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Effect of Different Types of Amines and Amine Blends on Acid Gases Removal, Energy Consumption and Amine Losses: A Case Study

H. Nejatian Daraei[1*], Z. Alipour Heidari[2], M. Ansari[3], E. Sahraei[4]
[1-3] National Iranian South Oil Company (NISOC)
[4] Sahand Research Institute of Oil and Gas (SRIOG), Sahand University of Technology

ABSTRACT

The gas sweetening unit of NGL-X plant is designed for removing H_2S and CO_2 from natural gas stream to 4 ppm and 20 ppm, respectively (optimum removing in this plant). Currently, 30 wt% DEA solution at circulation rate of 15700 Kgmole/h is used to achieving optimum removing of acid gases. In this simulation study, the effects of eleven different types of amines and amine blends on acid gases removal, consumed energy for amine regeneration and mine losses of this gas sweetening unit have been investigated. The results clearly show that 30 wt% DEA, blend of 20 wt% TEA and 20 wt% DEA and blend of 10 wt% MEA and 30 wt% MDEA have the potential of H_2S and CO_2 removal to optimum removing. Blend of 10 wt% MEA and 30 wt% MDEA is not recommended for gas sweetening due to high amine losses during gas sweetening process. Blend of 20 wt% TEA and 20 wt% DEA has the ability of acid gases removal to optimum removing at lower amine circulation rate, LP steam consumption and amine losses compared to the 30 wt% DEA. However, TEA is not recommended for gas sweetening and then use of 30% DEA is a logical choice for this plant.

Keywords: Acid Gas Removal; Simulation; Amine; Amine Blend; Sweet Gas.

1. INTRODUCTION

Recently, due to the increasing consumption of natural gas, development of gas treating process has been prospered. Gas sweetening is one of important gas treating process that it including removal of CO_2 and H_2S (acid gases) from natural gas stream to meet the gas pipe line specifications. Stewart and Arnold (2011) note that gas contracts restrict H_2S content about 4 ppm and CO_2 about 2% in natural gas stream. Thus, many gas sweetening processes have been developed to remove acid gases from natural gas stream, including chemical solvent methods, physical solvent methods, and solid bet sweetening methods (Abdulrahman and Sebastine; 2012a, 2012b). However, The method is widely used to remove acid gases is amine gas sweetening process that more than 50% of current acid gas removal technologies use aqueous solutions of alkanolanamines. Due to the molecular structure alkanolanamines, they are divided into three main groups: primary, secondary, and tertiary. Blended of amines are also used in the industry. However, the gas sweetening process is extremely energy-intensive particularly for amine regeneration (Wang et al., 2015). In the past few years, mixed amine solvents for the removal of acid gases have received increased attention in order to minimize energy consumption (Polasek et all, 2006). In this paper, the effect of eleven different types of amine and amine blends on acid gases removal and energy consumption during amine solution regeneration is studied using simulation. The amount of amine solution losses for each amine or amine blend is also investigated and the favorable amine/amine blend is proposed base on this case study.

2. PROCESS DESCRIPTION OF GAS SWEETENING UNIT OF NGL-X PLANT

The sour rich gas from the Siah Makan High Pressure slug catcher is brought to the NGL-X plant gas sweetening unit as the feedstock. The sour gas is processed in the gas sweetening unit, to produce sweet rich gas as the main

* Corresponding Author, Email Address: Hamed.Nejatiyan@gmail.com