Introduction

80% of manufacturing processes include at least one reaction of catalysis. The applications of the catalyst are very widespread: chemical (selective hydrogenations and oxidations by catalytic and electrocatalytic way,...), petrochemical (cracking and hydrocracking,...), environmental (automobile afterburning, nitrogen oxide elimination,...).

Zeolite is one of the most employed elements in the catalysis because of its molecular sieve power and its low cost. Its particles size has a big influence on the productivity catalyst reaction.

What is catalysis?

The aim of the catalysis is to introduce or to amplify a chemical reaction, a substance called catalyst is used. The catalyst is a substance which increases the speed of chemical conversion without modifying the output of it, and which is intact at the end products of the reaction (figure 1).

The Zeolite

Zeolite are natural materials (volcanic rock) or synthesis materials (three-dimensional assembly of tetrahedral units made of 4 oxygen atoms generally related to a central aluminium or silice atom).

Zeolite are microporous crystallized synthesis alumino-silicates used for catalysis and adsorption of volatile organic compounds. Assembly leads to a porous system and forms molecular sieves (figure 2).

The zeolite, stable at very high temperature and having very broad pores, opens new prospects for the treatment for large molecules in particular in the field of petroleum refining and petrochemical processing catalysts.
The importance of the Zeolite in the catalysis

The size of the particles is very important for the catalyst. **The exchange surface has to be the largest to improve the reaction.**

But a too small size does not make it possible to catch the molecules which have to be treated, and then not to start the catalysis (figure 3). Smaller are he particles, bigger is the reaction surface (specific surface).

The purpose is to find the best ratio between the size and the reaction power.

Environmental considerations to reformulate gasoline and reduce sulfur emission have been responsible for the increase in the consumption of zeolites for catalytic applications. Most of the current commercial processes, using shape selective catalyst, are in the **petroleum refining and in the petrochemical processes.** Average levels of zeolites in fluid catalytic cracking have risen significantly.

The current global consumption of zeolite catalysts is estimated to be around 117,000 metric tons per annum and constitutes 55% of the global market of the catalyst.

Zeolite measurement

Due to its chemical properties, the best mode to analyse zeolite is the dry mode. In wet mode the zeolite’s particles are affected by the carrier liquid. The particles inflate and the measured size is wrong.

Standard Operation Procedure

- Pressure: 500 mbars
- Vibratory feeder: 1
- Obscuration: 3%

CILAS’ dry measurement technology shows excellent reproducibility.

The pressure needed to disperse powders is low (less than 1 bar) and prevents the possible erosion of particles.

**Figure 4:** Reproducibility of 3 measurement of a NaX zeolite
Conclusion

The control of the zeolite’s particles size is very important in order to increase the catalysis reaction and to catch of the toxic components. CILAS provides with the possibility to obtain the accurate size with the new dry system: the Dry Jet Dispersion Technology.

Technical specifications

DJD technology is available on CILAS instruments in 3 different measurement ranges. All instruments are available with the DJD system alone or in combination with the Wet Iso Dispersion system (WID system).

<table>
<thead>
<tr>
<th>Principle of measurement</th>
<th>Modes of calculation</th>
<th>Range</th>
<th>Number of classes</th>
<th>Ways of Dispersion</th>
<th>Accuracy</th>
<th>Repeatability</th>
<th>Amount of sample</th>
<th>Acquisition time</th>
<th>Compressed Air (2)</th>
<th>Number of lasers</th>
<th>Wavelength</th>
<th>Power</th>
<th>Length/width/height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.3 - 500 µm</td>
<td>70</td>
<td>Venturi</td>
<td>&lt; 3 % on NIST traceable CRM (1)</td>
<td>&lt; 1 % on NIST traceable CRM (1)</td>
<td>5 g minimum</td>
<td>5 s minimum</td>
<td>0 - 4 +/- 0.01 bars</td>
<td>1</td>
<td>830 nm</td>
<td>110/240 V - 50/60 Hz - &lt; 100 VA</td>
<td>50 kg (110 lbs)</td>
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<td></td>
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<td>0.1 - 500 µm</td>
<td>100</td>
<td>Venturi - Free Fall</td>
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<td></td>
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<td>2</td>
<td>635 and 830 nm</td>
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<td>54 kg (119 lbs)</td>
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<td></td>
<td>0.1 - 2500 µm</td>
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<td>3</td>
<td>635 and 830 nm</td>
<td></td>
<td>60 kg (132 lbs)</td>
<td></td>
</tr>
</tbody>
</table>

(1): measures of diameter by weight made on certified reference materials, traceable to NIST standards
(2): Air compressor and vacuum cleaner systems available in option