Abstract

Process Economics Report 216

ACID GAS TREATMENT AND SULFUR RECOVERY

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This report addresses the technology and economics of removing acid gases—H_2S, CO_2, COS, CS_2, and mercaptans—from gaseous process streams and the subsequent conversion of H_2S to S for sale or disposal. This topic is especially important now to the process industries because environmental regulations governing the atmospheric discharge of sulfurous gases are becoming increasingly stringent. In another respect, recovered S from petroleum refining and natural gas and mineral processing is now the major source of S for fertilizer production and other industrial applications. In addition to an extensive review of technological developments and process selection guidelines, the report discusses market issues concerning the world supply/demand of S and the prospects for recovered S. These data are valuable to process developers, market researchers, and plant operators.

To illustrate the process economics of acid gas removal and S recovery, we selected the following four representative new or improved process chains for treating four different sour gas streams:

- Refinery gas desulfurization by methyldiethanoamine absorption-Claus S recovery-Hydrosulfreen® tailgas treatment
- Natural gas desulfurization by Sulfinol absorption-Claus S recovery-Super SCOT tailgas treatment
- Synthesis gas desulfurization by Benfield absorption-Selectox S recovery-CBA tailgas treatment
- Natural gas desulfurization by diethanolamine absorption-LO-CAT II® direct H_2S oxidation.

We selected these process chains because each has unique features that offer improved acid gas removal efficiency and/or reduction in energy consumption.

Our study findings indicate that a high flowrate sour gas stream containing small amounts of S compounds results in a high S recovery cost on an S weight basis, but a low treatment cost in terms of the sour gas volume treated. In contrast, a low flowrate sour gas stream containing high concentrations of S compounds results in a low S recovery cost on an S weight basis, but a high treatment cost in terms of the unit volume of the treated sour gas. Overall, at today's depressed market prices for recovered S, the sales value of recovered S is unlikely to be high enough to offset the recovery cost, except perhaps for very large or fully depreciated recovery plants. The shortfall can be considered as an environmental control cost.

GLOSSARY

Term	Definition
ADA	Anthraquinone-disulfonic acid
BSR	Beavon sulfur removal
CBA	Cold bed adsorption
CRU	Claus recovery unit
DEA	Diethanolamine
DGA	Diglycolamine
DIPA	Diisopropanolamine
DMPEG	Dimethyl polyethylene glycol
EDTA	Ethylenediaminetetraacetic acid
EPA	U.S. Environmental Protection Agency
GRI	Gas Research Institute
G-V	Giammarco Vetrocoke®
HEDTA	Hydroethylenediaminetetraacetic acid
IFP	Institut Français du Pétrole
LPG	Liquefied petroleum gas
lt	Long ton = 1.016 metric tons = 2240 pounds
MCA	Methylcyanoacetate
MDEA	Methyldiethanolamine
MEA	Monoethanolamine
MPE	Methyl isopropyl ether
NMP	N-methyl-pyrrolidone
NTA	Nitrilotriacetic acid
PC	Propylene carbonate
Redox	Reduction-oxidation
S	Sulfur
SCOT	Shell Oil's Claus Off-gas Treatment
SRU	Sulfur recovery unit
TBP	Tri-n-butyl phosphate
TEA	Triethanolamine
TMP	Tri-n-butyl phosphate
USBOM	U.S. Bureau of Mines

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