Design and Analysis of Co_2 Scrubber for Boiler

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Abstract*: Scrubber is an special arrangement packed with an special type of hard limestone, which is connected to the exhaust siAim of this project is to reduce CO_2 emission from the automobile. lencer and act as an secondary catalytic converter.A carbon dioxide scrubber is a piece of equipment that absorbs carbon dioxide (CO_2). It is used to treat exhaust gases from industrial plants or from exhaled air in life support systems such as rebreathers orin spacecraft, submersible cra ft or airtight chambers. Carbon dioxide scrubbers are also used in controlled atmosphere (CA) storage. They have also been researched for carbon capture as a means of combating global warming.The project scope included concept generation of a device to remove CO_2 from air, the development of a CO_2 measurement technique, investigation of chemistry and flow phenomena to determine design relations, and product design and embodiment. The scrubber system conceived specifically for AFC systems uses the temperature swing chemistry of a liquid chemical absorbent, monoethanolamine, and a packed bubble column apparatus to provide intimate gas-liquid interaction. Prototype development proved the Carbon Dioxide Continuous Scrubber (CDOCS) concept and a Patent Cooperation Treaty (PCT) patent was granted, followed by a full American patent.

Keywords: Analysis of CO2 scrubber, CO2 scrubber, Scrubber by using limestone, Design and analysis of CO2 scrubber, CO2 scrubber for boiler, Analysis of boiler

I. INTRODUCTION

Before starting every project its planning is to be done. Planning is very important task and should be taken with great care, as the efficiency of the whole project largely depends upon its planning while planning a project each and every detail should be worked out in anticipation and should carefully is considered with all the relating provisions in advance. Project planning consists of the following steps.

1. DRAWINGS

Drawing been decided for the project to be manufacture .Its detailed drawing specification for raw material and finished products should be decided carefully along with the specification of the machines required for their manufacture.

2. MATERIAL EQUIPMENT

The list of materials required for manufacture is prepared from the drawings. The list of is known as “BILL OF MATERIALS”. This is passed to the store keeper and the required materials taken from the store under permission of store keeper operation, the necessity of operation, the person to do the job, machine to be used to do the job are considered while planning the operation. Finally a best method is developed and the best method is applied to the fabrication of project.

3. MACHINE LOADING

While planning proper care should be taken to find the machining time for each operation as

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correct as possible. So that the arrangement for full utilization of machine can be made machine loading programmed is also known.

4. PURCHASE CONSIDERATION

It is different to manufacture the entire component needed for the equipment in the workshop itself. The decision about a particular item whether to purchase or to manufacture is taken by planning after making through study of relative merits and demerits.

5. EQUIPMENT CONSIDERATION

Result obtained from "PROCESS PLANNING" and "MACHINE LODING" helps in calculating the equipment requirement specification of the equipment should be laid down by considering the drawing. Drawing will also help in deciding and necessary requirement of tools, accessories.

6. COST CALCULATION/ COST ANALYSIS

The cost of the project can be calculated by adding following.

- Material Cost
- Machining Cost
- Overhead Expenses.

7. COMPARISION

The various items in the finished project are compared to the standards for the further correction.

8. REPORT

At the end of the project work report is prepared for future references. The report consists of all the items done the project work.

II.CARBON DIOXIDE

When a fossil fuel is burned, carbon dioxide – CO_2 for short – is inevitably produced as well. This is as true of coal as it is of natural gas and mineral oil.

CO_2 is a natural component in the atmosphere. Humans and animals emit it every time they exhale. Carbon dioxide, just like water vapour, shares the responsibility for the natural greenhousegas effect and brings Earth its moderate temperatures. The CO_2 ensures that some of the solar radiation does not escape back into space immediately, but remains in the atmosphere to warm the Earth's surface. Plants and sea algae need CO_2 to survive: they absorb it and, as a waste product, return the oxygen on which humans and animals, in their turn, depend.

One thing is clear: CO_2 is indispensable for life on Earth. But that does not mean that humans can release as much as they like into the atmosphere. So, if we are not to unduly inflate the natural greenhousegas effect and the observed rise in global temperatures, it makes sense to curb manmade carbon dioxide emissions.

Besides industry, traffic and private households, we find that the energy sector, as operator of coal and gasfired power plants, accounts for a large share of CO_2 emissions. So it is especially dutybound to lower its CO_2 emissions perceptibly.

III.CO_2 SCRUBBING

Imported fossil fuels are becoming scarcer and more expensive – because their geological deposits will be running out in the foreseeable future, and because they are used at times as instruments of power in economic and foreign policy. Germany's high dependence on imports for its energy supply makes it clear how sensible and necessary domestic lignite is for power generation.

Lignitebased power stations generate electricity reliably and at low cost. Their classic fluegas components sulphur dioxide, nitrogen oxide and dust have long since stopped being a problem thanks to optimized combustion technology and cleaning systems. Using processes like CO_2

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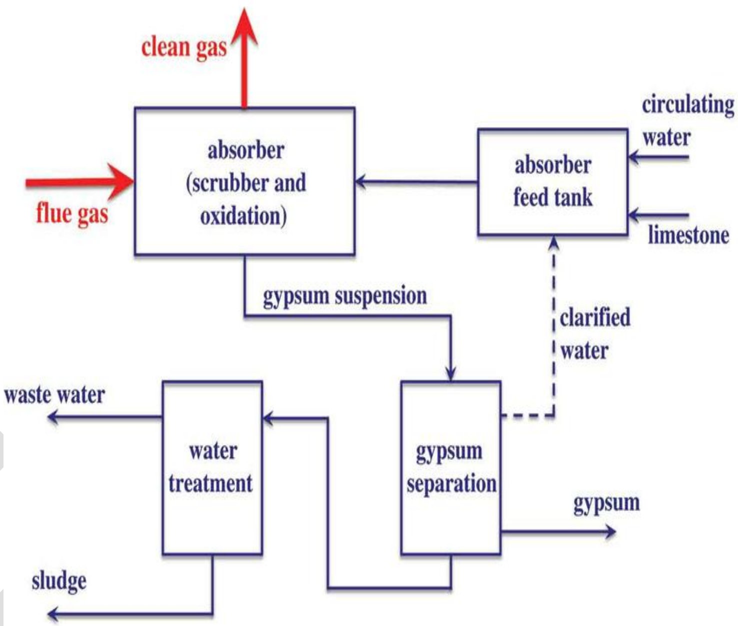
scrubbing, it could also be possible in future to avoid an additional 90% or so of CO_2 emissions in coalfired power generation. This method, referred to by specialists as PCC (postcombustion capture), is downstream of a power plant's combustion process. So, the process starts with CO_2 capture before the flue gas – cleaned of dust, nitrogen oxides and sulphur dioxide – reaches the atmosphere via a power station's cooling towers or stacks. The advantages of such a lowCO_2 power plant technology are obvious: the modern coalfired power stations being built today can be retrofitted with such a CO_2capture system, because it does not interfere with a power plant's actual combustion process. Even in a possible failure of the CO_2scrubbing system, electricity can still go on being produced reliably, i.e. the availability of the power plant is guaranteed at all times. This being so, all new RWE coalfired power stations are in principle being built "captureready", i.e. they can be retrofitted with CO_2scrubbing systems.

IV. MATERIALS CAN BE USED

- Calcium carbonate (caco3) lime stone
- Steel pipe (diameter 152.40 mm, length 457.2mm)
- Flexible metal tubes (heat transfer)
- Water pump
- Submersible water pump
- Pipe seaves (152.40 mm) (2 nos)
- Small size water sprinkler

V.BLOCK DIAGRAM



VI.FLUE GAS SCRUBBING WITH LIMESTONE SLURRY

A scrubbing process for flue gas desulfurization, based upon naturally occurring carbonate rocks, has been developed from laboratory to pilot plant scale. Calciticlimestones are better sulfur dioxide absorbents than dolomitic ones when used in the slurry form. The process was tested on a 200-cfm pilot plant on a coal-fired boiler. Various types of scrubbing equipment were evaluated. Up to 80 per cent sulfur dioxide removal was feasible. The consumption of limestone ranged between 20 and 30 per cent more than the stoichiometric requirements.

Limestone is a naturally occurring calcium carbonate rock which can react with sulfur dioxide. Limestone can therefore be used for desulfurization of flue gases. The reaction of sulfur dioxide with dry limestone requires a very high temperature such as

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that available within the actual boiler furnace. The efficiency of CO_2 removal by dry limestone injection has been found to be low. A much higher efficiency of CO_2 removal can be realized when the flue gas, after it has passed the precipitators, is scrubbed with an aqueous slurry of pulverized limestone. Since limestone is relatively cheap, it can be used on a nonregenerative basis; i.e., after it has reacted with CO_2, it can be disposed of as a solid waste. Provided adequate waste-disposal facilities are available, the limestone slurry process provides a relatively simple means of reducing sulfur oxide emissions from the power plants. This process is currently under development by the Research Division of Ontario Hydro. Results of the laboratory work and a 200-cfm pilot test are described here.

VII.CO2 SCRUBBER KIT


LIMESTONENOZZEL


CYLINDER INNER PLATE

BOTTEM PLATEWATER SPRAY PIPE

VIII. Mechanism of Sulfur Dioxide Removal

The absorption of CO_2 from the flue gases by alimestone slurry constitutes a three-phase system involving gas, liquid, and solid. When either calcium oxide or calcium carbonate is used, the active alkaline material is bicarbonate, formed as a result of a rather slow reaction between dissolved carbon dioxide and the stone. When the starting material is calcium oxide, it hydrates to form hydroxide, which subsequently undergoes a rather rapid reaction with the dissolved carbon dioxide to form calcium carbonate. The main reaction steps, regardless of which starting material is used, may be summarized as follows:

SO_2 (gas) ^ SO_2 (in solution) (1)

$SO_2 + H_2O$ ±; H+ + HSO_3- (2)

CO_2 (gas) ^ CO_2 (in solution) (3)

CO_2 (in solution) + H_2O ±=; H+ + HCO3- (4)

$CaCO_3$ (solid) ^ $CaCO_3$ (in solution) (5)

$CaCO_3$ (I Ca (HCO_3)2 ion) + HCO_3- + H+ ±; Ca (HCO_3)2 (6)

HSO_3- + H+ -> $CaSO_3$ + 2H2CO_3 (7)

$CaSO_3$ + ½ H_2O= $CaSO_4$ (8)

CaSOs + ½ H_2O = $CaSO_4$* ½ H_2O (9)

$CaSO_4$ + 2H_2O -> $CaSO_4$-2H_2O (10)

The overall reaction may be summarized by the two equations:

SO_2 + $CaSO_3$ +2 H_2O(11)

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$CaCO_3$ + $2H_2O$ ^5 $CaSO_3$-$2H_2O$| +CO_2 (11) $2H_2O$ -> $CaSO_4$-$2H_2O$ (12)

Calcium monosulphate, i.e., CaSOg, can further react with another molecule of SO_2 if the pH falls below 5, forming relatively soluble calcium bisufite,

i.e., Ca(HSO_3)2, as shown by the following equation:

$_P$H<5 $CaSO_3$ + SO_2 + H_2O ^=^ Ca (HSO_3)2 (13)

The sulfite-bisulfite reaction is pH controlled.

IX. CONCLUSION

Calciticlimestones are better absorbents for CO_2 than dolomitic stones. More than 70% CO_2removal from power plant flue gases appears feasible by scrubbing with aqueous limestone slurry. Limestone consumption is between 20% and 30% more than the stoichiometric requirement when the stone is ground to 200-mesh size and the slurry pH is maintained between 5.8 and 6.0. The flooded-bed type scrubbers, such as marble bed, sieve trays, are prone to plugging but can be operated trouble-free with proper control of operating conditions. Spray columns show promise for cleaning flue gases from power plants.

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