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OXIDATION OF SO_2 TO SO_3 OVER CATALYSTS – OPTIMIZING CONVERSION OUTPUT

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1 Introduction

This study designs basis of the gas calibrator for the continuous SO_3 emission monitoring device. Starting point for study is to utilize catalyst materials. According to earlier experiences stable production of SO_3 gas with catalyst is challenging task for monitoring purposes. However this method advantage is supposed to be a simple construction.

2 Goal

Ideal catalyst would have: stable output, good repeatability, maximum period of operation, minimum stabilizing time and reasonable maintenance costs. Chosen method should also be physically and operationally connectable to the SO_3 analyser. Calibration gas composition, temperature and flow should be suitable for analyser.

3 Description

Catalyst research has been published widely among the sulphur acid production and the SCR development. Sulphur trioxide (SO_3) online monitoring research and calibration methods with catalysts has been active only recent years and only few presentations has been published. The SCR development has contributed extensive studies where catalyst mechanism of SO_3 is described. This research can be applied also for designing optimize method for calibration of the SO_3 monitoring.

The SCR catalyst consists primarily of vanadium pentoxide (V_2O_5), tungsten trioxide (WO_3) and titanium dioxide (TiO_2). Low SO_3 conversion catalyst applications at higher operation temperatures are developed for engines and power plants. This is accomplished for example using zeolite materials in catalyst.

The Metal oxides and alkali metals improve SO_3 conversion in catalyst. Similar positive effects has also high vanadium level, high oxidation level of vanadium, high temperature, long reaction time, thickness of the catalyst plates, porous catalyst surface, certain SO_2 & NO_x concentrations, dry gas and low ammonium concentration. SO_2/SO_3 conversion is also favoured by high pressure. But it is not worth spending money to compress the reacting gases in the SCR or the sulphur acid production applications. Thermal sintering could decrease the catalyst activity.

The SO_3 monitoring developers have good experiences of platinum catalysts. Aluminium fraction decreases conversion rate of the platinum catalyst though it has also negative effects on catalyst stabilizing time. It should also pay attention to sample line materials. Certain materials may lead to catalyst poisoning. The sample line fittings should be tight despite of temperature variations. The pellet catalysts are easy to handle whereas the catalyst powder may give more effective reaction surface.

The FTIR analyser function temperature is below SO_3 condense temperature and this may cause interfering effects. The SO_3 condense may react with the KBr windows and they would start to fog up. In field test the response time of the SO_3 CEM has varied a consequence of ash reactions. This was observed when SO_3 was monitored over a particulate control device.

Conclusion: the most promising catalyst materials for the pilot test are platinum and vanadium. These materials active temperatures are relative low and SO_2/SO_3 conversion is supposed to be good enough.

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