1st Post Combustion Capture Conference

Simulation and Optimization of an Existing 150 ton/day CO_2 Capture Plant from a Flue Gas Slipstream of a Coal Power Plant

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1. Introduction

A rate-based model has been formulated to predict the actual behavior and performance of the existing 150 tons per day carbon dioxide (CO_2) capture plant. The model is also used to plan the operating conditions for optimum utilization of the resources; such as material, utilities, and units capacity. In addition, the developed rate-based model is used to explore the feasibility of changing the solvent concentration, altering the solvent composition, altering the existing equipment, and changing some of the operating conditions. The optimization study presented that it is possible to minimize the operating cost and to enhance the production capacity at minimum additional investment.

2. Plant Description

This CO_2 capture plant was built in 1998 to recover CO_2 from flue gases generated in coal fired steam boilers by using 16-17wt% Monoethanolamine solvent (MEA). A slipstream of 5-6% of the flue gas is taken from the coal power plant and sent to CO_2 capture plant through two blowers operating at 60% capacity. The flue gas enters the CO_2 recovery facility at the flue gas scrubber in order to reduce the SO_2 concentration to less than 10 ppmv. The flue gas is further cooled to 40 ^{o}C before entering the amine absorber column. The major equipments in the plant include SO_2 scrubber, flue gas cooler, CO_2 absorption column, solvent stripper column, solvent reclaimer, and filtration system. The captured CO_2 is sent to the purification/liquefaction package for food grade applications.

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3. Optimization Approach and Key Findings

A rate-based modeling approach is used to simulate the performance of the CO_2 capture plant using actual plant process flow-sheet and operating parameters, such as the flue gas rate/composition, solvent rate/composition, HSS content in the solvent, temperature/pressure of major streams, steam flow rate/condition, etc. Comprehensive material and energy balances were produced by the rate-based model based on the input parameters of the existing plant. Figure 1 shows a comparison between the actual plant data and modeling results. The average absolute deviation of the predicted parameters from the measured parameters is ± 8%.

Subsequent to this simulation results, this rate-based model is used to plan the operating conditions for optimum utilization of the resources; material, utilities, and units capacity. The optimization study indicated that:

a) It is possible to increase the capacity of the plant by increasing the solvent concentration and without any additional capital expenditure.

b) The operating cost can be reduced by operating at different lean/rich loading approach and without any additional capital expenditure.

c) Formulated solvent can be used within the existing equipment and it will enhance the production capacity and decrease the operating cost in terms of fluid pumps and reboiler duties.

d) Changing the absorber packing will enhance the production capacity.

The details of this optimization study and the findings will be presented at the conference.

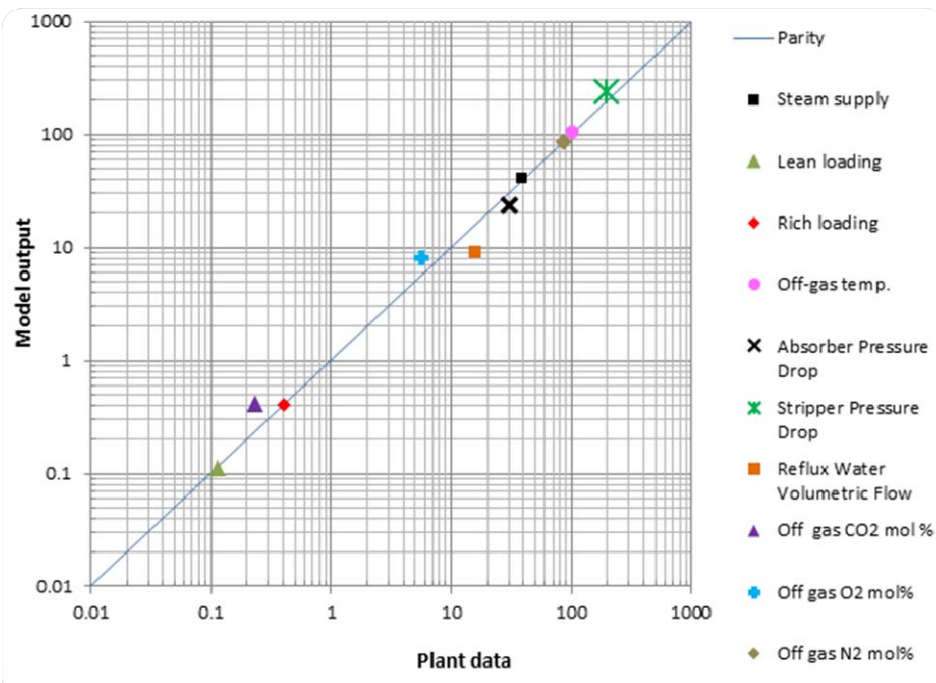

Figure 1 Comparison of Actual Plant Data versus Modeling Results for 150 ton/day Existing CO_2 Capturing Plant from Coal Flue Gas