MACHINE LEARNING APPROACH FOR CARBON CAPTURE AND UTILIZATION – A PRELIMENARY INVESTIGATION

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Due to the increase in the industrialization the environment is deteriorating. The major concern is to identify the sources those are contributing to the environment change. One of the major sources of interest is carbon in this domain. The carbon capture has been carried out with different methods and data is analyzed. The process of performing real time experiments is time consuming and sometimes the accurate results may not be obtained. In order to overcome the issues mentioned, a combined approach with machine learning is presented by the authors in this article. The present work provides a detailed overview of the laboratory processes for Carbon Capture and Utilization (CCU). In addition to this a detailed investigation of machine learning along with its probable implementation is presented. The combined approach will be beneficial as it efficient, quick and safe. The proposed approach will be beneficial to the industries as well as environment.

Keywords: carbon capture and utilization (CCU), machine learning, environmental hazards, climate change

Introduction. The greenhouse gases (GHG) contributes to the global warming, this results from different human activities like industrialization. The major components of the GHG's are carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_2O). These GHG's continuously contributing to the climate changes all across the globe. One of the concerns is with emission of carbon. There are several sources which contributes to the emission of CO2 viz., burning of fossil fuel, thermal power plants etc. [1]. The recent value of the carbon emission shows that it has surpassed 420 PPM, that may causes more damage to the environment [2]. It has been predicted that future global CO_2 level will increase drastically if the measure have not be taken in the present. The carbon capture and utilization is promising method [3]. There are several methods used for the identification of the sources and its capture. The first step is to separate the CO_2 from these sources, which pollutes the environment. The separation mechanism is preliminary operation and one of the energy intensive phases. Furthermore the techniques need advancements [4]. The process of carbon capture is studied by different research groups, the applications includes energy generation systems [5–7]. The different technologies for capturing carbon are listed in Fig. 1.

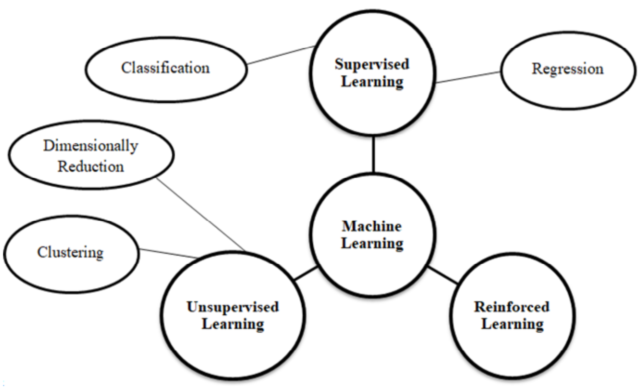

Fig. 1. Carbon capture techniques

The machine learning is one of the superpower the researchers have in today's era. The importance and working of the machine learning is illustrated in the Fig. 2. The machine learning is based on the three major parts of model learning i.e. supervised, unsupervised and reinforced learning. The major application includes image classification; identify fraud detection, population growth detection, structure discovery, customer segmentation, targeted marketing etc [8].

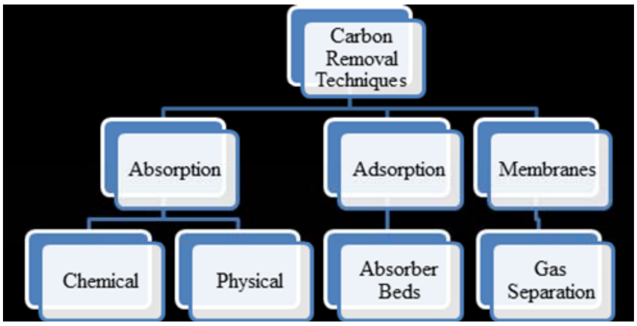

Fig. 2. Overview of machine learning

The manual working at lab scale is a tedious task. In order to achieve the better efficiency of the removal, advanced equipment's as well as techniques needs to take care. The present work emphasize on the combined approach with machine learning for the prediction of carbon capture to mitigate the environmental hazards.

Methodology. The present work highlights the use of the machine learning approach to this well-known problem.

The artificial neural network approach has been studied by many researchers earlier in the domain of chemical engineering [9–13].

The steps involved in the combined studies are listed below:

1) identification of the system;

2) development of the physical experimental setup, depending upon the method applicable;

3) data generation (Carbon Capture);

4) analysis of the data;

5) extraction of data for machine learning;

6) development of the model;

7) training-Testing-Validation;

8) optimization of the models developed;

9) optimized model and parameters for the further modeling.

The present study will start with the identification of the parameters that is very important criteria. Apart from this, the behavior of the system also plays a crucial role while developing the model. The proposed models will be tested for the data that has collected with variations in the experiments. The prediction is very important tool in this process; it reduces the risk in the process industries.

Remarks. The natural environment is facing lot of issues due to emission of the unwanted gases from different sources. The deterioration in the ecosystem imparts the unusual changes those should be minimized. In order to mimic this situation, prediction is one of the important tasks. In this series for process industries or GHG emission, machine learning will be crucial. The machine learning approach will require dataset that can be modeled or minimum experiments can be performed to obtain this dataset. The advantage of machine learning is to study the behavior of any system with less time, resources and risk of operation. Thus the proposed work applies the dataset obtained from the experiments carried out at different conditions and its application along with machine learning to predict the behavior. The present combined approach may be useful in many scenarios with improvised accuracy.

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