UTILIZATION OF WASTE CARBON DIOXIDE FOR THE PRODUCTION OF DIFFERENT USEFUL CHEMICALS

A Thesis Submitted to the Department of Chemical Engineering, School of Chemical and Materials Engineering(SCME),NUST, Islamabad, in the partial fulfillment of the requirements for the degree of

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Submitted by

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Declaration

I Hizba Waheed, hereby declare that I have produced the work presented in this thesis, during the scheduled period of study. I also declare that I have not taken any material from any source except referred to wherever due. If a violation of HEC rules on research has occurred in this thesis, I shall be liable to punishable action under the plagiarism rules of the HEC.

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Certificate

It is certified that Hizba Waheed has carried out all the work related to this thesis under my supervision at the School of Chemical and Materials Engineering (SCME) National University of Sciences and Technology (NUST).

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In the name of Allah, The most Gracious, Most Compassionate

Our Lord!

Grant us good in this world and good in

the life to come and keep us safe from the torment of fire.

(2:201)

Dedicated to,

My dearest family; respected Grandfather (Late), loving parents, and my siblings

Abstract:

In the modern world, the major dilemma that the world is facing is of Global warming. This concern is because of constantly increasing concentrations of green house gases in the environment.CO_2 is the main constituent of green house gases and is being emitted continuously from industries. Its emission through various sources including power plants and industrial sources like cement industries is contributing excessively in increasing the CO_2 atmospheric loading. This is resulting in gradual increase of average earth's temperature. According to latest research reports, it is forecasted that in developing countries the emission of CO_2 is expected to grow rapidly in next 15 years and would surpass emission of industrialized countries near 2018. Now such methods and techniques are needed that will contribute positively to either reduce the CO_2 atmospheric loading or utilize the produced CO_2 for some reproductive purpose. The CO_2 after formation in different industries and other sources should not be released into the atmosphere rather it can be captured and can be used for other constructive applications.

Here, in this work the captured CO_2 from different sources including power plant, cement industry etc is converted into useful chemicals that are being used in different industries and house hold activities. The gaseous CO_2 is made to react with freshly prepared CH_3MgBr (methyl magnesium bromide) to form acetic acid (CH_3COOH) at ambient temperature and pressure conditions. Iodine crystals were used as catalyst as well as it improves the activation of magnesium turnings. Next, the produced acetic acid is reduced by using reducing characteristics of $NaBH_4$ in combination with other chemical compounds like iodine (I_2) and hafnium tetrachloride ($HfCl_4$). There are other reducing agents with better reducing abilities like Lithium aluminum hydride ($LiAlH_4$) but $NaBH_4$ is easily available, cheap and has effective reducing qualities. The produced acetic acid and ethanol can separately be used as beneficial chemical compounds.

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Hizba Waheed

Contents

Abbreviations

THF:	Tetra Hydrofuran
HPLC:	High Performance Liquid Chromatography
FT-IR:	Fourier Transform Infrared Spectroscopy
$R^{\bullet}$:	Alkyl Radical
C:	Carbon
Mg:	Magnesium
RMgX:	Alkyl Magnesium Halide
CO_2:	Carbon dioxide
ppm:	Part per million
pH:	Power of hydrogen ion dissociation

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