Short Communications

THERMOGRAVIMETRY OF MOLECULAR SIEVES

NOTE 1

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Water-saturated molecular sieves were studied with a derivatograph. Apparent activation energies and orders of reaction were calculated and interpreted on the basis of the structures of the samples.

Up to now, thermal analysis has only been used sporadically for studying synthetic zeolites [1, 2] in papers dealing with other subject, and it has been of minor importance as compared with other methods. However, we consider that the data obtained with the thermogravimetric method provide important information as regards the structures and adsorbency characteristics of molecular sieves.

In this work the TG and DTG curves of molecular sieves are described and interpreted.

Experimental

Commercial molecular sieves Linde 5A, Ingelheim 5A, Bayer 3A and SMP-1 4A were tested. After prolonged saturation (24h) in an atmosphere of water vapour, the products were analysed on a MOM Paulik–Paulik–Erdey derivatograph on 70–120 mg samples at a heating rate of 12°C/min.

Results and discussion

From a study of the TG and DTG curves of the tested products (Fig. 1), it was ascertained that the desorption of water is not uniform but occurs in two well-separated stages: the first stage occurs at 118–155°C and the second at 192–209°C. The quantity of water lost was found to differ for each product and stage (Table 1).

The existence of the two stages as well as the different distribution of the losses lead to the assumption that the bond energies of the water molecules held back by adsorption are different too. To check this, the value of the apparent activation
energy and order of reaction were calculated for each product and each stage, using the Horowitz–Metzger method [3]. The results are given in Table 2.

To find the physical significance of the total order of reaction \( n \), and of the apparent activation energy, the following hypotheses were formulated: the numerical value of the reaction order is proportional to the number of the monomolec-

### Table 1

Water losses in the endothermic stages

<table>
<thead>
<tr>
<th>Product</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Total water loss %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DTG minim. ( ^{\circ} \text{C} )</td>
<td>Final temp. ( ^{\circ} \text{C} )</td>
<td>Water loss %</td>
</tr>
<tr>
<td>Linde 5A</td>
<td>82</td>
<td>128</td>
<td>6</td>
</tr>
<tr>
<td>Ingelheim 5A</td>
<td>90</td>
<td>122</td>
<td>9</td>
</tr>
<tr>
<td>Bayer 3A</td>
<td>90</td>
<td>155</td>
<td>11</td>
</tr>
<tr>
<td>SMP—1 4A</td>
<td>90</td>
<td>118</td>
<td>5</td>
</tr>
</tbody>
</table>

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