The Stabilization of an Atmosphere of Plasma Based Carbon Dioxide at Atmospheric Pressure

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Abstract *– Some reasons are discussed for the stabilization of a glow discharge at atmospheric pressure which was attained by controlling the following three conditions: the use of a high-frequency source, the use of gas for dilution and the insertion of a dielectric plate between electrodes. The three conditions interact: the dielectric plate in a plasma forms the pulsed discharge from a low-frequency source, the fast duration of pulse current prevents a transition to an arc style discharge and a large volume of met stable atomic carbon dioxide aids ionization or dissociation near the electrode plate and in the flowing gas. The measurements of discharge-maintaining voltage at several hundred volts provide evidence that this is really glow plasma at atmospheric pressure. The changes of the emission intensities of metastable carbon dioxide prove indirectly that some dissociation occurs as a result of the action.*

Key Terms – *Atmospheric Pressure, Carbon Dioxide, Plasma, Stabilization.*

PROJECT STATEMENT

Carbon emissions must be reduced because we can create employment with the adaptation of carbon absorption bio-reactors. This investigation is an indispensable tool for understanding how to reduce carbon emissions using the new biotechnology of carbon dioxide absorption and the upcoming paradigm for the next phase of industrial modernization. Carbon-free sources of energy have their own associated impacts, but in general, these technologies generate energy without producing and emitting carbon dioxide to the atmosphere. Carbon-free energy sources include solar power, wind power, geothermal energy, low-head hydropower, hydrokinetics wave and tidal power, and nuclear power.

Alternatively, switching from high-carbon fuels like coal and oil, to reduced-carbon fuels such as natural gas, will also result in reduced carbon dioxide emissions. The extent to which biomass energy is considered to be carbon-free or a reduced-carbon fuel depends on the type of biomass used and the processes by which it is converted to energy. Capture and sequestration of CO_2 from fossil fuel power plants is gaining widespread interest as a potential method of controlling greenhouse gas emissions. Performance and cost models of an amine (MEA)-based CO_2 absorption system for post combustion flue gas applications have been developed and integrated with an existing power plant modeling framework that includes multipollutant control technologies for other regulated emissions. [4] The integrated model has been applied to study the feasibility and cost of carbon capture and sequestration at both new and existing coal-burning power plants.

The cost of carbon avoidance was shown to depend strongly on assumptions about the reference plant design, details of the CO_2 capture system design, interactions with other pollution control systems, and method of CO storage. The CO_2 avoidance cost for retrofit systems was found to be generally higher than for new plants, mainly because of the higher energy penalty resulting from less efficient heat integration as well as site-specific difficulties typically encountered in retrofit applications. For all cases, a small reduction in CO_2 capture cost was afforded by the CHO_4O emission trading credits generated by amine-based capture systems. Efforts are underway to model a broader suite of carbon capture and sequestration

technologies for more comprehensive assessments in the context of multipollutant environmental management.

PROBLEM STATEMENT

How can stabilize carbon dioxide through a process of ionization in the pharmaceutical to control consumption and gas emissions in the air?

Research Objectives

The objectives for this project are:

- Control the air flow valve.
- Improvement and efficiencies in the columns of the recycle exhaust gas and the process for other uses.
- Efficient operation and control plasma gas emission.
- Change in the process CO_2 to methanol.

Materials

- Stainless steel
- Fittings
- Adapters
- Couplings
- Plasma equipment
- Vac-U-Flat stainless steel
- Quartz 2.75'' Flange
- View port
- Chemical product CO_2
- Thermometer
- Chronometer

Research Contributions

The project has implementation of process improvements. This assessment may extend other Operational Regions, eventually impacting the OSHA and EPA Department through the island and creating a precedent in the service industry. Carbon capture involves the separation of CO_2 from coal-based power plant flue gas or syngas. Commercially available first-generation CO_2 capture technologies are currently being used in various industrial applications. However, in their current state of development, these technologies are not ready for implementation on coal-based power plants because they have not been demonstrated at appropriate scale, require approximately one-third of the plant's steam and power to operate, and are cost prohibitive. The program also supports related CO_2 compression efforts. Post-combustion capture is primarily applicable to conventional pulverized coal PC-fired power plants, where the fuel is burned with air in a boiler to produce steam that drives a turbine/generator to produce electricity. The carbon is captured from the flue gas after fuel combustion. Pre-combustion capture is applicable to integrated gasification combined cycle IGCC power plants, where solid fuel is converted into gaseous components syngas by applying heat under pressure in the presence of steam and oxygen. In this case, the carbon is captured from the syngas before combustion and power production occurs. Although R&D efforts focus on capturing CO_2 from the flue gas or syngas of coal-based power plants, the same capture technologies are applicable to natural gas- and oil-fired power plants and other industrial CO_2 sources.

Research Description

This project has been outlined the purpose of analyze stabilization carbon dioxide of plasma and evaluate the changes states depend of temperature and pressure. Primarily to reduce gas emission out in the atmosphere and maintenance cost in the company. The investigation the idea is reduction the contamination. Develop carbon dioxide to methanol and recycle with the new design. Then sell other clients needed. The possible causes that increase frequency, installation equipment, requirements and procedure

LITERATURE REVIEW

Current R&D efforts conducted within the Carbon Capture Program include development of advanced solvents, sorbents, and membranes for both the post- and pre-combustion technology areas. Under both technology areas, the program is developing second-generation and transformational

CO_2 capture technologies that could provide step-change reductions in both cost and energy penalty compared to currently available first-generation technologies.

Gaseous emission may be controlled either by physical and physicochemical means of separation or by chemical conversion, including thermal or catalytic combustion, and chemical oxidation or reduction. [1]

Three processes important:

- Absorption dissolving the compounds to be separated from the how to be treated in an auxiliary liquid.
- Adsorption onto suitable solid adsorbents.
- Condensation of vapors.

In this investigation depending on the nature of the forces at hand either absorption or adsorption may be purely physical or at least chemical. However, both types are difficult to distinguish, since the methods of implementation are practically identical cases.

In most cases the best pollution control strategy is prevention. Selecting appropriate Air Pollution Control Technology should start by data collection and analysis. Measures for reducing air pollution should be devised in the following order:

1. Prevention or reduction reducing the flow to be treated and the amount of pollutants.
2. Treatment pollutants loads below some limit or target values.
3. Dispersion of emissions in the atmosphere.

Prevention strategies can be classified, according to their area application in to:

- Cleaner combustion techniques.
- Cleaner products.
- Avoiding products.
- Greenhouse and ozone depleting compounds.

Prevention is the only possible method to reduce fugitive emissions. These are omnipresent at piping flanges and valves, pump shafts, instrument connections etc as opposed to the much more important guided emissions, escaping from a stack or, a vent, and depend on the quality of both preventive and curative maintenance, equipment specifications, and on the selection and quality of gaskets, seals and packing. The part of carbon dioxide CO_2 is a naturally occurring chemical compound composed of 2 oxygen atoms each covalently double bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state, as a trace gas at a concentration of 0.04 per cent 400 ppm by volume. As part of the carbon cycle, plants, algae, and cyanobacteria use light energy to photosynthesize carbohydrate from carbon dioxide and water, with oxygen produced as a waste product. However, photosynthesis cannot occur in darkness and at night some carbon dioxide is produced by plants during respiration Carbon dioxide is produced by combustion of coal or hydrocarbons, the fermentation of sugars in beer and winemaking and by respiration of all living organisms. It is exhaled in the breath of humans and other land animals. It is emitted from volcanoes, hot springs, geysers and other places where the earth's crust is thin and is freed from carbonate rocks by dissolution. CO_2 is also found in lakes, at depth under the sea and commingled with oil and gas deposits.

The environmental effects of carbon dioxide are of significant interest. [2] Atmospheric carbon dioxide is the primary source of carbon in life on Earth and its concentration in Earth's pre-industrial atmosphere since late in the Precambrian eon was regulated by photosynthetic organisms. Carbon dioxide is an important greenhouse gas; burning of carbon-based fuels since the industrial revolution has rapidly increased the concentration, leading to global warming. It is also a major source of ocean acidification since it dissolves in water to form carbonic acid, which is a weak acid as its ionization in water is incomplete. [5] This purpose of investigation is CO_2 convert methanol is recycle in the process for then sell. Methanol, also known as methyl alcohol, wood alcohol, wood naphtha or wood spirits, is a chemical with the formula CH_3OH. Methanol acquired the name wood alcohol because it was once produced chiefly as a

byproduct of the destructive distillation of wood. Modern methanol is produced in a catalytic industrial process directly from carbon monoxide, carbon dioxide, and hydrogen. Methanol is the simplest alcohol, and is a light, volatile, colorless, flammable liquid with a distinctive odor very similar to, but slightly sweeter than, that of ethanol drinking alcohol at room temperature, it is a polar liquid, and is used as an antifreeze, solvent, fuel, and as a denaturant for ethanol. It is also used for producing biodiesel via reaction [4] [5]. Methanol is produced naturally in the anaerobic metabolism of many varieties of bacteria, and is commonly present in small amounts in the environment. As a result, there is a small fraction of methanol vapor in the atmosphere. Over the course of several days, atmospheric methanol is oxidized with the help of sunlight to carbon dioxide and water.

METHODOLOGY

For order to achieve the proposed objectives, this section provides an overview of procedure and methodology that will be applied in the design project. The project methodology to be used is DMAIC six improvement strategy coming from Six Sigma principles. Six sigma is an acronym that has five phases: Define, Measure, Analyze, Improvement and Control.

- Define Phase: This phase consists in defining the scope, goals and project statement. It will use a project charter in order to describe the process and identify the possible opportunities of improvement.
- Measure Phase: The objective of this phase is the collection of the key aspects of current process and relevant data. As well as the identification of potential factors that may affect the process. It will use data collection and detailed process flow diagram. The tools to be use to show visual representations of the current state are graphs, charts, flowcharts and SIPOC diagram.
- Analyze Phase: This phase consists on identifying deep causes with the objective of validate them with relevant data. The key components of this phase include cause-effect, root cause and value- non value added analysis. It will use a cause-effect diagram.
- Improvement Phase: The objective of this phase is optimizing the current process based on data analysis. The key components for this phase include lean manufacturing tools, optimized process parameter settings and standardized work.
- Control Phase: This phase includes designing and documenting the new controls and procedures, in order to hold the gains. Key components to this phase are visual work places; periodic audit exercises and training process to monitor the success for prove your investigation.

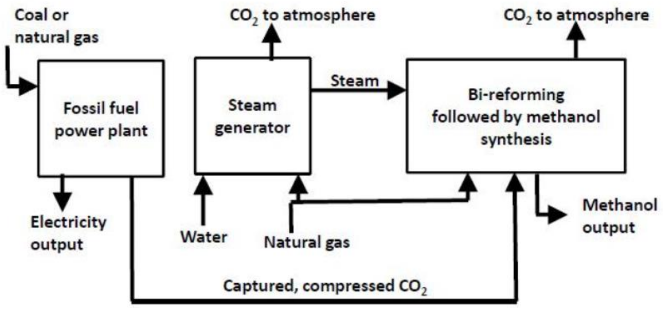

Figure 1
Process Change CO_2 to Methanol CH_4O

RESULTS AND DISCUSSION

This section presents the problem analysis and improvement results using the calculus of reaction the investigation. Methanol burns in oxygen including open air, forming carbon dioxide and water:

$$2\ CH_3OH + 3\ O_2 \rightarrow 2\ CO_2 + 4\ H_2O \quad (1)$$

that certain catalysts synthesize methanol using CO_2 as an intermediary, and consuming CO only indirectly.

$$CO_2 + 3\ H_2 \rightarrow CH_3OH + H_2O \quad (2)$$

where the H_2O byproduct is recycled via the water-gas shift reaction: Refer to (3) for mechanism.

$$CO + H_2O \rightarrow CO_2 + H_2 \quad (3)$$

This gives an overall reaction, which is the same as listed above. Refer to (4)

$$CO + 2\ H_2 \rightarrow CH_3OH \qquad (4)$$

Stoichiometry for methanol production requires the ratio of H_2 / CO to equal 2. The partial oxidation process yields a ratio of 2, and the steam reforming process yields a ratio of 3. The H_2 / CO ratio can be lowered to some extent by the reverse water-gas shift reaction, to provide the appropriate stoichiometry for methanol synthesis. Methanol is used on a limited. Refer to (5).

$$CO_2 + H_2 \rightarrow CO + H_2O \qquad (5)$$

Density vs. Pressure in the Investigation

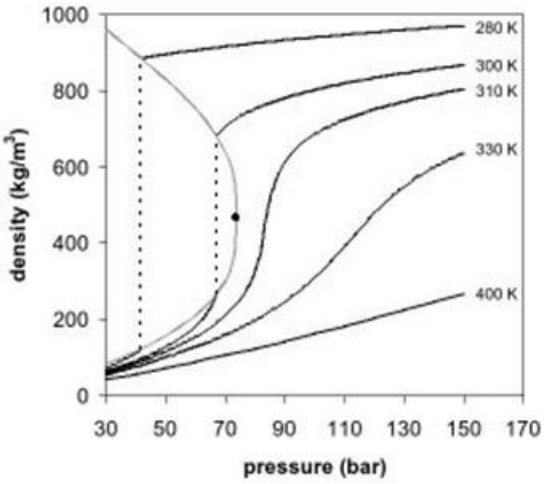

Figure 2
Density vs. Pressure

Description Result Investigation

Pure methanol is required by rule to be used in different strategy, Methanol is also used, as the primary fuel ingredient since the late in the power plants for radio control, control line and as methanol is required in the engines that primarily power them, cars and trucks, from such an engine's use of a platinum filament glow plug being able to ignite the methanol vapor through a catalytic reaction. Methanol is required with a supercharged engine in one of the potential drawbacks of using high concentrations of methanol and other alcohols, such as ethanol in fuel is the corrosives to some metals of methanol, particularly to aluminum.

Methanol, although a weak acid, attacks the oxide coating that normally protects the aluminum from corrosion: Refer to (6)

$$6\ CH_3OH + Al_2O_3 \rightarrow 2\ Al(OCH_3)_3 + 3\ H_2O \qquad (6)$$

The resulting methoxide salts are soluble in methanol, resulting in a clean aluminum surface, which is readily oxidized by dissolved oxygen. Also, the methanol can act as an oxidizer: Refer (7)

$$6\ CH_3OH + 2\ Al \rightarrow 2\ Al(OCH_3)_3 + 3\ H_2 \qquad (7)$$

This reciprocal process effectively fuels corrosion until either the metal is eaten away or the concentration of CH_3OH is negligible. Concerns with methanol's corrosives have been addressed by using methanol-compatible materials, and fuel additives that serve as corrosion inhibitors.

Figure 3
The Principal Instrument of Investigation with the Plasma

Figure 4
The Connection between the Plasma and the Instrument

Figure 5
The Vac-U-Flat, Flanges and Fittings Sealing Equipment

Figure 6
Nozzle of the Plasma

Figure 7
The Instrument with the Plasma

When produced from wood or other organic materials, the resulting organic methanol bioalcohol has been suggested as renewable alternative to petroleum-based hydrocarbons. [3] Low levels of methanol can be used in existing vehicles, with the use of proper co solvents and corrosion inhibitors.

Methanol fuel has been proposed for ground transportation. The chief advantage of a methanol economy is that it could be adapted to present internal combustion engines with a minimum of modification in both engines and infrastructure to store and deliver liquid fuel.

In summary, the result of the investigation:

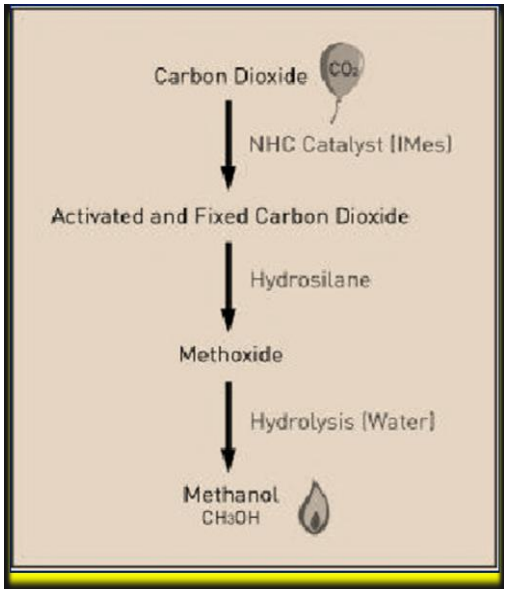

Figure 8
Description of Result

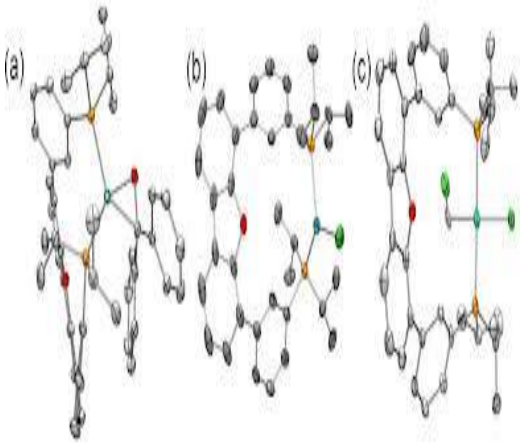

Figure 9
Strategy Process Change: Strategies for the Reduction of Carbon Dioxide to Methanol

CONCLUSIONS

In this study, the steps in this research we take the CO_2 air is discharged as a result of industrial processes and the incomplete combustion of wood, gas and coal. The chemical methods are those in which the contaminant of interest is trapped in an absorption solution and produce the reaction of formation. Plasma treatment is a well-established technique in a number of processes, such as plasma cleaning, etching and coating. Concerning cellulosic materials and paper, special after-glow plasma was used to remove microbial contamination and to increase. However, plasma-induced coatings can modify surface properties of high-porosity materials and the extent of plasma permeation can be controlled. When CO_2 is stabilized by the plasma and the ionization process could observe the reaction of serene and stabilizations that had the components giving a high efficiency and the exothermic reaction temperature and pressure changes.

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