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Research of composite catalysts for the process of thermocatalytic hydrogenation processing of plastic waste

Abstract. Processing plastic waste in landfills is becoming unprofitable due to the increasing costs and poor biodegradability of commonly used polymers, as well as due to large public objections. Thus, the recycling of mechanical or chemical waste seems to be the only way to handle plastic waste in the direction of sustainable development. Polyolefins, mainly polyethylene (LDPE or HDPE) and polypropylene (PP) are the main type of thermoplastics used worldwide in a wide variety of applications. In the process of thermocatalytic hydrogenation during processing of polymer waste, hydrocarbon fractions similar to motor fuels will be obtained. In general, this will allow us to process secondary raw materials, add additional fuel materials to the market and have a positive impact on the environment. Studies of new catalysts based on natural zeolite from the Taizhuzgen deposit modified with tungsten and molybdenum salt were carried out in order to jointly study the processes of thermocatalytic hydrogenation of plastic waste and optimize the process. The purpose of the study is to study the characteristics and composition of catalysts based on natural zeolite, which contain active metals for the process of thermocatalytic hydrogenation using physical and chemical methods.

Key words: fuels, plastic, recycling, polymer, Taizhuzgen zeolite, composite catalyst.

Introduction

In recent years, due to the growing need for environmental problems, especially in developing countries, and a decrease in demand for heavy oils, there are high concentrations of macromolecules and the substances contained in them, which must comply with strict environmental norms and standards. Thus, the processes that turn high molecular weight oil solutions into clean and light products have attracted the attention of researchers [1–3]. Polymers have become common materials in our daily existence and many of their properties such as service life, universalism and light weight can be an essential factor in achieving significant elaboration. However, the use of polymeric materials also increases the amount of solid waste generated, as polymeric products are often only used once before being recycled. The problem of recycling is not only technical, but also has social, economic and even political dimensions. It is for this reason that several different methods have been investigated and applied to solve problems related to the management and disposal of polymer waste [4]. The key parameter is the use of plastic waste as a source of hydrocarbon fuel. The habit of discarding plastic waste has created many environmental problems and threats to water bodies. To solve this problem, various thermochemical recycling processes have been adopted, namely thermocatalytic, pyrolysis, incineration, gasification, pyrolysis-reforming strategies for converting plastic waste into fuel-class transport hydrocarbons.

Type of thermochemical process chosen for converting plastic waste into useful energy depends on the existence of feedstock and the conversion efficiency. All processes are multi-stage and require a special type of reactor to overcome the problems of toxic gas emissions into the atmosphere [5–9]. In this study, a method for using plastic waste for the synthesis of carbon-containing materials for energy production and the use of capacitors is proposed. Environmental problems caused by plastic waste are addressed properly [10].

Processing takes place thanks to hydrothermal liquefaction – waste melts at ultra-high temperatures and dissolves in supercritical water. After that, it turns