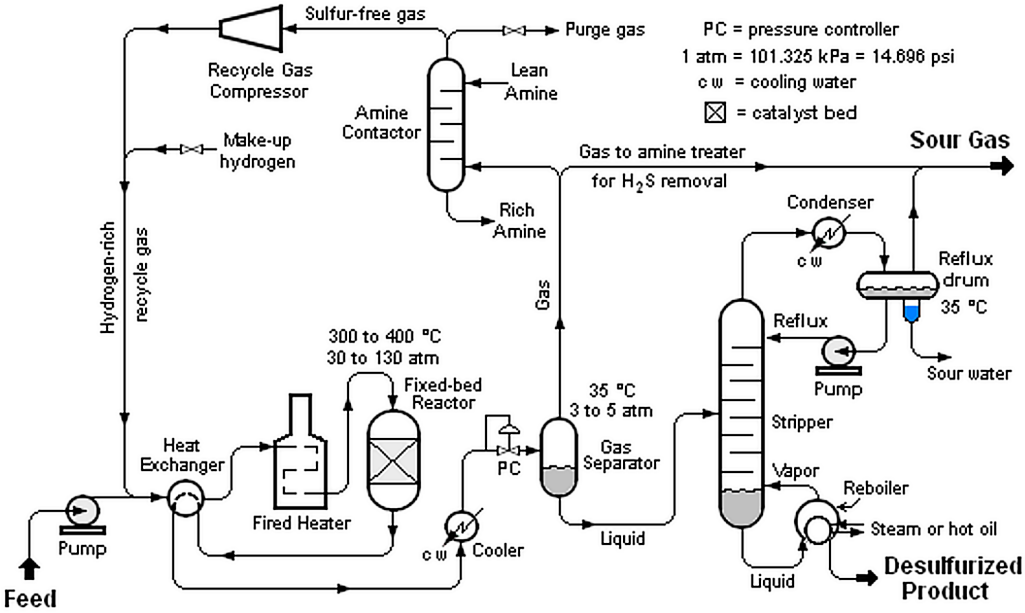
Process Application Note AN-PAN-1026

Mercaptans and Hydrogen Sulfide Derived from Crude Oil According to ASTM D3227 and UOP163

Fossil fuels are known for their sulfur content, which originates from the decomposition of dead organisms over millennia. Mercaptans (thiols) and hydrogen sulfide (H_2S) are two sulfur compounds present in crude oil which contribute to its characteristic odor. In the refining process, these can lead to increased corrosion in distillation equipment at the high temperatures used. Additionally, excess sulfur dioxide ($SO_{2(g)}$, a pollutant) can be emitted after combustion if sulfur is present in the refined products. Therefore, it is in our best interest to remove as much sulfur as possible early in the refining process.

Sulfur compounds are present throughout the entire boiling range of hydrocarbons in crude oil. Depending on the size and bond strength of these compounds, different desulfurization treatments are available. Lighter impurities (including mercaptans and sulfides) can be removed via hydrotreating in a reactor with a catalyst (generally cobalt molybdenum) and hydrogen under high temperature and pressure. Heavier sulfur compounds can be removed with hydrocracking after the hydrotreating process. Desulfurization can occur at many points within a refinery, from the crude feedstock to the distillate streams. A Metrohm Process Analytics 2045TI Ex-proof Process Analyzer with a customized sample preconditioning system could be implemented in many areas within a refinery to ensure the catalysts in the reactors are not exhausted and to limit corrosion further on in the distillation unit. The analyzer fulfills EU Directives 94/9/EC (ATEX95) and is certified for Zone-1 and Zone-2 areas.



Schematic diagram of a typical hydrodesulfurization (HDS) unit in a petroleum refinery.

Application: The mercaptan and H_2S content in crude oil is determined by a 2 endpoint argentometric titration based on ASTM D3227-83 and UOP163-67. Endpoint 1 corresponds to H_2S and endpoint 2 to the mercaptans.

Typical Range: Untreated: 100–500 mg/L mercaptans, 0–100 mg/L H_2S Treated: 0–50 mg/L mercaptans, 0–1 mg/L H_2S

Remarks: Other applications are available for the petrochemical industry such as: salt in crude oil, ammonia, phenol, bromide index, saponification value, halogens, acidity, and many more.

Keywords: Mercaptans, thiols, sulfide, desulfurization, refinery, corrosion, 2045TI Ex-proof

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