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LETTER TO THE EDITORS

Some Comments on Bolton's "Deamminated Ammonium Y" Zeolite

In a recent paper (*1*) Bolton and coworkers made the statement, "The term deamminated ammonium Y is preferable to the term hydrogen Y because the occurrence of dehydroxylation at low calcination temperatures prevents the formation of pure hydrogen Y." This statement was made on the basis of an earlier report of Bolton and Lanewala who made these observations (*2*):

> (1) On heating hydrogen zeolite Y from 500 to 900°C in a thermogravimetric analyzer the weight loss corresponded to the theoretical weight loss for the complete dehydroxylation reaction. They stated, "The observed weight loss derived from thermogravimetric analysis only matches the calculated value if the former is taken over the temperature range 500 to 900°C." Thus, it can be seen that the pure hydrogen zeolite is obtained up to 500°C.
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> (2) The concentration of hydroxyl groups in hydrogen zeolite Y, as determined by infrared analyses, remained constant up to about 500°C. They stated, "On raising the temperature, the maximum hydroxyl concentration remained constant with increasing temperature until 500°C, after which it rapidly decreased to zero at about 600°C." These hydroxyl concentrations agreed with the thermogravimetric results.
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> (3) The ion exchange capacity of the hydrogen zeolite Y is markedly lower than expected. Their Fig. 7 shows that the ion exchange capacity of a hydrogen Y, derived by heating a 95% exchanged ammonium Y to 500°C, has about 75% of the exchange capacity of the initial ammonium zeolite Y.
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> (4) Finally, Bolton and Lanewala made the statement, "The apparent constant concentration of the hydroxyl groups as indicated by infrared analyses of a 95 percent ammonium-exchanged Y having SiO_2/Al_2O_3 molar ratio 5.0, over the temperature range of approximately 300 to 500°C would not appear to be in agreement with the ion exchange data. An explanation of this discrepancy is not immediately apparent."

It is very clear that their thermogravimetric results agree with their infrared analyses. In this respect, the studies of Bolton and Lanewala agree with earlier findings (*3–5*). Thus, the ion exchange capacities obtained by Bolton and Lanewala are open to question. Cattanach, Wu, and Venuto (*4*), and later Kerr (*5*), showed that hydrogen zeolite Y reacts essentially quantitatively with *dry gaseous ammonia* to yield the ammonium zeolite containing the same concentration of ammonium ion as the initial ammonium zeolite. In a private communication Bolton informed the author that his ion-exchange reactions consisted in contacting the hydrogen zeolite with aqueous salt solutions. Such mixtures would be expected to attain some equilibrium state rather than react completely to yield a pure zeolite salt as

do acid–base systems. Indeed, Kerr showed that hydrogen zeolite Y reacts quantitatively with sodium hydroxide solution to yield the expected pure sodium zeolite (*5*). Moreover, recent studies in this laboratory show that hydrogen zeolite Y loses about 25% of the Bronsted acidity simply by slurrying the zeolite in water for 10–15 min. Most of the crystallinity was retained. The acid concentration was determined by treating the water-slurried hydrogen zeolite with 28% ammonium hydroxide solution and measuring the resultant ammonium ion concentration. This loss of ion-exchange capacity explains the discrepancy admitted by Bolton and Lanewala. Exactly how water effects this loss is not understood at present.

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