DESIGN AND FABRICATION OF A SYSTEM TO CAPTURE AERIAL CO_2

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College ***:*** *S.D.M. College of Engineering And Technology, Dharwad*
Branch ***:*** *Department of Chemical Engineering*
Guide(s) ***:*** *Dr. Lokeshwari Navalgund*
Dr. Keshava Joshi
Student(S) ***:*** *Ms. Sagir K Khan*
Ms. Ayesha Nadaf
Ms. Preksha Kumari Bafna
Mr. Shashank M Baligar

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Introduction:

The world is transitioning to cleaner sources of energy. However the transition is prolonged, and while it completes over the next few decades, tons of carbon dioxide will be released into the atmosphere, accelerating climate change. To contain the amount of carbon dioxide released into the atmosphere, many strategies are being applied, with direct air capture (DAC) being one of them.

Our idea for this project is to achieve net-zero carbon emission, by providing a system which not only uses less energy but also provides good results at the same time. Many facilities/companies around the globe are working on the same problem for decades, but the cost to capture carbon is still very high. Clime Works provides carbon capture and has the world's first commercial facility in Iceland but at a very high cost of $1200 per ton of CO_2. Carbon Engineering claims they will bring down the cost to $95– $150 per ton of CO_2 but yet they haven't commercialized any plant likewise there is Thermostat, Clean Carbon, etc.

Objectives:

- Design and fabrication of a contactor
- Data collection on the contactor.
- Experiments with variable parameters.
- Substantiating optimum process conditions for operation.
- Providing validation on the low-temperature operation.
- 25-30% capture rate.
- The data collected from the contractor will be used in the simulation of further process

Fig: Top view

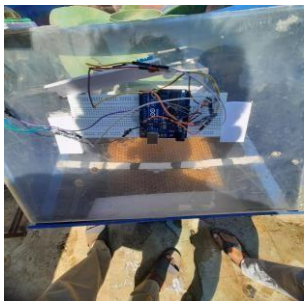
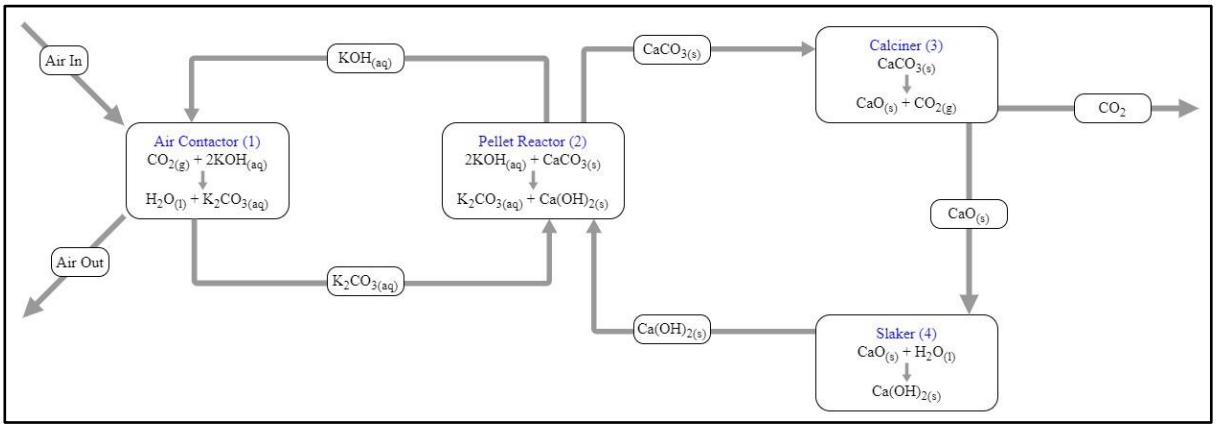


Fig: IOT Based system

Methodology:



Main process and chemical reactions in the direct air capture process

- Ambient air is sucked into the contractor using a fan with an efficiency of 80% through a converging section of 1 ATM followed by 25 Celsius and 400 ppm by concentration.
- Before entering into the cellulose pad ambient air passes through a smooth pipe hence achieving a laminar flow and pressure drop of 55.4 Pascal.
- Capture solution enters at the desired flow rate through a spray nozzle wetting evenly the walls of cellulose pad.
- A cross-current reaction takes place in the cellulose pad at the walls of the channel between the air entering into the cellulose pad and a capture solution.
- The result of this reaction is that Carbon dioxide molecules diffuse into the capture solution and form, a carbonate solution at a pressure drop of 100 Pascal.
- The carbonate solution trickles, down the contractor and gets collected in a tank.

- At the end of the process, the air exists a through the contractor with a carbon dioxide concentration of 100 ppm
- A contactor prototype construction to collect the data for the pilot plant.
- The design suggests 70 % carbon Capture from the air at 25 Celsius.
- The performance of carbon capture depends upon what temperature it is to be operated on because as temperature decreases, the air becomes denser which leads to an increase in CO_2 loading. Hence more can be captured for the same energy output.

Results and Conclusion:

The contactor is designed to capture at least 50% of CO_2 at each run. It was found that at least 85% of the contactor's energy requirements are due to the pump, large savings could be achieved if the pump was not run continuously. Via an intermittent operation of the contactor with a 5% duty cycle, the fluid pumping work was reduced by 90%. Experimental results of simultaneous leaching and precipitation are in good agreement with the theoretically expected values. All together making the CO_2 captured from air using an alkaline-based system is a plausible process to consider for the mitigation of climate change.

Scope for future work:

Our proposal will address the most severe consequences of climate change that mankind has ever faced. The only way to tackle the climate crisis is to reduce the amount of pollution and remove what we already have in the atmosphere, on which we are working now.

Not only will it address climate change by eliminating the variable, *but it will also be used to create synthetic fuel for future usage that emits 90% less carbon dioxide. This technology will* replace the petroleum market in the future (phase down of petroleum market has already been in action due to climate change)

It has the potential to generate employment since the amount of CO_2 in the atmosphere is enormous (over a trillion tonnes), and removing it within the stipulated time constraint (by 2070) will necessitate thousands of DAC facilities throughout the world, which will create huge employment.