Study of the influence of different factors on the oxidation process of N-Butane

Abstract

1 Introduction
and two-stage, in which the replacement of contact oxygen and olefin with a catalyst solution is carried out alternately (in different apparatuses).

The feedstock (n-butenes) and the catalyst are fed to a column-type reactor where almost complete conversion of n-butenes is achieved in one pass. The process is carried out at a temperature of 100 ℃. MSC yield is 80%; butyric aldehyde (4%), chlorination products (4–6%), carbon dioxide (0.5–1%) and others (2–2.5%) are obtained as by-products [19].

The conversion of n-butene is 95% [20]. Today, the process of obtaining alkenes and aromatic hydrocarbons as a result of catalytic aromatization of methane and propane–butane fraction or methane oxycondensation reactions is gaining importance in the world. Therefore, extensive work is being carried out in this direction [21–25].

2 Experimental part

Figures 1 and 2 show xTiO$_2$•(1–x)SiO$_2$ (x=0.0001–0.04) with 33% porosity obtained by hydrothermal reaction in the ratio of tetra-n-propylammonium hydroxide/tetraethylorthosilicate=0.085 and 0.5, respectively. Microphotographs of the catalyst samples are shown. Infrared spectroscopy and illumination electron microscopy methods were used to characterize the structure and morphology of the obtained catalyst samples.

Figures 3 and 4 show the porosity of 33% obtained by hydrothermal reaction without stirring and with stirring during processing in aqueous solutions at temperatures above 100 ℃ and pressures above 0.1 MPa. Photomicrographs of catalyst samples containing xTiO$_2$•(1–x)SiO$_2$ (x=0.0001–0.04) are shown.

Fig. 1. The appearance of the catalyst obtained in the ratio of tetra-n-propylammonium hydroxide/tetraethylorthosilicate=0.083 mol.

Fig. 2. The appearance of the catalyst obtained in the ratio of tetra-n-propylammonium hydroxide/tetraethylorthosilicate=0.5 mol.
3 Results and discussion

A comparison of the main indicators of the catalytic activity of the catalyst samples obtained at different initial molar ratios is shown in Fig. 5.

At the initial molar ratio of tetra-N-propylammonium hydroxide/tetraethylorthosilicate = 0.083, "Shurtangaz chemical complex waste has a porosity of 33% obtained by the reaction of n-butane with potassium permanganate solution in aqueous solutions at temperatures above 100°C and pressures above 1 atmosphere.

The formation of butanone-2 obtained as a result of butane oxidation in the presence of a catalyst containing xTiO$_2$•(1-x)SiO$_2$ (x=0.0001-0.04) is not observed. The waste of the Shurtangaz chemical complex is xTiO$_2$•(1-x)SiO$_2$ (x=0.0001-0.0) with a porosity of 33% obtained by the reaction of n-butane with a solution of potassium permanganate in aqueous solutions at temperatures above 100°C and pressures above 1 atmosphere. The increase in the initial rate of formation of butanone-2 obtained as a result of the oxidation of butane is explained by the increase in the total specific surface area of the catalyst.

Thus, studies on the synthesis of the catalyst containing xTiO$_2$•(1-x)SiO$_2$ (x=0.0001-0.04) with 33% porosity obtained by hydrothermal reaction with different tetra-N-propylammonium hydroxide/tetraethylorthosilicate molar ratio shows that the ratio of E3S Web of Conferences 402, 14011 (2023) TransSiberia 2023

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The ratio of tetra-N-propylammonium hydroxide/tetraethylorthosilicate = 0.5 provides the maximum selectivity of the formation of butanone-2 obtained.

Table 1. Results of catalytic tests of samples with different ratios of tetra-N-propylammonium hydroxide/tetraethylorthosilicate.

<table>
<thead>
<tr>
<th>№</th>
<th>The ratio of tetra-N-propylammonium hydroxide/tetraethylorthosilicate</th>
<th>Butanone-2 obtained by the oxidation of butane in the presence of a catalyst containing $x\text{TiO}_2 \cdot (1-x)\text{SiO}_2$ ($x=0.0001-0.04$) with a porosity of 33% yield, %</th>
<th>Conversion of potassium permanganate solution, %</th>
<th>$W_0 \times 10^4$ mol/(l$^<em>$min$^</em>$g (cat))</th>
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Table 2. The influence of the initial tetra-N-propylammonium hydroxide/tetraethylorthosilicate molar ratio on the main process variables: the conversion level of potassium permanganate solution; yield of butanone-2; initial rate of formation of butanone-2.

<table>
<thead>
<tr>
<th>№</th>
<th>Solvent</th>
<th>n-butene: solvent. mass</th>
<th>n-butene: potassium permanganate solution. mol</th>
<th>T, ºC</th>
<th>Catalyst containing $x\text{TiO}_2 \cdot (1-x)\text{SiO}_2$ ($x=0.0001-0.04$) with 33% porosity obtained by hydrothermal reaction 1.2 g/l</th>
<th>Butanone-2 yield. %</th>
<th>Conversion of potassium permanganate solution. %</th>
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Fig. 5. The influence of the initial tetra-N-propylammonium hydroxide/tetraethylorthosilicate molar ratio on the main process variables: the conversion level of potassium permanganate solution; yield of butanone-2; initial rate of formation of butanone-2.
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The catalytic hydrothermal treatment of butane with hydroperoxide, potassium permanganate solution, and butanone in the presence of a catalyst is studied. The conversion of potassium permanganate solution, %

Table 3. The results of the catalytic hydrothermal treatment at different temperatures and different reaction times. The conversion of potassium permanganate solution, %

<table>
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<tr>
<th>№</th>
<th>Hydrothermal treatment temperature is ℃</th>
<th>Butanone-2 product, %</th>
<th>The conversion rate of potassium permanganate solution, %</th>
<th>W₀<em>10⁴ mol/(l</em>min*g (cat))</th>
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Table 4. The results of the catalytic hydrothermal treatment at different reaction times. The conversion of potassium permanganate solution, %

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<th>№</th>
<th>Hydrothermal treatment time</th>
<th>Butanone-2 product, %</th>
<th>Conversion of potassium permanganate solution, %</th>
<th>W₀<em>10⁴ mol/(l</em>min*g (cat))</th>
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4 Conclusion
References