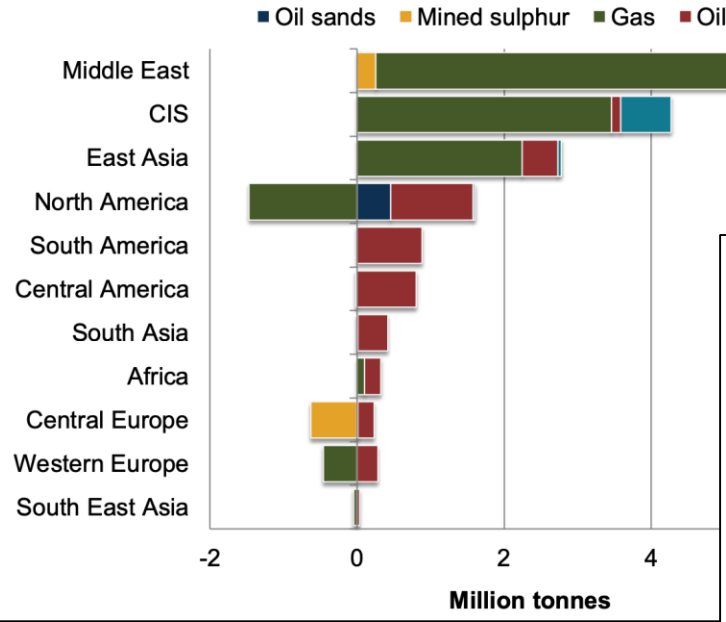
Global incremental changes to supply by source, 2012 - 2017



Middle East sulphur supply, 2011 -2017

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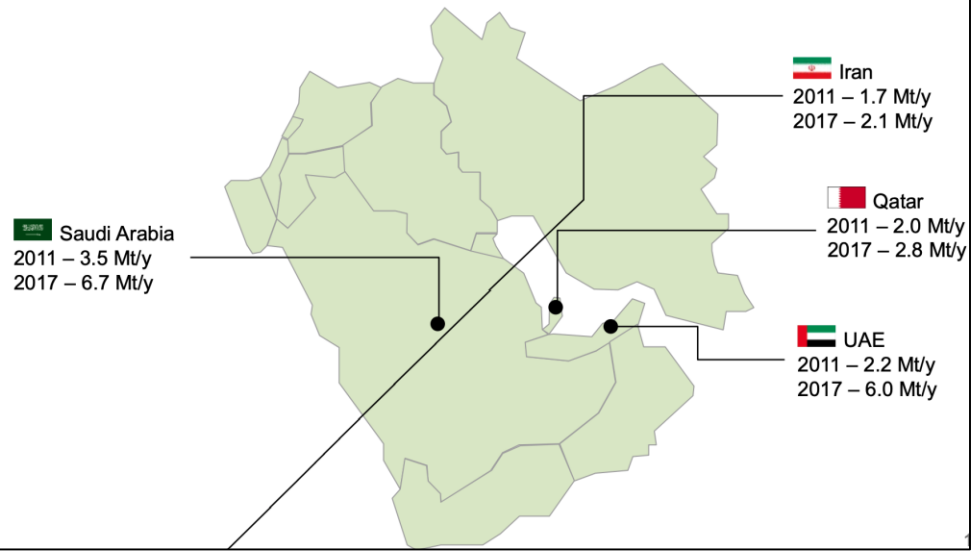

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