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Methanation of recovered oxyfuel-CO_2 from Ketzin and of flue gas emitted by conventional power plants

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The catalytic conversion of CO_2 with H2 into CH4 is possible by the Sabatier reaction CO_2 + 4H2 -> CH4 + $2H_2O$. Using excess energy from renewable electricity generation, this reaction offers an opportunity for recycling of CO_2 as synthetic natural gas, for example. In result, CO_2 emissions caused by fossil natural gas are reduced by the amount of this reintegrated and recycled CO_2.
In laboratory scale, we study the Sabatier reaction in the context of carbon capture and storage. We use used real processed oxy-fuel CO_2 before and after injection at the pilot plant in Ketzin/Brandenburg. Here, one important aspect is the stability of the performance of catalysts for Sabatiers reaction against contaminations like SOx or NO_x. We find a stable conversion before and after storage in the Ketzin aquifer.
In addition, we report on the performance of the Sabatier reaction as direct methanation of flue gas, emitted by conventional power plants. We use an upscaled system, with a maximum input flow rate of 50Nm3/h Gas (or 5Nm3/h CO_2, 25Nm3/h flue gas, 20Nm3/h H2, according to the flue gas composition). The performance is characterized in a simulated composition of flue gas and under real conditions at a power plant in Schwarze Pumpe, Brandenburg, Germany.
In all cases, we find a conversion near 90%, with $\sim$100% selectivity. In an upscaled system with high input flows of educt gas, the reaction is also autoorganized. At a certain limit of gas flow, a steady state equilibrium of exothermic heat production and thermal flow is reached and the reaction needs no further external annealing.