

Abstract

Process Development with Modular Mini Plants Using the Example of an Emission Free Sulfuric Acid Process

In this thesis a methodology is presented that uses mathematical models, simulation and experimental data to substantially reduce the time needed to develop and validate new chemical processes. This new methodology is applied in the context of a sulfuric acid process that is part of the gas cleaning process of coking plants. The resulting new sulfuric acid process is completely emission free, making it stand out regarding the emission of air pollutants.

The presented methodology represents an intensified process development which is carried out with support of modular mini plant technology. The process development steps are continuously accompanied using simulation tools. For process steps for which no suitable models exist, applicable models were developed and validated using measurements in a modular mini plant.

The two-step experimental approach starts with measurements with pure substances in the technical centre. The results are then validated under real industrial conditions using a mobile mini plant on a suitable industrial site. The experiments are designed using model-based design of experiments to ensure an effective performance in the experimental work and for quantifying the accuracy of the developed model. In addition, the experiments are continuously accompanied by simulation calculations for the entire plant to allow continuous integration of the experimental data into the design of the process.