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Dynamic Design Simulation of Acidic Natural Gas Sweetening Analysis and the Utilization of Hybrid Amine Membrane

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Abstract

In order to remove acid gases, chemical absorption by solvents is the most often used sweetening gas strategy. While this method is well-known and tested, it may be difficult to implement, expensive, and wasteful when used to extract very acidic gas. But novel polymeric membranes have been used to remove large amounts of H_2S from natural gas, even at high levels of H_2S. Recent advancements in this field might lead to the production of unconventionally high acidity gas or the retrofitting of existing facilities. For example, the membrane system might be used to lower the bulk concentration of H_2S and CO_2 in the input gas. An amine-based method might be used to sequentially meet the ultimate sweet gas product criteria. It is thus possible to reduce capital and operational costs by using this sort of hybrid design. Using a simulation-based approach, this research evaluates the sweetening of extremely acidic gas with 15% H_2S (i.e., over 20% of H_2S and CO_2 combined). ProMax® v3.2 was used to model the suggested hybrid procedure. According to the simulation findings, a hybrid system approach to the sweetening process might cut operational and utility costs (instead of a stand-alone amine system).

Keywords: Water, Sweetening, CO_2, Acidic Gas, Hybrid, Simulation, Amine, ProMax® v3.2

1.0 INTRODUCTION

Increased concerns about achieving future natural gas needs and export obligations have been voiced recently by a rising number of nations. Due to rising electricity and desalinated water needs, rising living standards, and gas injection for enhanced oil recovery (EOR) operations to extend the life of existing oil fields, this trend is especially visible in the Middle East area [1]. In order to fulfill rising demand for natural gas, companies have been compelled to tap previously uneconomical acidic gas reserves. Sulfur concentration in natural gas poses a significant technological and economic issue [2]. The most frequent method for removing acidic gases from natural gas is absorption using amines. An aqueous solution of alkanolamines (e.g., MEA, DEA, DGA, and MDEA) is used in a tray-packed tower to contact the acidic gas As a result, the process is very energy-intensive because of the high temperature needs for solvent regeneration. Acid gas concentration and natural gas supply flowrate are directly related to the matching energy needs. New approaches like hybrid systems may help overcome the problems and significant operating expenses associated with handling very acidic gas. As a first step, a membrane module may be able to reduce the acid content in the feed gas, while a subsequent stage of gas absorption might match the

4.0 CONCLUSION

An amine-based absorption unit and a single membrane module are presented in this work as a hybrid system. Stand-alone absorption units using DGA and MDEA as solvents were determined to be the most energy-efficient procedures for sweetening extremely acidic gas, according to a preliminary simulation analysis and literature material. DGA and MDEA were chosen for the suggested hybrid system analysis since they are both solvents.

When compared to a standard stand-alone absorption process, the hybrid system's economics indicated that it might be more cost- and energy-effective. It is thus possible to save money by using hybrid system principles, which may reduce the usage of steam and electricity. Due to their improved energy efficiency, hybrid systems may also be better for the environment.

In terms of operability, hybrid processes are more adaptable. Retrofitting gas facilities using membrane modules for bulk removal of H_2S might minimize sweetening costs while increasing operational flexibility for treatment input flow rates and composition variations. H_2S removal using membrane modules can only go so far; consequently, depending only on membranes to decrease acid gases concentration into ppm levels is infeasible because of methane losses and the large membrane area requirements. The membrane module's operational costs are heavily influenced by methane leakage. Because of the decreased methane recovery rates, this is one of the key issues and obstacles of using membrane modules.

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