Creating a Cleaner Atmosphere with Zeolite: Utilizing the Carbon-Sequestering Properties of Molecular Sieves to Selectively Eliminate Pollutants in Vehicle Exhaust

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The largest contributor to global warming is the presence of carbon dioxide in the atmosphere. According to the Environmental Protection Agency, vehicle exhaust is responsible for over 30% of carbon dioxide emissions resulting from human activity. The objective of this project was to research materials that naturally capture and store carbon dioxide, and design a filter which utilizes this property to remove carbon dioxide from vehicle exhaust. The material found to be most promising was molecular sieve zeolite 13x, which is designed at the atomic level to maximize the capacity to capture carbon dioxide. A filter was designed that could connect to the tailpipe of a vehicle and direct the exhaust through certain filter materials. In this experiment, zeolite was tested against another known carbon-sink: activated carbon. The filter was designed to be relatively cost efficient, easily serviceable, and allow for the reusing of filter material. An idling car and a four-gas analyzer were used to detect and record the levels of oxygen, carbon dioxide, carbon monoxide, and hydrocarbons in the exhaust. Tests were repeated using different filter materials in the same quantities, as well as a mix of zeolite and activated carbon. It was hypothesized that zeolite, due to its uniform and synthetic structure, would outperform activated carbon in carbon dioxide reduction. Showing a 40% decrease in carbon dioxide levels, zeolite was determined to be the most efficient carbon sink. Also observed were higher levels of hydrocarbon adsorption with activated carbon. This led to the design of a theoretical filter which could hold multiple filter materials to selectively eliminate different molecules from vehicle exhaust.

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