Post combustion CO_2 absorption- A review

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Abstract

Green house gases (GHG) emissions have triggered global efforts to reduce its level as much as possible for sustainable development. Carbon dioxide is one of the green house gas that is imperative anthropogenic due to its increased excessive accumulation on annual basis. So, a serious attention is required to reduce the level of CO_2 using advance efficient CO_2 capture technologies. Carbon dioxide capture and storage (CCS) may play an important role in this direction. This study is mainly focused on the effect of nanotechnology on post combustion CO_2 absorption. The role of nanomaterials and nanoparticles has been studied in the present work.

Keywords: Carbon dioxide capture, Process industries, Nanomaterials, Green house gases

1. Introduction

Increase in the worldwide carbon dioxide emission and their impact on environment has created a lot of challenges for human being living on earth. The increase in the environmental pollution is due to the discovery of conceivable answers to meet the worldwide outflow targets. The nations are competing with each other to fulfil the target of developed nation in entire world. So, set-up of large scale industries, factories and companies are going on in a continuous manner and going to ignore the enevironment concern. Otherside, nation security concern has created a competition in the field of advance weapon discovery and nuclear weapons are dangerous for environment In this category. At present, the entire population is seriously subjected to oil-based commodities where coal, combustible gas, and oil contribute about 41%, 21%, and 5%, respectively and their consumption raises stress of climate destabilization caused by growing carbon dioxide CO_2 released in the air. Carbon Capture and Storage (CCS) is the innovation utilized nowadays to catch CO_2 and its storage for useful purposes. Over the previous decade, the possibility of environmental change is due to the anthropogenic carbon dioxide (CO_2) emission at a rapid rate in the atmosphere. CO_2 is the main gas polluting the environment at large level despite of its cost. According to data available, it can be predicted that fossil fuel derivatives are utilized to create about 67% of the world's power, where, coal, flammable gas, and oil contribute about 41%, 21%, and 5%, respectively. This data indicates that the largest point sources of

CO_2 emission are coal and natural-gas fired power plants. Other large scale industries are also polluting the environment in the same manner. Gasoline based vehicles are also responsible for CO_2 emission in the present situation. So, coal based power plants are mainly responsible for CO_2 emission at large level. Coal fired power plants are continuously emitting huge amount of CO_2 per year. By introducing CCS in new or existing plants, it will be conceivable to catch and store a major share of CO_2 for useful purposes. This will add major ecological advantages in the atmosphere. As proposed by the International Energy Agency (IEA), the petroleum derivative utilized for power age will keep on expanding amid for the coming 20 years. At present, reduction in CO_2 emission and their impact on environment is a burning issue and consist of number of challenges. So, CO_2 capture and storage for useful purposes is highly required in the present scenario. The researchers are working in this direction in a continuous manner so that a balance and pollution free environment may take place. The main target in this direction is not only to reduce its level but also to balance the overall carbon dioxide concentration in the environment. However, there are different approaches to control the atmospheric CO_2 level to improve energy efficiency of plants. Still, there is a lack of a suitable and cost effective system to capture CO_2. The main concern of decarbonisation approach is to maintain a balance between supply and demand sides and thereby increase in energy efficiency. It can be concluded from the literature that the capture of carbon dioxide using various technologies is expensive [1] and requires huge amount of energy in process industries. The implementation reduces the overall efficiency of the plant which is a major drawback of these techniques. However, environmental pollution can be reduced using these technologies in the present scenario. Nowadays, a number of researchers are focusing their research on the adoption of various techniques to capture CO_2 in various process industries. The roles of nanomaterials are playing a crucial role in the present scenario. The present work deals with the study of implementation of nanotechnology in carbon dioxide capture processes and its future scope.

2. Carbon dioxide capture techniques

Carbon capture and storage (CCS) is the process in which CO_2 is stripped out from various process industries at high temperature using various solvent in columns and injected in deep beneath ground. After that it is transported to storage and thereby helps in reducing GHG emission. Three basic techniques are used to capture carbon dioxide viz. Pre-combustion, Post-combustion and oxy-fuel combustion (see fig. 1) and viable options to reduce GHG emissions by 50-85% by 2050. Researchers have already provided an overview regarding carbon dioxide capture and storage technologies [2], [3], [4], [5], [6], [4], [5], [7], [8]. Thermo-physical properties related to carbon capture system design during operation have been reviewed also [9].

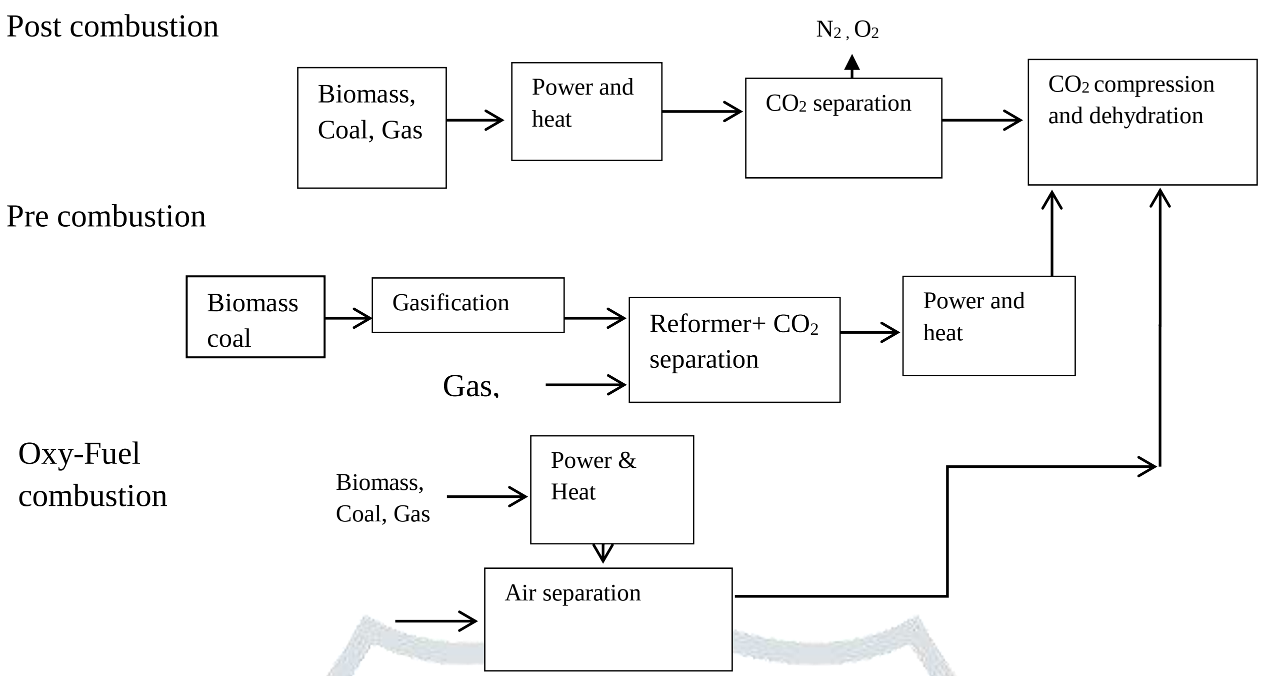

Fig. 1 Different CCS techniques [10]

3. The role of nanoparticles and nanomaterials in carbon dioxide capture

Table 1: Nanomaterials based sorbents application for carbon dioxide

Sorbent	Utilization	Reference
DD3R nano zeolite	It has high selectivity for CO_2	[11]
T-type zeolite Nps	It can be used for CO_2 separation	[12]
Zeolite NaA nanocrystals	Higher CO_2 adsorption capacity	[13]
M gO/SBA-15	It can be used for CO_2 separation	[14]
MW-CNT@JUC32	It helps in increasing CO_2 adsorption enthalpy	[15]
Graphene	Higher CO_2 adsorption capacity	[16]

4. Conclusions

The study concluded through the extensive literature search that there is a great potential to capture CO_2 using nanoparticles and nanomaterials in the various processes. Nanomaterials are also expected to be more efficient due to their exceptional properties highlighted them to include in CO_2 capture processes. So, further research is needed to explore nanomaterials in real scale applications.

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