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Gas Purification on a Laboratory Scale
New Approaches for Steel Mill Gas Treatment

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Objective

The purification of complex gas mixtures for use in chemical synthesis poses open questions and challenges that cannot be solved by commercially available technologies. Here, various approaches were investigated on a laboratory scale. The focus was on issues related to the removal of oxygen from unpurified coke oven gases (COG) and the possibilities of using electric swing adsorption.

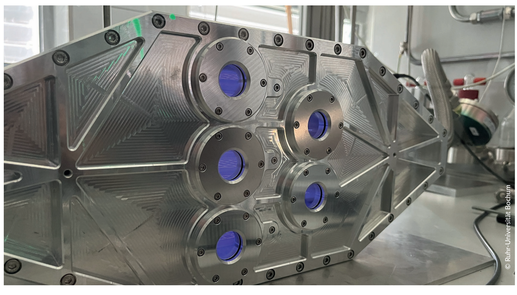
Thermo-catalytical removal of oxygen

The removal of oxygen traces from coke oven gas was initially investigated by using Pt or NiMo/CoMo catalysts from Clariant in a laboratory plant with synthetic gas mixtures. Depending on the catalyst pretreatment, as well as the added impurities such as H_2S and COS, high conversion rates close to 100 % could be achieved at temperatures of 250 °C and a pressure of 8–10 bar. The transferability to the operational environment is verified in a specially constructed experimental setup. Application to other gases will be addressed next.

View into the experimental container for thermo-catalytic oxygen removal from steel mill gases in operational environment.

Coke oven gas treatment with non-thermal plasma

Non-thermal plasma enables gas treatment using electricity from renewable sources without significant temperature rise of the gas. Two different reactor concepts with plasma formation throughout the entire gas volume (volume DBB/UMSICHT) or partially on defined surfaces (surface DBD/RUB) were developed on a laboratory scale and subsequently tested under operating conditions. Depending on the gas flow rate, generator power, pressure and oxygen. concentration, conversion rates above 90 % for synthetic gases and up to 60 % for real coke oven gases could be achieved.



Surface DBD reactor (RUB) for treatment of 10 Nm^3/h coke oven gas.

Electric swing adsorption (ESA)

ESA utilizes the electrical resistance of the adsorbent material for heating. This allows the desorption process to be better controlled compared to usual temperature swing adsorption. In gas purification, ESA can be used as a pre-adsorber before the COG-PSA. Other applications, such as the separation of CO_2 from other gas streams (e. g., BFG, BOFG), are also possible. Fundamental studies on adsorbents and reactor design were conducted with synthetic gases on a laboratory scale and subsequently verified with real steel mill gases.

ESA on a laboratory scale with GC system for measuring minor components.

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