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Sorbents based on mixed oxides of zinc, iron and titanium for the removal of hydrogen sulfide from hot gas from the coal gasification

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Abstract

The thesis is an attempted to develop the optimum composition and the method of production of sorbents, based on mixed metal oxides, to the process of high temperature desulphurisation of gas from coal gasification. The gasification technology of this raw material is going through a renaissance of interest, which is reflected in a significant increase in the number of installations worldwide. Gasification technologies based on coal are more efficient than those traditional, where it is burned, furthermore it allows to reduce emissions of pollutants to the environment. Implementation gas desulphurisation process, without the need to cool, raises the efficiency of the entire gasification system, but this solution has not been fully developed.

In the first part of the thesis the introduction to coal gasification was widely described. Basic information about the raw materials subjected to gasification, process chemistry, functioning technology or gas composition depending on the solution adopted were presented in consecutive points. The processes of gas purification, which takes place in every installation, including: ash removal; removal of tars; water gas shift reaction; the removal of sulfur and ammonia; release of carbon dioxide was described in a detailed sequence. Due to the subject of the work, information on accepted methods of desulphurisation, divided into low and high temperature solutions, were presented. The existing knowledge on the high-temperature hydrogen sulfide sorbents on the basis of the elements: zinc; iron; copper; cerium; manganese was widely shown. The above part of the work was closed by a summary, and it resulted with an inspiration to study it.

The experimental part begins with identifying the purpose of this work and scope of research, that serves the realization of its objectives. In the next paragraph research methodology, specifying of used source materials, methods of sorbents synthesis and research techniques, such as low-temperature sorption of nitrogen, mercury porosimetry; mechanical resistance to crushing, scanning electron microscopy; X-ray powder diffraction, temperature programmed reduction in hydrogen, sulphate content, numerical calculations, measurements of sorption activity for hydrogen sulphide were discussed . This point was terminated with results concerning the diffusion areas of hydrogen sulfide, affecting the sorption measurements.

In the further part of the work there were presented results of research and a discussion around them. In the following sections the effect of sorbent components selection on their

properties was shown. Then the effect of synthesis methods, with division on sorbents group: ZT, ZF and ZFT was presented. In the following sections the effect of modifying the properties of the sorbent through the use of various binders and pore-forming substances was shown. Next the influence of temperature conditions of the process on the sorption capacity of the bed and the changes taking place in the sorbents phase compositions was presented. With the division into groups (ZT, ZFT), the impact of doping prepared materials by oxides of cobalt or nickel was discussed. In the following sections items describe regenerative properties of individual sorbents groups and the influence of basic parameters (temperature, composition) for the duration of the process, phase composition and amount of formed sulphates. In a separate section the results of this research in large laboratory scale on the selected monolithic bed were presented. A further part of the work provides a summary and discussion of the results, along with the excerpt of cited literature.