Closing the carbon cycle – Electrochemical reduction of CO_2 to ethylene

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The extensive use of fossil fuels has led to a sharp rise in CO_2 emissions and thus to serious environmental problems. WACKER is taking a leading role in shaping a sustainable future for our planet. WACKER's ambitious goals are therefore based on a variety of research initiatives. One of these is closing the carbon cycle and thus avoiding CO_2 emissions while creating new carbon sources for sustainable products. Electrochemical CO_2 reduction is a promising technology for converting CO_2 into high-quality chemical feedstocks using renewable electrical energy. Two different approaches are being investigated at WACKER: The direct conversion of gaseous CO_2 and CO_2 previously captured in an absorber solution. The advantage of the first variant is that the restriction of mass transport is minimised by feeding the gaseous CO_2 directly to the catalyst. The second variant concentrates more on simplifying the overall process by reducing the CO_2 from the absorber solution, which is used to purify the CO_2 from the flue gas anyway. Both approaches are run in flow-through cells with either a gas diffusion electrode or a modified flow field. The products converted during electrolysis are mainly gaseous. Besides, ethylene, often also carbon monoxide and hydrogen can be produced. These products are analysed by in-line GC analysis. Liquid products such as formic acid are quantified by sampling the liquid electrolyte with NMR Spectroscopy. The aim is to establish an industrial process that uses green electricity to convert CO_2 into ethylene, which can then be utilised by the chemical industry.

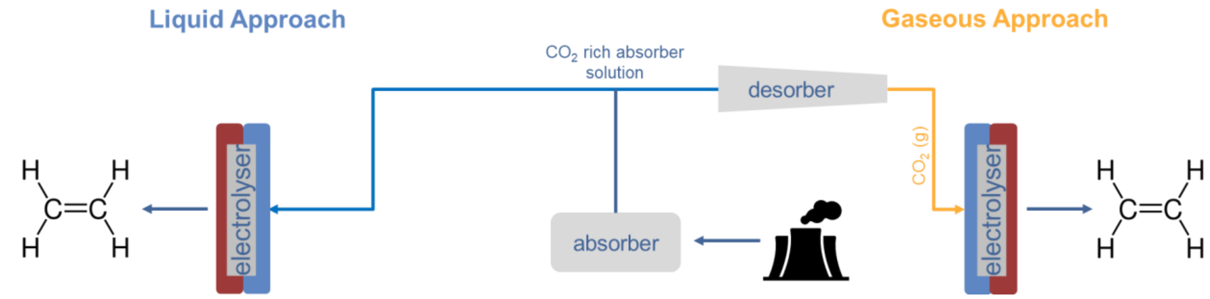

Figure 1: Two different approaches investigated at WACKER to convert CO_2 to green ethylene.