

The oxidation of limonene with oxygen over the TS-1 catalyst

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Abstract

Limonene can be obtained from orange peels which are a waste biomass obtained from the orange juice industry. Thus, limonene is a renewable, easy available and a relatively cheap organic compound which can be used as a raw material in organic reactions (for example in oxidation and isomerization reactions). The work presents the preliminary results of the studies on limonene oxidation over the TS-1 catalyst with the titanium content of 5.42 wt%. No solvent was used in the oxidation studies, and molecular oxygen was used as the oxidizing agent. The effect of reaction time on the conversion of limonene and the selectivities of appropriate products was investigated. It was found that it is most advantageous to carry out the process of limonene oxidation for 6 h. Under this time the conversion of limonene amounted to 43 mol%, and main products of limonene oxidation were: 1,2-diepoxy (selectivity of 34 mol%), carveol (selectivity of 11 mol%) and 1,2-epoxylimonene diol (9 mol%). In smaller quantities also carvone and perillyl alcohol were formed. The oxidation of limonene over TS-1 catalyst with the use of molecular oxygen as the oxidant was carried out in a 25 cm³ glass reactor equipped with a reflux condenser, a magnetic stirrer with heating function and a glass bubbler for oxygen supply from the cylinder. Limonene was introduced into the reactor first, followed by the addition of the appropriate amount of TS-1 catalyst and the supply of oxygen from a bottle at a rate of 40 ml/min. The flask was placed in the paw, immersed in the oil bath and agitated at 500 rpm. The oxidation was carried out at the temperature of 85 °C, during 3-48 h and with the catalyst content of 1 wt%. After the reaction, the post-reaction mixture was separated from the catalyst using a centrifuge. The described limonene oxidation process allow for the management of waste in the form of orange peels, as well as for obtaining valuable compounds for the perfume, cosmetics, food, polimer industries and also for medicine.

Keywords: limonene, oxidation, TS-1 catalyst