PHYS.ORG

Artificial enzymes to reduce carbon dioxide emissions

May 19 2015

Dr Hernandez analyses the composition of water from a process for cleaning smoky carbon dioxide. Credit: University of Nottingham Malaysia Campus

Enzymes are biological catalysts that accelerate chemical reactions, such as the conversion of gaseous carbon dioxide (CO2) into carbonates. Carbonates are the basic component of coral reefs, mollusc shells, geological platforms and kidney stones. Although naturally occurring enzymes would be ideal for converting human-generated CO2 emissions into carbonates, they are generally incapable of coping with the extreme conditions of industrial plants.

Led by Dr Ernesto Hernandez of the University of Nottingham Malaysia Campus, researchers in Denmark, Malaysia, Spain and the United Kingdom are now developing artificial enzymes that can withstand the harsh environments of industrial plants while accelerating chemical reactions. His team ultimately aims to create a clean, cheap, practical and socially responsible solution for global warming by reducing CO2 emissions.

"We believe that our novel artificial enzymes will be the first tailor-made enzymes for industrial plants to produce carbonates," says Dr Hernandez. So far, Dr Hernandez and his colleagues have built an artificial environment composed of chimney-like equipment, measuring 1.5 metres in height and 15 centimetres in diameter, that mimics the smoke released by power plants. Using the artificial environment, the researchers will ensure that their artificial enzymes can function properly under extreme conditions consisting of hot, corrosive, poisonous and sticky smoke as well as soot and other gases produced by power plants.

The team is basing the development of its artificial enzyme on naturally occurring carbonic anhydrase (CA), which accelerates the conversion of CO2 into carbonates. Carbonic anhydrase is capable of turning CO2 molecules into carbonates at a rate of one million molecules per second. However, "the enzyme's CO2 conversion rate slows down dramatically under industrial conditions," Dr Hernandez points out.

He and his colleagues are now engineering artificial enzymes based on natural CA, using directed evolution techniques. Their first step involves the creation of a library of diverse genes that encode for carbonic anhydrases. "This library includes sequences of unique forms of carbonic anhydrases recently found near deep-ocean chimneys (hydrothermal vents)," says Dr Hernandez.

The team plans to modify and multiply the genes encoding for carbonic anhydrases using a molecular technique called random mutagenesis. The researchers will then place the mutated genes in the artificial environment to see which ones are most effective at converting carbon dioxide into carbonates. The best mutations will then be put through the modification and multiplication processes again. The researchers will repeat the whole process until they have isolated a mutated gene encoding for recombinant carbonic anhydrase that can convert CO2 into carbonates under industrial conditions.

With the help of artificial enzymes, CO2-converted carbonates could be used in everything from baking soda and chalk to Portland cement and lime manufacturing.

Provided by University of Nottingham Malaysia Campus

Citation: Artificial enzymes to reduce carbon dioxide emissions (2015, May 19) retrieved 19 April 2024 from
https://phys.org/news/2015-05-artificial-enzymes-carbon-dioxide-emissions.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.