1st Post Combustion Capture Conference

Design of Commercial Post Combustion CO_2 Capture Plant using Pilot Plant Scale-up Approach

Mohamed Elgarni and Ahmed Aboudheir*

HTC Purenergy, 150 – 10 Research Drive, Regina, SK, S4S 7J7, Canada

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1. Introduction

The post-combustion CO_2 capture from gaseous mixtures by means of liquid absorbents is a proven technology and will continue to be one of the leading industrial techniques for many decades to come. The rate-based modeling approach has been presented in this paper to scale-up CO_2 capture process based on coal flue gas from 150 and 800 ton per day existing CO_2 commercial Plants to 4000 tonne per day planned CO_2 commercial plant. The behavior of the rate-based model has been extensively verified based on actual pilot plant data using Monoethanolamine solvent (MEA), Regina Solvent (RS-2), Piperazine solvent (Pz), random packing, structured packing, conventional process configuration, and advanced process configuration.

2. Pilot Plant Scale-up Approach

Rate based modeling is a powerful tool for design, optimization and scale-up of reactive separation processes. The rate based model is a non-equilibrium approach to modeling absorption with chemical reactions and it involves the use of actual chemical kinetics, thermodynamic non-idealities, heat transfer, mass transfer of multi-component systems and employ the real column configuration and internals. The formulated model is extensively validated against actual performance data from pilot plants and existing commercial plants as follows:

a. ERTF Pilot (1) tonne/d -- MEA solvent, RS-2 Solvent, TKO configuration
b. Boundary Dam pilot plant (4) tonne/d -- MEA solvent, RS-2 Solvent, TKO configuration
c. SRP Pilot Plant, (3) tonne/d -- Campaign 2008, standard configuration, Piperazine solvent
d. Castor Pilot Plant (24) tonne/d -- Campaign 2, MEA solvent & standard configuration
e. SVM commercial CC plant (800) tonne/d -- MEA solvent & standard configuration
f. AES commercial CC plant (130) tonne/d -- MEA solvent & standard configuration

The predicted performance results were found to be in close agreement with the measured values in all the above cases. Based on these agreements between the predicted and measured performance data, it can be concluded that no significant challenges and risks should be expected in designing, building, and operating large-scale amine based plants which have been planned for the next five years in different parts of the world.

3. Case Study for designing 4000 TPD using Rate-Based Modeling

Our preliminary design for the planned 4000 tonne per day CO_2 capture plant from coal flue gas shows that this plant is feasible and that the production capacities and the clean-up targets can be easily achieved using formulated solvents, advanced one-train process configuration, and optimum operating conditions.

* Corresponding author. Tel.: +1-306-352-6132; fax: +1-306-545-3262.
E-mail address: aaboudheir@htcenergy.com.