DEVELOPMENT AND CHARACTERISATION OF PLANAR SORBENTS BASED ON CHEMICALLY TREATED BASALT FIBRES AND CHARCOAL FIBRES

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Planar sorbents were developed for treatment of gaseous industrial waste streams and hydrophilic acidic gases (e.g. H_2S, SO_2) involved in natural gas. Consecutive chemical leaching of the basalt fibers by sulphuric acid and hydrochloric acids was used in order to develop a porous active surface of the basalt fiber. Planar sorbents made of the leached basalt fibers have advantages in comparison to other inorganic sorbents, e.g. natural zeolites. They posses lower diffusion resistance and higher sorption ability towards SO; than natural zeolite (clinoptilolite).

The sorption properties of basalt based planar sorbents for SO_2, H_2S, and CH_4 involved in natural gas were tested both for dry and humid natural gas steams. Moreover, sorption isotherms for toxic organic compounds, such as phenol, methylphenol. 2-butanol, and dichlorethane on this sorbent were measured and the respective sorption capacities were determined.

A model describing gas transport and sorption of hazardous compounds was developed in order to characterize the planar sorbents. Two types of pores (macropores controlling the gas transport, and micropores controlling the sorption of hazardous components) are considered in the model. It was found that gas transport and heat flux conditions can be improved in the units using the planar sorbents.

Thermal stability of macropores and micropores was determined experimentally by means of emanation thermal analysis. Emanation thermal analysis [1] (ETA) was used for the characterisation of morphology changes of the sorbents under "in-situ" conditions of their heat treatment in dry air in the temperature range 20-1300°C.

Radon atoms ^{220}Rn were used as tracers making possible to characterise porosity and microstructure changes of planar sorbents using chemically treated basalt fibres.

Temperature range suitable for the regeneration of the chemically treated basalt planar sorbents was determined. Temperature necessary for the regeneration of the chemically treated basalt planar sorbents is by 100-200°C lower than that for natural zeolites. Significant energy savings can be achieved in the industrial scale, when using the planar sorbents units made of leached basalt fibres. The porosity collaps of leached basalt-fiber planar sorbent was indicated by ETA in the range 800-1100°C. In this temperature range the encapsulation of hazardous elements in the porous basalt can be achieved.

Surface area measurements and scanning electron microscope were used for the direct characterisation of "as leached' and 'as regenerated' sorbents.

A good agreement between the experimental results of various methods and characteristics calculated from our model was found.

Moreover, the combination of porous basalt fibres and charcoal fibres was proposed for planar sorbents of hazardous organic volatile compounds.

Optimal conditions for activation of planar porous charcoal sorbents and for their regeneration after use were determined. Sorption isotherms for vapours of dichtormethane, 2-butanol and methylphenol on the charcoal-fibers based planar sorbent were measured and the respective sorption capacities were determined [2].

Emanation thermal analysis was used for the characterisation of morphology changes of the sorbents under in-situ conditions of their heat treatment in argon in the temperature range 20-750"C.

Optimised conditions for preparation and further treatment of the planar sorbents based on porous charcoal fibres were recommended [2].

Surface area and microstructure of the charcoal fibers prepared under optimized conditions were determined by means of nitrogen sorption measurements and scanning electron microscopy.

Two-steps-heating and subsequent cooling of the activated charcoal sorbent was carried out in the temperature ranges 20-500°C and 20-750°C, respectively, in order to **assess** the diffusion resistance of the planar sorbent. Using radon atoms ^Rn as tracers of the diffusion characteristics and microstructure development of the charcoal fibres, it was shown that the decrease of the diffusion resistance of the transport pores in the charcoal fibres resulted after thermal treatment in argon up to 500°C.

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References:

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