Carbon2Chem®

Analytics
A Key to Develop Steel Off-Gas Purification

Max Planck Institute for Chemical Energy Conversion | thyssenkrupp Steel Europe AG

Objective

The Carbon2Chem® project utilizes steel production gases to synthesize commodity chemicals, e. g. methanol. The composition of steel mill gases as well as a profile of trace components can be determined in both, raw gases and after gas purification, by gas chromatography and proton transfer reaction mass spectrometry.

Key challenge
Analysis of steel mill gases

One aim of the Carbon2Chem® project is to use process gases of the steel production as educts for the synthesis of chemicals, e. g. methanol. The raw gases from the steel mill contain trace components, that impair the usage of these gases as feedstock for further catalytic processes due to catalyst poisoning.

At the technical center operated by thyssenkrupp in Duisburg based on catalysts and sorbents of Clariant, the gases are analyzed in the so-called HüGaProp container (raw gas) and after being cleaned within a purification unit in a laboratory (purified gas).

The main components of these gases are analyzed by gas chromatography (GC). For investigating components only present in small concentrations, proton transfer reaction mass spectrometry (PTR-MS) can be utilized, allowing to determine the concentrations of trace components in the low ppb to ppt range.

Conclusion
PTR-MS analysis confirms the efficiency of gas purification

The analysis of the gas composition by GC shows that for both, blast furnace gas (BFG) and basic oxygen furnace gas (BOFG), the composition of main components is similar before and after the purification process and overall in agreement with literature (Fig. 1).

Trace components were also determined before and after the purification by PTR-MS. In Fig. 2, the concentrations of COS and CS_2, two common catalyst poisons, are determined in BOFG. Successful removal reduces the concentration of COS by a factor of 100 (1-3 ppm to 10 ppb) and of CS_2 by a factor of 20 (5 ppb to 0.1 ppb) to values in the low ppb range.

PTR-MS is a powerful tool for verifying the removal of typical catalyst poisons and a crucial step for further usage of these gases.

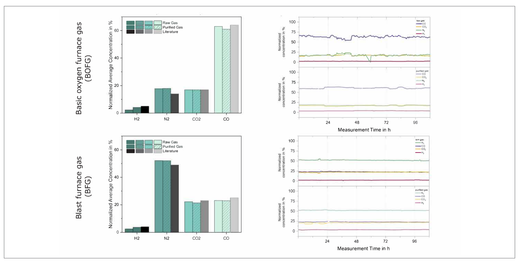

Fig. 1: Composition of main components determined by gas chromatography of basic oxygen furnace gas (BOFG, top) and blast furnace gas (BFG, bottom).

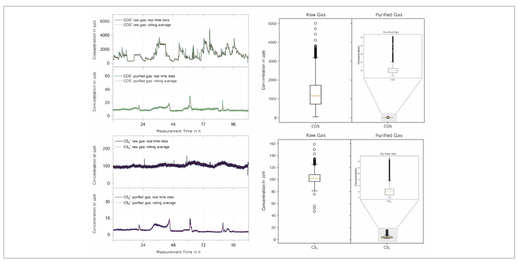

Fig. 2: PTR MS trace analysis of COS (top) and CS_2 (bottom) in BOFG measured before and after the purification unit.

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