CATALYTIC PROPERTIES OF THE VANADIUM-MOLYBDENUM OXIDE SYSTEM FOR ACROLEIN OXIDATION


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The catalytic properties and phase composition of the silica-supported vanadium-molybdenum oxide system have been studied in acrolein oxidation. The active component of the catalyst is the compound $\text{VMo}_3\text{O}_{11+x}$, whose maximum content is observed in the compositions range of $10-15$ mol. $\%$ V$_2$O$_5$ - $90-95$ mol. $\%$ MoO$_3$.

Vanadium and molybdenum oxide catalysts are highly selective and active for acrolein oxidation to acrylic acid. Efficient are the catalysts with excess molybdenum /1-3/, but various authors suggest different V/Mo ratio as optimum.

We have studied the catalytic properties of the above catalyst to find its optimum composition and active component for acrolein oxidation to acrylic acid.

V$_2$O$_5$, MoO$_3$ and binary silica-supported vanadium-molybdenum oxide catalysts with various molybdenum-vanadium ratios have been investigated. The active mass was 30 wt. $\%$. Samples were prepared by evaporating an aerosil suspension in aqueous ammonium paramolybdate and metavanadate, then dried at 110 $^\circ$C for 10 hrs and calcined at 300 $^\circ$C in air for 4 hrs. The experiments were performed in the kinetic region in a flow circulation reactor with chromatographic analysis of the reactants.
Fig. 1. Selectivities to acrylic acid (1), CO + CO₂ (2) activity (3), intensity of the lines with d/n = 4.00-4.08 Å (4) and the lattice parameter (5) vs. the chemical composition of the vanadium-molybdenum oxide system.

Samples were pretreated by the reaction mixture at 400 °C for 3 hrs, then the temperature was decreased to 300 °C and the catalytic activity was estimated in the mixture: 4 vol.% acrolein, 6-8 vol.% oxygen, 20 vol.% water, the rest being nitrogen. After the experiments the phase composition was studied on a DRON-1.5 diffractometer with monochromatized CuKα radiation.

The products are acrylic and acetic acids, CO and CO₂.

Figure 1 illustrates selectivities to acrylic acid (curve 1), CO + CO₂ (curve 2) and the rate of total acrolein consumption (curve 3) at 70% acrolein conversion vs. the chemical composition of the sample. Two regions with sharply different catalytic properties can be distinguished: the region of compositions rich in vanadium, and