GTC VORRO TECHNOLOGY

A Novel Approach for Sulfur Removal from Coal or PetCoke Derived Syngas

15th World PetroCoal Congress April 15th -16th, 2025

Who is GTC Vorro . . .



Operating West Texas location

US privately-owned company in business since 2014 based in Houston, Texas, delivering engineered solutions. Two divisions:

- Environmental Services Focused on removing harmful H₂S from upstream and midstream natural gas on a turnkey basis. 60 units in operation.
- Technology Licensing Focused on
 - Innovative Sulfur Removal Pathways
 - Refining and Petrochemical Technologies



Coal Gasification Global Market Size 2024 to 2034 (USD Billion)



Source: https://www.precedenceresearch.com/coal-gasification-market



Coal Gasification - Indian Scenario

- India targets 100 million tones of coal gasification by 2030 (ET Energy world, July 27, 2024)
- Reliance Industries has an operational petcoke gasification plant at its Jamnagar refinery complex of capacity of 8.75 million metric tons per annum (MMTPA).
- JSPL started up India's first coal gasification technology at its Angul plant of 2 MTPA capacity in January 2020.
- JSPL is planning to build two more coal gasification-based DRI plants, one in Angul, Odisha, and another in Raigarh, Chhattisgarh. (AIST – Steel News Feb. 5, 2022)



// Sulfur in Coal/Petcoke-derived syngas

- Sulfur contained in feedstock mostly gets converted into H₂S during gasification.
 3-10% converts into COS.
- Syngas TOTAL S specifications vary, as per downstream usage.

a) Chemical Synthesis applications: TOTAL S < 1ppmv

b) Power Generation or Fuel Gas applications: TOTAL S < 10-30 ppmv

• COS is more difficult to remove than H₂S.





Trapp, B., 2001, Eastman and gasification-The next step-Building on past success: Gasification Technologies 2001 Conference, pdf slide show,

Schematic : Coal Gasification for Power Generation



https://www.netl.doe.gov/research/Coal/energy-systems/gasification/gasifipedia/syngas

Conventional Acid Gas Removal Technologies



https://www.netl.doe.gov/research/Coal/energy-systems/gasification/gasifipedia/syngas

Syngas Sulfur Removal: Traditional Methods

- Physical Solvents: Rectisol or Selexol. Low temperatures and require high syngas pressure. Do not completely remove COS.
- Chemical Solvents: Amines. However, partial or no removal of COS.
- COS removal facilitated by hydrolysis reaction over a catalyst. Equilibrium reaction.

$$COS + H_2O \leftrightarrow H_2S + CO_2$$

- Hydrolysis generally upstream of amine wash. Does not accomplish complete removal.
- Sometimes 2 hydrolysis stages, with in-between amine wash, required due to inlet COS concentration and outlet specification. Still does not accomplish complete removal.



Conventional 2-stage Hydrolysis + Amine configuration



High CAPEX and OPEX



Syngas TOTAL S removal using NanoSØRB™



Low CAPEX and OPEX



Introducing Catalytic Adsorption: NanoSØRB

- Singular dimension nano-wire technology gives much higher dispersion of metals with improved activity and selectivity.
- Ni/ZnO nanowires. 25 wt% S capacity
- Capable of removing H₂S, Mercaptans, Disulfides, COS and Thiophenes.
- Can be used for S removal from gas (NG, Syngas) as well as liquid streams (Gasoline and Diesel)
- Regenerable media. Ideal for fine sulfur removal.
- Regeneration done via Air at 550 deg C for 6-8 hours





Metals Dispersion

Traditional Metals Deposition



Packing of spherical powders: sinter over time – Lose surface area and activity

Nanowire Structure



Packing of nanowires: No sintering and loss of area, resulting in higher lifetime



Schematic - NanoSØRB[™] Process Flow





Proven Adsorbent - NanoSØRB™

- Diesel Desulfurization, from 300 ppmw to < 15 ppmw, achieved at a US refinery.
- 15 tons of Media will go online in a SMR for ZnO bed replacement in the Middle East.
- Media available for onsite demonstration at client site.





- India is set to witness substantial growth in coal gasification capacity, leveraging the country's abundant coal reserves.
- To utilize coal reserves as a clean energy and chemical resource, liquefaction through the syngas route emerges as the most viable and efficient solution.
- GTC Vorro offers a novel approach to syngas cleaning, specifically designed for the effective removal of H2S and COS, ensuring optimal performance and longevity of coal gasification facilities.
- This adsorbent based novel approach offers a proven, operationally simple, and reliable solution for removing H2S and COS to a level of < 1 ppm total S at low CAPEX and OPEX.



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