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Materials and Methods of Carbon Capture

The frequent use of fossil fuels has caused an excess amount of carbon dioxide to build up in the atmosphere, which contributes to climate change. It is critical to the health of the planet that this extra carbon dioxide be removed. Goeppert *et al.* reviewed several different methods and materials that can be used to remove carbon dioxide directly from the atmosphere. The first method that the researchers reviewed was the use of biomass to capture carbon dioxide. Plants already use solar energy to capture carbon dioxide from the air, which makes this method appear to be an excellent method. However, photosynthesis is rather inefficient as generally only 0.5-2% of sunlight is converted into biomass, which means that large amounts of land have to be utilized in order to capture large amounts of carbon dioxide.

Another method that can be used to capture carbon dioxide is the Na/Ca cycle. In this method, carbon dioxide is captured by dripping a sodium hydroxide solution through one end of a packed column and flowing the carbon dioxide through the other end. The sodium hydroxide solution absorbs the carbon dioxide to produce sodium carbonate and water, and the sodium carbonate is then sent to a causticizer where it reacts with calcium carbonate to form sodium hydroxide and calcium carbonate. The sodium hydroxide is sent back to the packed column, while the calcium carbonate is dried and sent to the calciner to separate into calcium oxide and carbon dioxide. The separated carbon dioxide can then be stored, and the calcium oxide is reacted with water to form calcium hydroxide, which is sent back to the causticizer. However,

the main problem with this method is that the regeneration of calcium hydroxide requires a large amount of energy.

The researchers also reviewed other materials that could be used to remove carbon dioxide from the atmosphere including other hydroxides, metal oxides, sodium titanate, and sodium borate. However, these materials all require intense heat for the recovery reaction. There was only one material that did not require as much energy for the recovery reaction: potassium carbonate. This material only requires about 100-200°C of heat, and its cycle could possibly capture carbon dioxide with 100 percent efficiency.

Potassium carbonate may be the material that can make carbon dioxide filters efficient. If a reliable and efficient method of removing carbon dioxide is discovered, there is a possibility that these filters can be mass produced and used in cities everywhere to reduce the amount of carbon dioxide that is in the air, making the environment both cleaner and safer. A few lingering questions raised by this paper include: Does the Na/Ca cycle only work for sodium hydroxide, or does it work for other hydroxides as well? Is potassium carbonate as efficient as the researchers say it is? And if so, is the material costly to produce and buy?

Reference:

Goeppert, A., Czaun, M., Prakash, G., & Olah, G. A. (2012). Air as the renewable carbon source of the future: an overview of CO2 capture from the atmosphere. *Energy and Environmental Science*, (7), 7833-7853. doi:https://doi.org/10.1039/c2ee21586a