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CO_2 utilisation: Waste or resource for chemical industry

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CO_2 emissions into atmosphere is a global concern and a recent theoretical model provides a quantitative approach for its connection with global warming and climate change. CO_2 is potentially a suitable resource of carbon which can partially replace oil and gas in many synthetic applications. Benefits can also extend to safety considerations since it is not toxic. It can replace certain toxic building blocks such as CO and phosgene in several commercially important processes, such as methanol or polyurethane manufactures. In addition, it can be used as a viable technological fluid with distinct advantages over other possible solutions in applications such as enhanced oil recovery and supercritical solvent. In near future, the use in carboxylation processes (synthesis of carbonates, carbamates and carboxylates, including cyclic compounds in both monomeric and polymeric forms) appears to be the most likely synthetic applications. In these cases, CO_2 serves as both carbon and oxygen sources. Replacing CO for making acrylic acid and use as a mild oxidant are other interesting applications. Reduction by catalytic and electrocatalytic hydrogenation necessitates energy from non-fossil fuels and solar and renewable energy resources should then be incorporated. The photocatalytic reduction of CO_2 in water under solar light irradiation, which is known as artificial photosynthesis, is a potential option that would increase carbon recycling. A unique aspect of this paper is the exploitations of reactions of CO_2 which stems from existing petrochemical plants-with the commodity petrochemicals (such as, methanol, ethylene and ethylene oxide) produced at the same or nearby complex in order to obtain value-added products while contributing also to CO_2 fixation simultaneously. Exemplifying worldwide ethylene oxide facilities, it is recognized that they produce about 3 million tons of CO_2 annually. Such a CO_2 resource, which is already separated in pure form as a requirement of the process, should best be converted to a value-added chemical there avoiding current practice of discharging to the atmosphere.

Biography

Ozge Yuksel Orhan obtained her Ph.D. in Chemical Engineering from Hacettepe University, Turkey, in December 2014. Her thesis is entitled "The Absorption Kinetics of CO_2 into Ionic Liquid-CO_2 Binding Organic Liquid Hybrid Solvents". Currently, she is a Research and Teaching Assistant at Chemical Engineering Department of Hacettepe University. Her research topics have dealt with the study of carbon dioxide capture by novel solvents. Erdogan Alper is a Professor at the Chemical Engineering Department of Hacettepe University in Ankara, Turkey. He obtained his BSc (Honours) (First Class) from Birmingham University, England (1968), and earned his PhD from Cambridge University (1972). In 1977–1978, he was an Alexander von Humboldt fellow at Hannover University, Germany, and received Turkish Scientific and Technological Research Council prize in Engineering in 1982. His research areas include carbon dioxide capture by innovative solvents, fuel cell modelling by CFD, petroleum refining and petrochemical technologies. He published 4 books and around 150 research papers in cited journals.

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