Aspen Plus simulation of CO_2 removal from the coal and gas fired power plant

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Post combustion absorption technology is the most effective removal process for carbon dioxide from flue gas using regenerable solvents. Implementation of an adaptable model that simulates the removal of CO_2 from coal fired power plant and gas fired power plant increases the flexibility of the overall model. The sensitivity analysis helps to find the optimum conditions to get better removal efficiency. This paper presents a detail description of the CO_2 removal process of coal and gas fired power plant. The flue gases of 500MW coal and gas fired power plants were considered for the simulation. The parameters and other operating conditions for Aspen Plus rate based model were selected to achieve 85% of CO_2 removal. Composition of the flue gas was selected to best approximate the industrial conditions. Due to chemical reactions and ions participating for the process, Electrolyte NRTL property method was selected. Figure 1 illustrates the process flow diagram implemented in Aspen Plus.

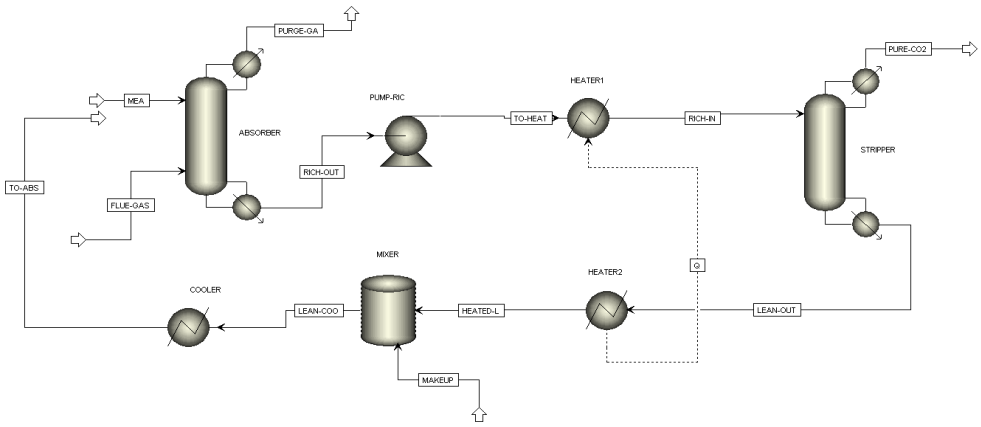

Figure 1: Process Flow Sheet

The sensitivity analysis was carried out to examine the effect of various factors on re-boiler duty. The effect of absorber pressure and packing height as well as solvent temperature on re-boiler

duty were analyzed. The re-boiler duty variation on absorber packing height is given in the Figure 2.

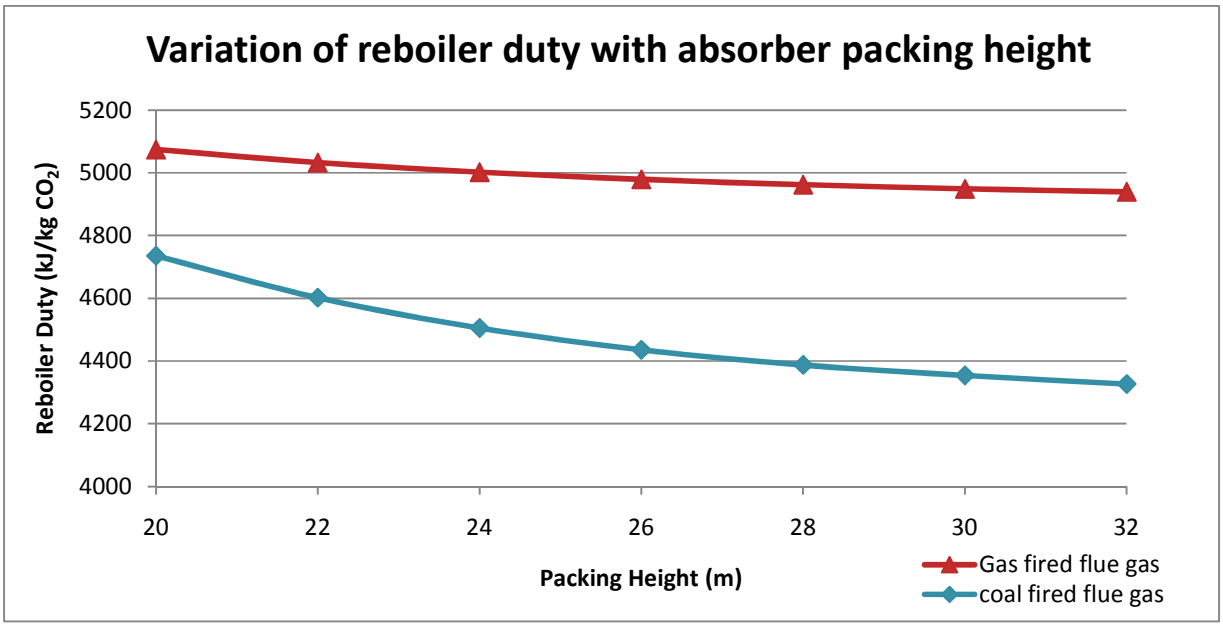

Figure 2: Re-boiler duty variation with absorber packing height

In order to study the effect of packing height on re-boiler duty, the diameter of the packing is kept constant and height of the absorber was varied. The re-boiler duty variation with absorber packing height is given in Figure 2. As it can be seen from Figure 2, the re-boiler duty for CO_2 recovery process decreases as the absorber packing height increases. The attained rich loading increased with the increase in the absorber packing height. As a consequence, the re-boiler duty and the total energy requirement decreased. Re-boiler duty for gas fired flue gas CO_2 removal process is higher compared to the coal fired flue gas system. This is because higher CO_2 composition in coal fired system compared to that of gas fired system. Gas fired system required to process large amount of flue gas to remove the CO_2.

Similarly, absorber pressure and solvent temperature effect on re-boiler duty were analyzed. Re-boiler duty decreases with the increase in absorber pressure. It is due to CO_2 removal efficiency is higher with high absorber operating pressure. However, the absorber pressure greater than 1 bar has got converging problems. Likewise, the re-boiler duty decreases with an increase in solvent temperature from 20 to 40^{o}C. This is because decreasing of the driving force with the increase in solvent temperature. Always gas fired re-boiler duty is higher compared to the coal fired removal process.