

# Technological breakthrough in the fight to cut greenhouse gases

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Scientists at Newcastle University have pioneered breakthrough technology in the fight to cut greenhouse gases. The Newcastle University team, led by Michael North, Professor of Organic Chemistry, has developed a highly energy-efficient method of converting waste carbon dioxide (CO<sub>2</sub>) into chemical compounds known as cyclic carbonates.

The team estimates that the technology has the potential to use up to 48 million tonnes of waste CO<sub>2</sub> per year, reducing the UK's emissions by about four per cent.

Cyclic carbonates are widely used in the manufacture of products including solvents, paint-strippers, biodegradable packaging, as well as having applications in the chemical industry. Cyclic carbonates also have potential for use in the manufacture of a new class of efficient anti-knocking agents in petrol. Anti-knocking agents make petrol burn better, increasing fuel efficiency and reducing CO<sub>2</sub> emissions.

The conversion technique relies upon the use of a catalyst to force a chemical reaction between CO<sub>2</sub> and an epoxide, converting waste CO<sub>2</sub> into this cyclic carbonate, a chemical for which there is significant commercial demand.

The reaction between CO<sub>2</sub> and epoxides is well known, but one which, until now, required a lot of energy, needing high temperatures and high pressures to work successfully. The current process also requires the use

of ultra-pure CO<sub>2</sub> , which is costly to produce.

The Newcastle team has succeeded in developing an exceptionally active catalyst, derived from aluminium, which can drive the reaction necessary to turn waste carbon dioxide into cyclic carbonates at room temperature and atmospheric pressure, vastly reducing the energy input required.

Professor North said: 'One of the main scientific challenges facing the human race in the 21st century is controlling global warming that results from increasing levels of carbon dioxide in the atmosphere.

'One solution to this problem, currently being given serious consideration, is carbon capture and storage, which involves concentrating and compressing CO<sub>2</sub> and then storing it,' he said. 'However, long-term storage remains to be demonstrated'.

To date, alternative solutions for converting CO<sub>2</sub> emissions into a useful product has required a process so energy intensive that they generate more CO<sub>2</sub> than they consume.

Professor North compares the process developed by his team to that of a catalytic converter fitted to a car. 'If our catalyst could be employed at the source of high-concentration CO<sub>2</sub> production, for example in the exhaust stream of a fossil-fuel power station, we could take out the carbon dioxide, turn it into a commercially-valuable product and at the same time eliminate the need to store waste CO<sub>2</sub>', he said.

Professor North believes that, once it is fully developed, the technology has the potential to utilise a significant amount of the UK's CO<sub>2</sub> emissions every year.

'To satisfy the current market for cyclic carbonates, we estimate that our technology could use up to 18 million tonnes of waste CO<sub>2</sub> per year, and

a further 30 million tonnes if it is used as an anti-knocking agent.

'Using 48 million tonnes of waste CO<sub>2</sub> would account for about four per cent of the UK's CO<sub>2</sub> emissions, which is a pretty good contribution from one technology,' commented Professor North.

The technique has been proven to work successfully in the lab. Professor North and his team are currently carrying out further lab-based work to optimise the efficiency of the technology, following which they plan to scale-up to a pilot plant.

The paper 'Synthesis of cyclic carbonates from atmospheric pressure carbon dioxide using exceptionally active aluminium(salen) complexes as catalysts' s been published in the *European Journal of Inorganic Chemistry*.

Source: Newcastle University

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