

Studies on The Catalytic Activity of Materials Obtained from Waste in the Form of Coffee Grounds in Oxidation and Isomerization Reactions

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Abstract

The aim of the study was to use waste in the form of coffee grounds to obtain heterogeneous catalysts and their use in the oxidation of alpha-pinene, 1,5,9-cyclododecatriene (CDT) and cyclohexene, and in isomerization of alpha-pinene. On the basis of the obtained results, the catalytic activity of the materials obtained from coffee grounds was found in all tested reactions. During the tests, approximate, most favorable conditions for carrying out these reactions were determined. The main products of alpha-pinene oxidation were: alpha-pinene oxide, verbenol, verbenone, campholeic aldehyde, pinocarveol, myrtenol, myrtenal and carveol. During the oxidation of CDT as main product was 1,2-epoxy-5,9-cyclododecadiene, and during isomerization of alpha-pinene the main products were camphene and limonene. The catalysts that were used in the tests were prepared using coffee grounds that were initially washed with acetone to remove solvent-soluble impurities. They differed only in the additional grinding of the grounds used for the synthesis of one of them. The catalyst synthesis method consisted in dissolving Pluronic P123 (Aldrich, MW = 5800) in a mixture of water and HCl (37 wt% aqueous solution) at the temperature of 35 °C, and then adding to the mixture thus obtained: tetraethyl o-silicate (TEOS, 98 % Aldrich), tetraisopropyl o-titanate (TiPOT, 97%, Aldrich) and coffee grounds (the mass ratio the mixture obtained above to coffee amounted to 15:1). The resulting mixture was stirred at the temperature of 35 °C for 24 h. After the agitation was turned off, the contents of the reactor were further heated at the temperature of 35 °C for 24 h. The resulting precipitate was filtered off, washed with deionized water, and then dried at the temperature of 100°C for 24 h and next calcined for 6 h at the temperature of 550 °C. The described reactions allow for the management of waste in the form of coffee grounds, as well as for obtaining valuable compounds for the cosmetics and polymer industries and for medicine.

Keywords: coffee waste, oxidation, isomerization