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Electrochemical Pathway for CO2 conversion into Biofuel

Dr. Durgesh V. Wele[1],
[1] *Associate Professor, Department of Chemical Engineering, College of Engineering and Technology Akola, Maharashtra, India*

ABSTRACT

Due to the fact that the carbon dioxide levels are rising to a dangerous concentration to the world atmosphere and the strong reliance on the world's power production and non- renewable energy sources. Now importance of being able to convert Carbon dioxide back into a non renewable energy sources to be used in place of oil can be seen. The technique involves the electrochemical pathway and use catalyst of Cu, Carbon & Nitrogen. After applying electric potential, a chemical reaction occurs to essentially reverse the combustion process with about a 62% yield of biofuel. Carbon dioxide will continue to be produce regardless, which has been proven harmful to environment. However, converting carbon dioxide into biofuel is a two-fold success. The process reduces the global carbon footprint and produces the compound that is both useful and less harmful. Biofuel can be used as fuel for transportation. In this project we will evaluate the process and the effect of carbon dioxide to biofuel conversion, the use of Cu based catalyst to do so & practical uses for these process in everyday life
Keyword: - Catalytic conversion, Electrolysis, BioFuel

1. INTRODUCTION:

Carbon dioxide is very abundant constituent component of the atmosphere. The major threat from increased CO2 is the **greenhouse effect**. As a greenhouse gas, excessive CO2 creates a cover that traps the sun's heat energy in the atmospheric bubble, warming the planet and the oceans. An increase in CO2 plays havoc with the Earth's climates by causing changes in weather patterns. India Produces approximately 2.5 billion tons of Co2 annually from fossil fuels & Industry. According to the Inter governmental panel on Climate Change (IPCC), three quarters of the increase in CO2 in the air is related to the use of fossil- based fuels. The Government has proposed revision of the target of renewable energy capacity of the Ministry of New and Renewable Energy to 175 GW by 2022. The synthesis of other more useful compounds is a great solution for CO2 processing, as it will provide great and sustainable benefits. In addition, it will also provide a dual solution, i.e. reducing the amount of CO2 as well as the production of a more useful compound.

1.1 need of the research work :

Carbon dioxide (co_2) is **an important heat-trapping (greenhouse) gas**, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions. The concentration of carbon dioxide in earth's atmosphere is currently at nearly **412 parts per million (ppm)** and rising. This represents a 47 percent increase since the beginning of the industrial age, when the concentration was near 280 ppm, and an 11 percent increase since 2000, when it was near 370 ppm

1.2 Mechanism of Electrolysis:

First of all, we have to prepare the electrode plate (cathode and anode). Cu electrode is taken as the cathode electrode. Carbon electrode is taken as the anode electrode. Sodium bicarbonate electrolyte solution / WATER is incorporated into an electrochemical synthetic reactor. Electrochemical synthetic reactor should equip with the cathode and anode electrode. Power source should be DC current either DC battery or solar panel.

2. METHODOLOGY:

Conversion of CO2 into ethanol in an electrochemical synthesis reactor is done by varying the voltage, concentration of sodium bicarbonate electrolyte solution/Water and time of electrolysis to obtain the optimum conditions to convert CO2 into ethanol. The successful conversion of CO2 into ethanol by electrochemical synthesis is influenced by the type of metal on the electrode. The electro-catalytic properties of metals used as electrodes will not only affect the percent conversion of CO2, but also their distribution to the resulting compounds. Then the CO2 gas flowed into the electrochemical synthesis reactor with a flow rate of 1 L/minute. The optimum voltage is studied by flowing voltages with variations of 1, 3, 5 and 7 volts. The electrochemical synthesis process is carried out for 90 minutes. Then the CO2 gas flowed into the electrochemical synthesis reactor with a flow rate of 1 L/minute. The optimum voltage is studied by flowing voltages with variations of 1, 3, 5 and 7 volts. The electrochemical synthesis process is carried out for 90 minutes.

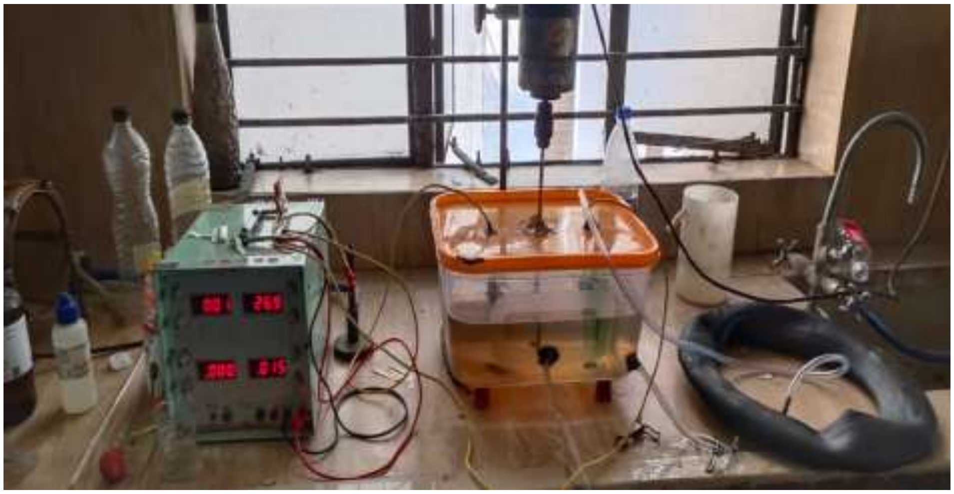


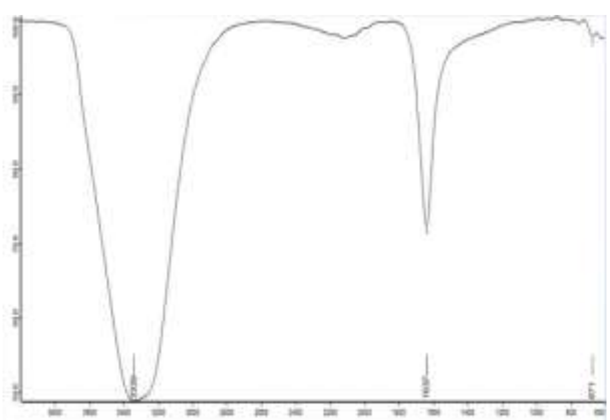
Fig -1: Electrolysis Setup

2.1 Observation :

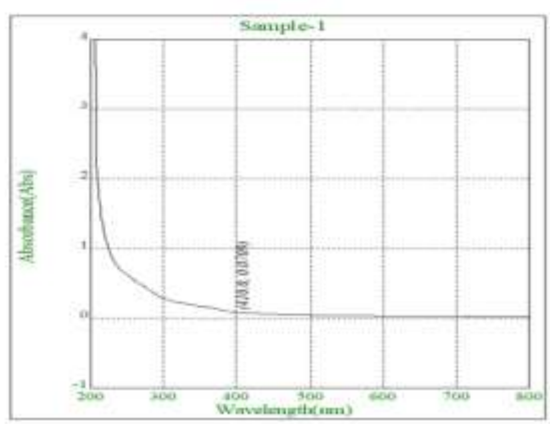
Table -1: Observation Table

Parameters/ Batches	Batch A	Batch B	Batch C	Product A
Solution	H_2O+ CO_2	H_2O+ CO_2	$NaHCO_3$+ CO_2	H_2O+ CO_2
Room Temperature	42	39	39	40
Water Temperature	18	17	20	18
Ph OF WATER	6- 5	7- 6- 5	9	6- 5
Co_2 Purging Time (Min)	60	60	60	60
Voltage (V)	26	26	23.3	3
Flow Rate (Lit/ Min)	3.6	3.6	3.6	3.6
Pressure (Kg/M^3)	76	76	76	76

3. OBSERVATION AND DISCUSSION :



FTIR Test



UV Test

Discussion:

FTIR Analysis :

- **Peak at ~3353 cm⁻¹:**

This broad peak indicates **O-H stretching**, typically found in alcohols, phenols, or carboxylic acids. The broadness suggests strong **hydrogen bonding**.

- **Peak at ~1637 cm⁻¹:**

Corresponds to **C=O (carbonyl) stretching**, which is characteristic of ketones, aldehydes, carboxylic acids, or esters.

- **Peak at ~871 cm⁻¹:**

This region often represents **C-H bending** from aromatic compounds or **C-Cl stretching** in halogen-containing compounds.

Interpretation :

Possible Functional Groups Present are:

- Hydroxyl (-OH) groups (from alcohols, phenols, or acids).
- Carbonyl (C=O) groups (suggesting esters, aldehydes, ketones, or carboxyl compounds).
- Aromatic rings (indicated by low-frequency bending vibrations around **871 cm⁻¹**).

2. UV-Vis Analysis :

Observations:

- **Significant Absorbance Below 300 nm:**

The sample has a steep absorbance drop-off, indicating absorption primarily in the **ultraviolet region**.

Absorbance Peak at ~270 nm (0.709 Abs) and 410 nm (0.0709 Abs): The **270 nm peak** suggests π-π* electronic transitions, typical for **aromatic rings, conjugated double bonds, or phenolic compounds**.

The **small absorbance near 410 nm** could indicate *n-π transitions**, possibly from carbonyl or other chromophores.

Possible Interpretation:

- The sample likely contains **aromatic or conjugated compounds**.
- If this is a natural extract, it could contain **flavonoids, polyphenols, or other UV-active molecules**.
- If this is an industrial or synthetic sample, it may have **organic dyes, antioxidants, or polymer additives**.

4. CONCLUSION:

- **FTIR results** suggest the presence of **hydroxyl (-OH) and carbonyl (C=O) groups, along with possible aromatic structures**.
- **UV-Vis results** indicate strong absorbance in the UV region, suggesting the presence of **conjugated and aromatic systems**.
- It suggests the sample may contain **phenolic compounds, flavonoids, or other bioactive molecules**.
  Fossils fuels are likely to continue to be a major source of energy for the next few decades. As the consequences of increasing CO2 concentrations in the atmosphere become more severe, the adoption of large-scale carbon-negative technologies is necessary. Alleviating effects caused by waste CO2 emission remains a critical issue to modern society. Electrochemical reduction of CO2 offers an intriguing way for CO2 mitigation, by which CO2 as a feedstock can be converted into value added products. Electrochemical conversion of CO2 into the useable chemicals is one of the efficient methods to tackle the global warming issue as it can recover excess CO2.

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