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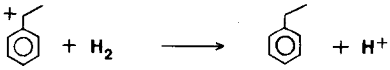
# LETTERS TO THE EDITORS

## Comments on Disproportionation of Ethylbenzene as a Potential Test Reaction for Acidity on Bifunctional Zeolite Catalysts

In a recent paper Karge *et al.* (*1*) showed the existence of an inhibiting effect of hydrogen on the activity of bifunctional Pt/LaNa*X* catalysts in a purely acidic reaction, namely the disproportionation of ethylbenzene. The authors regard this decrease in activity as connected with a decrease in the acidity of the catalyst. Another interpretation of this inhibiting effect is proposed here: we believe that the decrease in activity observed is not due to a decrease in the acidity but is connected with a decrease in the concentration of the benzylic carbocations, which are intermediates in the disproportionation. This concentration decrease can be caused either (i) by hydrogen or (ii) by the products of ethylbenzene hydrogenation.

(i) The reaction of hydrogen with the benzylic carbocations



is the inverse reaction of the carbocation formation on the Brønsted acid sites (*2, 3*). As Karge *et al.* (*1*) propose, the role of the metallic sites would be to serve as an entrance to the support for hydrogen; however, we propose that activated hydrogen does not decrease the catalyst acidity but decreases the concentration of benzylic carbocations. This explanation was recently advanced by us to account for the decrease caused by hydrogen in the rate of *o*-xylene disproportionation on nickel mordenites (*4*). In that experiment the isomerization of *o*-xylene was not affected, which allowed us to exclude the hypothesis of an acidity decrease.

(ii) Under hydrogen the disproportionation of ethylbenzene over Pt/LaNa*X* is accompanied by its hydrogenation into ethylcyclohexane (*1*). This hydrocarbon could in part be responsible for the decrease in activity. It has been shown that on a HY zeolite *branched* alkanes inhibit the disproportionation of aromatic hydrocarbons, but have no effect on their isomerization (*5*). The action of these alkanes on the benzylic carbocations, with the formation of a tertiary carbocation and the desorption of the aromatic hydrocarbon, would be the reason for this phenomenon. Because of this reaction the benzylic carbocation concentration and consequently the disproportionation rate are decreased (*5*).

If the decrease in benzylic carbocations concentration is responsible for the decrease in disproportionation activity, the acidity of the bifunctional catalyst must be estimated from the disproportionation activity of ethylbenzene measured not under hydrogen but under inert gas.

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