Design of Apparatus for Testing of Catalytic Filters for Flue Gas Treatment

Zach, Boleslav
2015

Design of Apparatus for Testing of Catalytic Filters for Flue Gas Treatment

Student: Ing. Boleslav Zach
Supervisor: Ing. Michael Pohořelý, Ph. D.
Supervising Expert: Ing. Michal Šyc, Ph. D.

Flue gas from municipal solid waste incineration contains high concentrations of various pollutants. Treatment of flue gas is therefore required to meet legal emission limits. A lot of research has been dedicated to the topic of flue gas cleaning, most of it, however, associated with large municipal solid waste incineration (MSWI) plants. In areas with low population density, smaller MSWI plants can be the only option if the area of collection is not to be too large, which would increase the costs of transportation. Small MSWI plants are feasible, but the technology has to be adapted to needs of small units.

Catalytic filters can simultaneously remove dust (DeDusting), catalytically destroy organic compounds (DeDiox), reduce nitrogen oxides (DeNOx) as well as (in case a sorbent is fed into the flue gas stream) remove acid compounds from the flue gas (DeSOx). This flue gas cleaning system is called *4D filtration*. Apart from being simple and relatively cheap, this flue gas cleaning system does not produce any wastewater. *4D filtration* therefore seems to be most suitable for small MSWI plants because wastewater treatment system is very expensive to build and to operate. In fact, *4D filtration* is primarily intended for small MSWI plants with processing capacity of around 5 tons per hour (10 MW_{th}).

The aim of this presentation is to describe an apparatus for testing of catalytic filters and for determination of optimal conditions for the operation of such filters. This apparatus has been designed and is currently being constructed.

The apparatus consists of four parts: retort burner with a screw feeder, duct system 1, filtration reactor (baghouse), and duct system 2. The essential part of this apparatus is the baghouse, in which four catalytic filter elements are placed. The filter elements can be made of PTFE or ceramic. Based on the baghouse, proportions and details of other parts of the apparatus were calculated. Flue gas is produced in the retort burner with the screw feeder. The feed are either wooden pellets or pellets of model waste. The flue gas is cooled in an air cooler,

from which the gas stream continues through the duct system 1 into the baghouse. The duct system 1 is provided with welded-on fittings used for feeding of pollutants, ash, and sorbent, as well as sampling. On the surface of the filters in the baghouse, the sorbent together with ash create a filter cake. The gas flows through the filter cake where it comes into contact with the sorbent. The duct system 2 (provided with welded-on fittings for sampling) leads the gas from the baghouse into a water cooler. The condensate formed in the water cooler is collected in condensate vessels. The gas subsequently flows through a straight pipe, where the gas flow stabilizes. The stable gas flow is necessary for an accurate measurement of flow-rate in the ultrasonic gas flowmeter. The flow-rate is set by a blower placed downstream of the ultrasonic gas flowmeter.

Using this apparatus, we are going to be able to study the effects of following parameters on *4D filtration:* temperature, type of filter (fibre, ceramic etc.), sorbent properties, gas flow-rate, and fly ash characteristics.