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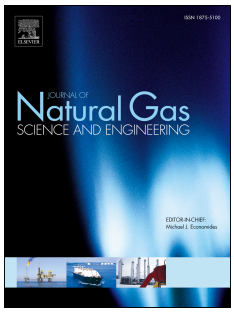

Feasibility Study of a Sulfur Recovery Unit Containing Mercaptans in Lean Acid Gas Feed

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Abstract

Acid Gas Enrichment (AGE) and Tail Gas Treatment (TGT) are conventional processes to enhance recovery of sulfur in sulfur recovery plants. Depending on the presence of organic sulfur components such as mercaptans and carbonyl sulfide, two configurations for AGE off-gas may be considered. Optionally, AGE off-gas can be sent to incinerator or fed to TGT section. In this paper, these two cases are investigated in terms of technical and economical points of view. The achieved results show that although routing AGE off-gas to TGT section will increase the size and cost of TGT equipment, it can reduce the environmental pollutants.

Keywords: Sulfur Recovery, Tail Gas Treatment, Mercaptan, AGE Off-Gas

1. Introduction

Claus process is usually applied for converting hydrogen sulfide to elemental sulfur in oil and gas refineries. This process consists of a reaction furnace, a waste heat boiler (WHB) and a series of catalytic converters and condensers. In first stage, about 60% of H_2S is converted to elemental sulfur. More conversion is achievable in the catalytic converters. Overall recovery of sulfur in the Claus process hardly exceeds 96 percent. Unrecovered sulfur compounds including elemental sulfur, COS, and CS_2, are burned and converted to SO_2 in the Claus incinerator and then sent to atmosphere. Nowadays, stricter environmental regulations have limited the allowable emission of SO_2. For low calorific gases from gasification of refinery residues, SO_2 emission has been limited to 800 mg/Nm^3 in the EU and the USA. According to Iranian parliament law, this value must be lower than 800 mass ppm. In both of them O_2 content must be less than 3 mole% in the flue gas. Therefore, TGT section is applied before incinerator for more processing of the Claus tail gas and improving the overall recovery of sulfur [1-6].

On the other hand, a lean acid gas feed containing a relatively low concentration of H_2S may be incapable of producing a stable flame in the reaction furnace. Moreover, incomplete combustion of hydrocarbons in the feed can lead to deterioration of the catalyst. Furthermore, the amount of the byproducts such as COS will be increased at low furnace temperatures. During decades, several configurations for processing of lean acid gas have been presented, including oxygen enrichment of the combustion air, acid gas bypass around the furnace, fuel gas injection, acid gas preheating, acid gas enrichment, etc [7-9]. The AGE section enriches the H_2S content of the acid gas stream making it practical to recover sulfur in a Claus section. Figure 1 shows the schematic diagram of the AGE and TGT sections [10-12].