Facility Inspection Report

Tail Gas Treatment Unit

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Tail Gas Treatment Unit

Executive Summary

- This unit was installed in 2000 as part of a gasification facility to convert heavy refinery residues into clean syngas. The facility shut down in early 2013. The entire gasification facility is available for sale.

- The unit was designed by ABB Lummus Global and utilizes Parsons technology for the removal of approximately 2.2% of hydrogen sulfide (H\textsubscript{2}S) and sulfur dioxide (SO\textsubscript{2}) from 11,000 kg/hr of tailgas leaving the Sulfur Recovery Unit (SRU) section which is also available for purchase. The MDEA flow rates in the contactor and regeneration sections are 100 m\textsuperscript{3}/hr.

- The Tail Gas Treatment Unit can be used for the removal of H\textsubscript{2}S and SO\textsubscript{2} from any tailgas-type stream in refinery, petrochemical, or metallurgical applications.

- The unit uses conventional equipment; reducing gas generator, hydrogenation reactor, contact condenser column, MDEA contactor column, MDEA regeneration column and forced-draft thermal oxidizer.

- Spare parts for this facility are abundant and include complete exchangers, motors, and some column trays and other internals.

- Documentation is excellent in both paper and electronic formats. All types of documentation were reviewed and found acceptable during the inspection. We have electronic copies of PFDs, major equipment data sheets, major equipment manufacturers’ drawings, mass balances, detailed equipment lists, plot plans, process descriptions, and historical production data.

- Process control is by ABB Advant DCS and is available with the sale of the unit.

- There is no asbestos in this facility due to its fairly recent construction.

- The site has good rail and truck access. It is located directly on the ocean and has its own harbor. Equipment removed from this facility can be loaded directly on barges at the facility shoreline, since this is how the equipment was delivered.
As mentioned in the Executive Summary, the Tail Gas Treatment Unit is part of a larger gasification plant. The facility shut down in early 2013. The entire gasification facility is available for sale.

This Syngas Manufacturing Process Plant (SMPP) converts heavy refinery residues into clean syngas utilizing licensed technology from Texaco, ABB, UOP, Parson, and Praxair. Under normal operating conditions, approximately 59 mt/hr (1,400 mt/day) of heavy residues are consumed by the SMPP (Syngas Manufacturing Process Plant) in the production of about 140 mt/hr of clean syngas, consisting primarily of CO and H₂.

The syngas is then diluted with nitrogen and burned as a combustible fuel in the Combined-Cycle Process Plant (CCPP) gas turbine (not available for sale). This process results in very low production of sulfur oxides and NOₓ. The output from this unit includes about 33 m³/hr of pre-treated water and a 4 mt/hr of liquid sulfur.
The Tail Gas Treatment Unit (TGTU) takes 11,000 kg/hr of tailgas from the Sulfur Recovery Unit (SRU) section containing approximately 2.2% of hydrogen sulfide (H₂S) and sulfur dioxide (SO₂). The methyl diethanolamine (MDEA) flow rates in the contactor and regeneration sections are 100 m³/hr.

The tail gases are first heated in the reducing gas generator to 310°C through the combustion of natural gas. The refractory-lined combustion chamber of the reducing gas generator is 1.4 meters diameter by 4.6 meters long. Combustion air is supplied by blowers and steam is added to reduce the formation of soot. It is rated for a heat load of 1,138 KW.

The hot gases exiting the reducing gas generator flow to the hydrogenation reactor where all sulfur-containing compounds are reduced to H₂S so that they can then be recovered in the downstream MDEA system. The hydrogenation reactor is a fixed bed reactor containing cobalt/molybdenum catalyst supplied by Sud-Chemie (Extrusion Type C29-2). This catalyst has a surface area of 210 square meters per gram. The reactions are exothermic so the reaction products leave at about 385°C.
The hydrogenation reactor product gases are cooled in an exchanger and then sent to the contact condenser column where they are further cooled and scrubbed with caustic to remove any SO₂ before being fed to the MDEA system. The lower section of the column contains six baffle trays and two bubble-cap trays while the upper section of the column is packed. Caustic contact is carried out in the lower section and gas is washed with water in the upper packed section. A pH of about 8.5 is maintained in the lower section through the make-up of fresh, 50% caustic solution. Water is circulated through the upper packed section of the column to cool the gas to a suitable temperature for the downstream MDEA system. Water is circulated in the upper section with a pump taking suction from a chimney tray.

The cooled tail gas containing H₂S and CO₂ exits the top of the contact condenser column and enters to bottom of the MDEA contactor column. Here, the gas comes in contact with a countercurrent flow of lean MDEA solution (Ucarsol HS-101 in a 50% aqueous solution). The MDEA is circulated at about 100 m³/hr. The H₂S is preferentially absorbed in the MDEA solution. The gas leaving the top of the MDEA contactor column contains less than 150 ppm of H₂S. This gas flows through a knock-out pot which is built into the lower section of the MDEA contactor column, and on to the thermal oxidizer for final destruction.

The thermal oxidizer is a forced-draft incinerator designed to oxidize all of the combustible constituents of the MDEA tail gas. However, it can also handle the tailgas directly from the SRU if the TGU is shut down. The thermal oxidizer also takes gases from the sulfur storage pit and various storage tank vents. It is rated for a heat load of 4,300 KW.

The rich MDEA solution (loaded with H₂S) is pumped from the bottom of the MDEA contactor column and preheated prior to entering the MDEA regenerator column. This column has 22 valve trays, two chimney trays, and an upper packed section. Acid gases from the top of the column are sent back to the sulfur recovery unit (also available). The lean MDEA solution from the bottom of the column is recycled back to the contactor. The MDEA is circulated at about 100 m³/hr. Water is recirculated through the upper packed section with a pump taking suction from a chimney tray. Make-up purge water is added at this point. The lower section of the regenerator column is driven with a steam-heated reboiler.
The following picture includes all three Tail Gas Treatment Unit columns; the contact condenser column, the MDEA contactor column, and the MDEA regenerator column.
## Major Equipment Details

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<th>Equipment Description</th>
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<th>Pressure Sh/Tu (bar)</th>
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<th>Diameter (m)</th>
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<th>Area (m²)</th>
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