Modeling and Simulation of Gas Liquid Absorption Column for So2 Removal Process

V. Priya, Dhanasekar J , G.Vasumathi

Abstract* : *During coal combustion, sulphur in the coal is converted into sulphur dioxide (SO2).This sulphur dioxide (SO2) is responsible for the formation of acid rain which is one of the widespread forms of pollution all over the world that causes harmful effects to humans and environment. To minimize the adverse impacts of SO2, it must be removed from flue gas. For reduction of SO2, flue gas desulphurization (FGD) is most commonly used. The mathematical viewer is developed and simulated for a gas liquid absorption column to control the flow rate of H2O2.The model equation is developed by considering material balance around the column. The absorption rate is determined by using different concentration of sulphur dioxide with hydrogen peroxide. Hydrogen peroxide, not only absorbs the SO2 but it also produce useful by-product in the form of sulphuric acid (H2SO4).

Keywords: Air pollution, Flue gas, Sulphur dioxide, Desulphurization.

I. INTRODUCTION

SO2 is a vapid gas with a sharp smell delivered from the consuming of coal High convergences of SO2 can effectsly affect wellbeing, however increasingly significant today is its job as an antecedent to the development of particulates, a universal danger to general wellbeing and nature. Long-go transport of sulfuric mixes additionally prompts the testimony of sulfur in soils and conduits in areas far off from the wellspring of discharges. Sulfur affidavit, all the more generally known as corrosive downpour, adds to fermentation of timberlands and lakes. [1],[3],[5]

A. PREVENTION METHODS

Emanation of unsafe mixes to the air brought about by ignition of non-renewable energy sources is a natural concern everywhere throughout the world. Sulfur and nitrogen oxides are among the most disturbing poisons because of their extraordinary worldwide outflow and long range transport in the air.

(FGD)

Pipe (FGD) is an advancement used to empty sulfur dioxide (SO2) from the exhaust vent gases of oil subordinate power plants, and substance producers of sulfur oxides. As stringent normal rules with respect to SO2 spreads have been requested in various countries, SO2 is directly being removed from vent gases by a grouping of procedures. The underneath is among the ordinary systems used: [7],[9], [10]

Dry sorbent implantation systems.

For a regular coal-ended power station, FGD will clear 95 percent or a more noteworthy measure of the SO2 in the pipe gases

GAS LIQUID ABSORPTION COLUMN

By means of gas liquid interface gaseous component is transformed from gas phase to liquid phase.

Fig.1 Counter current packed tower

II. DEVELOPMENT OF MATHEMATICAL MODEL

The enduring state process ingestion of the CO2-NaOH framework has been examined already [1] where the pace of assimilation, the pace of exchange of material through the gas film will be equivalent to that through the fluid film, and the age for the age for mass exchange of a part is portrayed by condition (1)

Material balance around the column:

$$G(C_{G1} - C_{G2}(t) = L(C_{L1}(t) - C_{L2}(t)) \quad (2)$$

Material balance around the tank:

Inlet flow rate – outlet flow rate = rate of accumulation

Schematic Gas Liquid Absorption System

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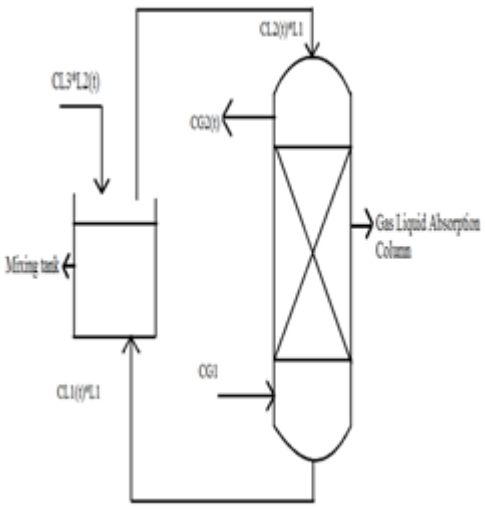

Fig2.Gas Liquid Absorption System

Henry's Law

An equivalent way of stating the law is that the solubility of a gas in a liquid is directly proportional to the Concentration of inlet gas.

$$CL_1(t) = \frac{CG_1}{H'} \quad (3)$$

$CL_1(t)$ = Mole fraction of solute in the liquid

CG_1 = Concentration of inlet gas

H' = Henry's law constant

Mixing Tank Equation

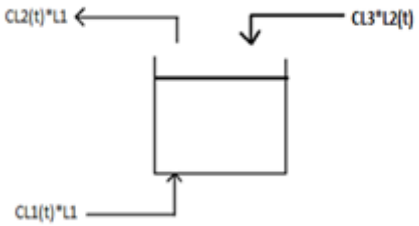

Fig 3. Mixing Tank

$$\frac{VdCL_2(t)}{dt} = L_1CL_1(t) + CL_3L_2(t) - L_1CL_2(t)$$

$$\frac{VdCL_2(t)}{dt} = L_1CL_1(t) - L_1CL_2(t) + CL_3L_2(t)$$

$$\frac{VdCL_2(t)}{dt} = (L_1(CL_1(t) - CL_2(t)) + CL_3L_2(t)$$

$$\frac{dCL_2(t)}{dt} = \frac{(L_1(CL_1(t) - CL_2(t)) + CL_3L_2(t)}{V}$$

$$CL_2(t) = \int \frac{L_1(CL_1(t) - CL_2(t) + CL_3L_2(t)}{V} \quad (4)$$

Material balance equation

$$G(CG_2(t) - CG_1) = L(CL_1(t) - CL_2(t))$$

$$CG_2(t) - CG_1 = \frac{L}{G}(CL_1(t) - CL_2(t) \quad (5)$$

Simulink block for Mixing Tank Equation

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Function CL_2= fcn(CL1,CL2,L2)
L1=0.2;
V=50;
CL3=0.1;
CL_2= ((L1*(CL1-CL2)+(CL3*L2)/V));
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Simulink block for Wet scrubber Equation

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Function [CG2,CL_1,CL_12]= fcn(CL1,CL2,L2)
CG1=650;
CL3=0.1;
K1=1;
K2=1400;
L1=0.2;
G=50;
CG2 = (CG1-((L1/G)*(CL1-CL2)));
CL_1= CG1/K1;
CL_12= (CG1*(CL3/L2)*K2)
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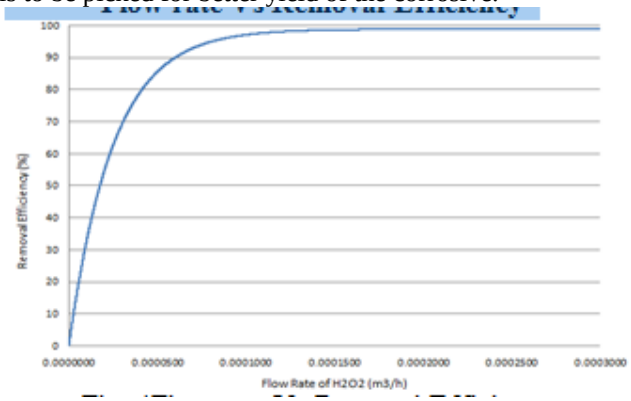
III. RESULT AND DISCUSSION

Characteristic graph:

Flow rate Vs Removal Efficiency

For different flow rates, corresponding Removal Efficiency of the acid are noted. It is realized that for expanding in the stream pace of hydrogen peroxide the Removal Efficiency of the acidobtained gets expanded. Thus reasonable stream rate is to be picked for better yield of the corrosive.



Flow rate Vs Removal Efficiency

Time Vs Outlet Concentration of SO_2

When the time increase the outlet concentration of SO_2 continuously decreases and after a certain period of increasing time the outlet concentration remains constant.

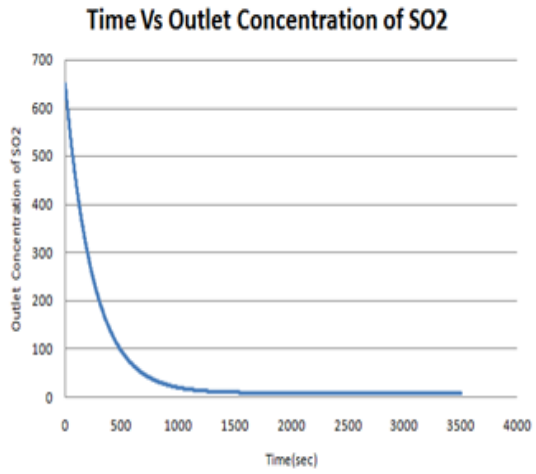


Fig.5 Time Vs Outlet concentration of SO_2

IV. CONCLUSIONS

From reproduction work it is affirmed that, (SO2) is changed over to sulfuric corrosive by utilizing Hydrogen peroxide (H2O2).By fluctuating stream pace of H2O2 and furthermore by differing the centralization of SO2. From simulation it is concluded that the setting time period is increased by increasing the inlet concentration of SO2.The modelling approach used, provides the better performance result. [2],[4],[6]

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