



REMOVAL OF CARBON DIOXIDE FROM FLUE GAS BY N, N-DIMETHYLAMINE N-ETHYLAMINE CHITOSAN SALT

ASWAR S.A. AND BHAGAT P.R.*

Organic Chemistry Division, School of Advanced Sciences, VIT University, Vellore-632 014, (India)

*Corresponding Author: Email- drprbhagat111@gmail.com

Received: February 28, 2012; Accepted: March 06, 2012

Abstract- The aim of this work is to analyze and describe the process of capturing of carbon dioxide (CO₂) from the flue gases by means of chemical absorption. N, N-dimethylamine N-ethylamine Chitosan salt is synthesized for the capturing of carbon dioxide (CO₂) from the flue gases. Aqueous N, N-dimethylamine N-ethylamine Chitosan salt 5 wt % in 1litre demineralized water has been selected for removing CO₂ from the combustion gases. The concentration of CO₂ in the flue gases ranges from 10 to 13 % after combustion and 100 % removal of CO₂ for 6 minutes at flow rate 1 liter per minute. This is having the removal capacity about 1.2 gm of CO₂ per liter of 5 % N, N-dimethylamine N-ethylamine Chitosan salt solution. Experimental test result has shown that the emission of CO₂ has been significantly reduced during the removal process.

Keywords- CO₂ Capture, Flue Gas, N, N-dimethylamine N-ethylamine Chitosan salt

Citation: Aswar S.A. and Bhagat P.R.(2012) Removal of Carbon Dioxide from Flue Gas by N, N-dimethylamine N-ethylamine Chitosan salt. International Journal of Knowledge Engineering, ISSN: 0976-5816 & E-ISSN: 0976-5824, Volume 3, Issue 1, pp.-135-136.

Copyright: Copyright©2012 Aswar S.A. and Bhagat P.R. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Power generation represents the chief contributor to globe artificial emissions, accounting in support of concerning one-third of the world's total exhausted amount of CO₂. These emissions can be reduced by a variety of measures, such as (i) improving combustion efficiency of the power plant, (ii) fuel substitution to lower or zero-carbon fuels, (iii) CO₂ capture technologies and (iv) Increasing the use of renewable energy sources. If no actions will be taken, the global manmade CO₂ emissions will dramatically increase and support the ever known green gas effect, meaning irreversible the global warming process^[1]

In principal among the types of fossil fuel used, coal has the highest carbon content, resulting in coal-fired power plants having the highest output rate of CO₂ per kilowatt-hour produced. Mitigation of the emissions of carbon dioxide from coal-fired power plants is the target of this work-project. Co-combustion of biomass with coal seems to be a solution for solving this problem. The explanation is based on the fact that the use of biomass for energy production does not supplementary increase the CO₂ content of the atmosphere through combustion in comparison to the CO₂ de-

stroyed by photosynthesis during the lifetime, and so, it is considered CO₂ neutral. Moreover, biomass has low concentration of sulfur, which is also very important. Substantial research & development efforts are now in progress aimed at improving capture technologies so as to render them more efficient and more cost-effective. Under these efforts also the presently reported research is included.

Capturing CO₂ might be applied to large point sources, such as large fossil fuel or biomass energy facilities, industries with major CO₂ emissions, natural gas processing, synthetic fuel plants and fossil fuel-based hydrogen production plants. Air capture is also possible. Air away from the point source also contains oxygen, however, and so capturing and scrubbing the CO₂ from the air, and then storing the CO₂, could slow down the oxygen cycle in the biosphere.^[2] Concentrated CO₂ from the combustion of coal in oxygen is relatively pure, and could be directly processed. In other instances, especially with air capture, a scrubbing process would be needed. Plants that produce ethanol by fermentation generate cool, essentially pure CO₂ that can be pumped underground.^[3] Fermentation produces slightly less CO₂ than ethanol by weight.

World ethanol production in 2008 is expected to be about 16 billion gallons or 48 million tonnes.^[4] Broadly, three different types of technologies for scrubbing exist: post-combustion, precombustion, and oxyfuel combustion:

- In post combustion capture, the CO₂ is removed after combustion of the fossil fuel this is the scheme that would be applied to fossil-fuel burning power plants. Here, carbon dioxide is captured from flue gases at power stations or other large point sources. The technology is well understood and is currently used in other industrial applications, although not at the same scale as might be required in a commercial scale power station.
- The technology for pre-combustion is widely applied in fertilizer, chemical, gaseous fuel (H₂, CH₄), and power production.^[8] In these cases, the fossil fuel is partially oxidized, for instance in a gasifier. The resulting syngas (CO and H₂O) is shifted into CO₂ and more H₂. The resulting CO₂ can be captured from a relatively pure exhaust stream. The H₂ can now be used as fuel; the carbon dioxide is removed before combustion takes place. There are several advantages and disadvantages when compared to conventional post combustion carbon dioxide capture.^{[5][6]} The CO₂ is removed after combustion of fossil fuels, but before the flue gas is expanded to atmospheric pressure. This scheme is applied to new fossil fuel burning power plants, or to existing plants where re-powering is an option. The capture before expansion, i.e. from pressurized gas, is standard in almost all industrial CO₂ capture processes, at the same scale as will be required for utility power plants.^{[7][8]}

Materials

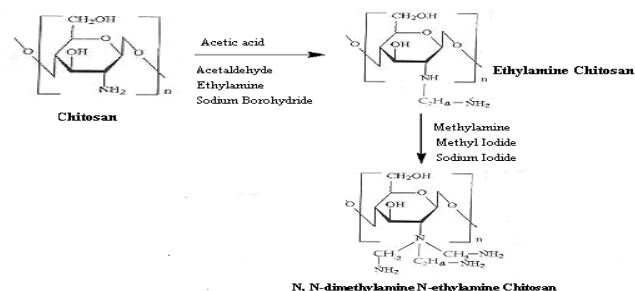
Chitosan (98.1% deacetylated), Methyl iodide, Sodium Borohydride, Acetaldehyde, N- methylpyrrolidone (NMP), Ethylamine, Methylamine, Acetone and Sodium iodide.

Method

500 mg of chitosan were dissolved in 1% w/v acetic acid (original pH 3.7±0.5). Then specific amounts of acetaldehyde were added to the chitosan solution and after 1.5h of stirring, the pH of solution was adjusted to 4.5 by adding Ethylamine solution. Then 2.0mL of a 10% sodium borohydride solution were added and magnetically stirred for 2h. The first step was to obtain ethylamine chitosan precipitate. The precipitate was washed with distilled water and then Soxhlet extracted with ethyl alcohol and ether (1:1 v/v) for 3 days to give ethylamine chitosan in high yield.

200mg of ethylamine chitosan were dispersed in 10mL of NMP for 5h. Then methylamine (2.0mL) methyl iodide (5.0mL) and sodium iodide (600mg) were added to the dispersion. The reaction was carried out with stirring for 5 h at 60°C. Finally, acetone was added to precipitate the N, N-dimethylamine N-ethylamine Chitosan Chemical Reaction:-

5 wt % N, N-dimethylamine N-ethylamine Chitosan salt was dissolved in 1litre demineralized water forming alkaline solution, the mass ratio of N, N-dimethylamine N-ethylamine Chitosan salt to H₂O was 1:1000, respectively the flue gases get into direct contact with the selected aqueous solutions which are pumped to the scrubber with 1lit / Min. At the testing time the initial concentration of CO₂ was 11.23%. Carbon dioxide reacts with N, N-dimethylamine N-ethylamine Chitosan salt.



Results

The % CO₂ is removed from the flue gas by means of a chemical solvent is summarized in table No.1 & Graphical presentation in Figure No.1. The concentration of CO₂ in the flue gas is 11.23% after combustion and 100 % removal of CO₂ for 6 minutes at flow rate 1 liter per minute. This is having the removal capacity about 1.22 gm of CO₂ per liter of 5 % N, N-dimethylamine N-ethylamine Chitosan salt solution.

Table & Figure

Table 1- CO₂ Removal Time

Time (Min)	% CO ₂
0	11.23
2	0.00
4	0.00
6	0.00
8	3.78
10	5.12
12	6.89
14	9.50
16	11.51

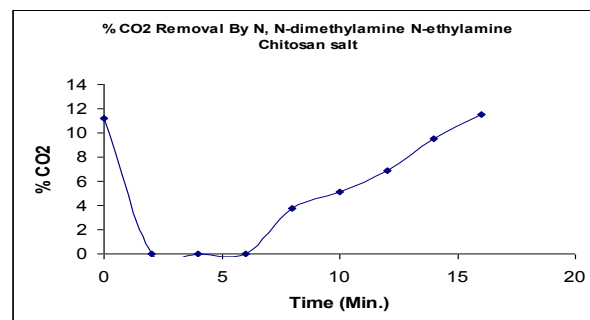


Fig. 1- CO₂ Removal Graph

References

- [1] Capturing Carbon Dioxide From Air (2011) <http://www.netl.doe.gov>.
- [2] Energy Current. (2010) <http://www.energycurrent.com>.
- [3] Market Research Analyst. (2012) <http://www.marketresearchanalyst.com>.
- [4] Gasification Body (2010) <http://www.netl.doe.gov>.
- [5] Bryngelsson M., Westermarck M. KTH — Royal Institute of Technology, Dept. of Chemical Engineering and Technology, SE-100 44 Stockholm, Sweden. www.sciencedirect.co.
- [6] Bryngelsson M., Westermarck M. (2009) GHGT-9, *Energy Procedia* 1, 1403 - 1409.