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Pilot tests of a new domestic ZhKD catalyst for the dehydrogenation of isoamilenes into isoprene

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Abstract

At the Synthetic Rubber Plant of OAO Nizhnekamskneftekhim, the dehydrogenation of isoamilenes into isoprene is currently performed on KDOM-08 catalysts with an insufficiently high yield of iso-prene throughout the period of its industrial operation. More stable and highly active catalysts must be used to make the process more efficient. Under Russian Federation Government Decree No. 218, ZhKD-1 and ZhKD-2 iron-potassium catalysts have been developed by improving their formulas and optimizing their phase composition through selecting the proper ratio of initial compounds. To evaluate the possibility of tran-sitioning to the new domestically-produced iron-potassium catalysts, we have performed pilot tests of the ZhKD-1 and ZhKD-2 catalysts in the dehydrogenation of methylbutenes into isoprene in adiabatic flow fixed-bed reactors at the Synthetic Rubber Plant of OAO Nizhnekamskneftekhim. The KDOM-08 catalyst used in the amount of 25 t in reactor 1 of the first system is taken as a base for comparison. The ZhKD-1 and ZhKD-2 catalysts are loaded into parallel reactors 7 and 8 of the fourth system. The KDOM-08 catalyst is shown to operate more efficiently under industrial conditions at loads of 1.0-2.0 t/h for 1000-3000 h, after which its performance characteristics deteriorate due to its gradual deactivation. The ZhKD-1 and ZhKD-2 catalysts are substantially superior to their industrial analogues in isoprene yield. It has been found that the ZhKD-2 catalysts operate more efficiently at even longer runs (4000-5000 h) and feedstock flow rates of 1.0-2.0 t/h, and the ZhKD-1 catalysts exhibits better activity (30-33 %) and selectivity (87-92 %) at higher loads of 2.3-3.0 t/h for up to 5000 h. From our analysis of the catalysts' operation over the last 1000 h, it fol-lows that at the same process temperatures (619°C) and feedstock loads (2.5 t/h), the ZhKD-1 and ZhKD-2 catalysts operate at a lower steam dilution coefficient (6.1 t/t) than the KDOM-08 catalyst (6.8 t/t). The rebuilding of reactors 7 and 8 allows the loaded catalyst mass to be reduced from 25 to 17 t, thereby almost doubling the daily output of isoprene per ton of catalyst. It is obvious that higher activity and selectivity along with smaller loads makes the use of the ZhKD-1 and ZhKD-2 catalysts economically profitable. © Pleiades Publishing, Ltd., 2012.

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Keywords

Dehydrogenation of isoamilenes into isoprene, Iron-potassium catalyst, Isoprene synthesis