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CO_2 emissions mitigation by cryogenic separation processes

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Talk Abstract

Worldwide targets to reduce carbon dioxide emissions and avoid the most severe impacts of climate change can be partly achieved by carbon capture from process gases or exhaust streams. Current carbon capture processes have high energy consumption and high capital cost which make them unattractive as an emission reduction measure, limiting options available for deep reductions in CO_2 emissions and delaying large scale application of the technology. An alternative novel solution is the use of cryogenic separation, which achieves high CO_2 capture efficiencies and delivers a much reduced energy consumption and process equipment size. These characteristics, along with the absence of process chemicals, offer the potential for application across a range of sectors where current technologies are unsuitable, such as biogas upgrading, hydrogen production through steam methane reforming and exhaust gases from natural gas combined cycles.

The aim will be to describe the most research and mature carbon capture technologies and introduce the potential offered by cryogenic separation. The proposed process uses a low temperature separation of CO_2 from a mixed gas stream. The challenges posed by CO_2 deposits as a frost will be discussed, and novel solutions will be presented. For example, the use of a moving bed of metallic or ceramic beads in counterflow is proposed as cold heat exchange medium. This allows intensive heat transfer and inherently avoids the adverse effects on heat transfer of heavy frost deposition in heat exchangers as earlier proposed.

The process is found to have low energy consumption and costs for conventional applications. The energy performance and capital cost estimates have been combined using a life cost model to generate typical levelised costs of carbon dioxide removal for the target applications to benchmark the cryogenic process against more established processes and identify applications for which it is superior to existing technologies.

Keywords
carbon capture, cryogenic separation, moving bed

Short biography

Dr Carolina Font-Palma is a Senior Lecturer in Chemical Engineering at the University of Chester. Previously she was a Research Fellow at the Univeristy of Leeds and Research Associate at Center for Research and Applied Technology in Jalisco (CIATEJ), Mexico. She has expertise on process simulation, process integration of energy systems and carbon capture. She has worked on the OxyPROP

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(Oxygen Penalty Reduction Options Programme) project, involving oxy-combustion and cryogenic CO_2 purification, as leading researcher of the University of Leeds team; this project was executed jointly with Costain and the University of Edinburgh, and funded by DECC CCS Innovation Programme. She currently works on a novel cryogenic CO_2 separation process funded by Innovate UK through the Energy Catalyst Round 4, led by PMW Technology Ltd and in collaboration with University of Sheffield, WSP UK Ltd, GL Industrial Services Ltd and Costain, and the Eco-Innovation Cheshire and Warrington programme part-funded by the ERDF (European Regional Development Fund) with PMW Research Ltd. She is also a Visiting Lecturer at Energy2050 – University of Sheffield.