PhD THESIS ABSTRACT

The oxidation of limonene with t-butyl hydroperoxide in the presence of titanium-silicate catalysts

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This dissertation first presents general information on biomass and directions of its use. While discussing issues related to biomass and its transformations, special attention was paid to orange peels, which are valuable waste from fruit juice production plants. One of the directions of their use may be obtaining high-purity limonene (R(+)-limonene) from them, which can be used as a raw material in organic syntheses, especially in oxidation processes with hydrogen peroxide and t-butyl hydroperoxide (TBHP) on heterogeneous catalysts. This part of the work also discusses the properties and applications of limonene and its oxygenated derivatives. At the end of the literature part, there is information on: structure, properties and applications of titanium silicate catalysts, both of the older generation and the newest titanium silicate catalysts.

The experimental part of this dissertation presents the results of research on the oxidation of limonene (R(+)-limonene) using TBHP as an oxidant and on titanium silicate catalysts, such as: TS-1, Ti-MCM-41, Ti-MWW and Ti-SBA-15. The tests were carried out using a glass apparatus (tests under atmospheric pressure at lower temperatures) and autoclaves (tests under autogenous pressure at higher temperatures), and methanol was used as a solvent. Natural limonene used in oxidation reactions was obtained by the distillation methods from waste orange peels. The last stage of research on the oxidation of limonene on titanium silicate catalysts was the mathematical optimization of this process with the application of Ti-SBA-15 catalyst. Ti-SBA-15 catalyst was selected for further optimization as the most effective catalyst among the tested ones, because its use allowed to obtain the highest selectivity of transformation of limonene to 1,2-epoxylimonene.

This dissertation presents one more practical application of orange peels, not only as the source of high purity limonene, but also as a raw material for the production of carbon catalysts

active in the limonene oxidation process. The proposed method of obtaining activated carbons consists in obtaining limonene from the peels first, and then using the orange pulp remaining after the distillation of limonene to obtain activated carbons. Catalysts obtained from orange pulp were used in the limonene oxidation process.

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