North Sea water and recycled metal combined to help reduce global warming

December 13 2017

Scientists at the University of York have used sea water collected from Whitby in North Yorkshire, and scrap metal to develop a technology that could help capture more than 850 million tonnes of unwanted carbon dioxide in the atmosphere.

High levels of carbon dioxide in the atmosphere are a major contributor to greenhouse gases and global warming. Carbon overload is mainly the result of burning fossil fuels, such as coal and oil, as well as deforestation.

Global efforts are being made to reduce carbon dioxide levels as well as find novel ways of trapping excess gases from the atmosphere. The team at York have now found a way to safely trap the gas as dawsonite, a solid mineral and natural component of the Earth's crust.

Professor Michael North, from the University's Department of Chemistry, said: "We wanted to look for methods of trapping the gas using environmentally friendly tools to produce a result that could be highly scalable to capture millions of tonnes of unwanted carbon dioxide.

"We started with the realisation that using graphite, the material used in pencils, to line aluminium reactors, results in the mineralisation of carbon dioxide. We wanted to trap the gas at much higher levels, using low-energy processes, so we decided to look at waste materials, such as scrap metals, to see if this could be done without using chemical agents

as a catalyst."

Researchers filled the aluminium reactor with sea water taken from Whitby Bay, and waste aluminium such as that found in kitchen foil or food wrappings. The gas is transferred to the sea water inside the reactor. Electricity, captured from solar panels, is passed through it, resulting in the aluminium turning the dissolved carbon dioxide into the mineral, dawsonite.

Professor North said: "Tens of millions of tonnes of waste aluminium are not recycled each year, so why not put this to better use to improve our environment? The aluminium in this process can also be replaced by iron, another product that goes to waste in the millions of tonnes. Using two of the most abundant metals in the Earth's crust means this process is highly sustainable."

The research showed that 850 million tonnes of carbon dioxide could be mineralised each year using a combination of sea water, solar-powered electricity, and scrap metal, eliminating the need to use high energy gas-pressurisation and toxic chemicals to produce the same effect.

Unlike other electrical reaction systems for carbon dioxide treatment, hydrogen is not needed to cause the chemical reaction in the first instance, which would normally make the process more expensive.

Instead, hydrogen is produced from the electrical circuit and becomes a side-product of the process. Hydrogen gas, a non-polluting gas that is valuable to the future of fuel production at low cost and 'zero emissions'.

Researchers are now working to maximise the energy efficiency of the process and allow the hydrogen by-product to be collected and utilised, before seeking to build toward full-scale production.

More information: Katie J. Lamb et al. Capacitance-Assisted Sustainable Electrochemical Carbon Dioxide Mineralisation, *ChemSusChem* (2017). DOI: 10.1002/cssc.201702087

Provided by University of York