## Gas separation unit: simulation and characterization of the adsorbent

G. S. Alves[(1)*] and A. C. L. Lisbôa[(1)]

(1) School of Chemical Engineering, University of Campinas, UNICAMP, P. O. Box 6066, 13083-970, Campinas-SP, Brazil, giselealves@feq.unicamp.br.
* Corresponding author.

**Abstract** – A granular synthetic X-type zeolite was characterized and the results were used to simulate a nitrogen adsorption pilot unit. XRD revealed that the material is similar to faujasite zeolite. According to BET analysis the superficial area was 593 $m^2$ $g^{-1}$. MEV showed the structure of zeolite 5000 times the grain size (Fig. 1). The Langmuir model was used to simulate the process on zeolite. The simulation was accomplished by *pressure-swing adsorption* using the MATLAB software. The program showed results similar to literature. The nitrogen adsorption process was fast, within seconds due to the affinity of the nitrogen for the zeolite (Fig. 2).

Zeolites are crystalline porous materials found naturally or synthetically manufactured with high adsorbent power. The study of this material as an industrial adsorbent began in the mid 50's. The fields of zeolite application are rather wide. Zeolites have been used as adsorbents for purification of gases and liquids, as catalysts for petroleum refining and for synthesis of organic compounds. A granular sample of a synthetic X-type zeolite was characterized and used in a simulation of a nitrogen adsorption pilot unit.

The size of the grains was 1.5 mm. The characterization indicated the hygroscopic nature of zeolite. XRD revealed that the material is similar to a natural zeolite called faujasite. According to BET analysis the superficial area was 593 $m^2$ $g^{-1}$. The scattering electron microscopy showed the structure of the zeolite. The image has 5000 times the grain size (Fig. 1).

Besides the characterization, it was also made a simulation of a nitrogen adsorption pilot unit. The Langmuir model was used to simulate this process onto zeolite. The simulation was accomplished by *pressure-swing adsorption* (PSA) using the MATLAB software. This process consists of selective adsorption of gases through the porous of solid.

The program showed results similar to literature. The nitrogen adsorption process was fast, within seconds due to the great affinity of the gas for zeolite (Fig. 2). Cycle process of PSA used to be short within seconds of duration. [1] Factors as bed parameters and type of adsorbent influency on velocity process. Zeolites have history of being power gas adsorbents specially nitrogen. [2]
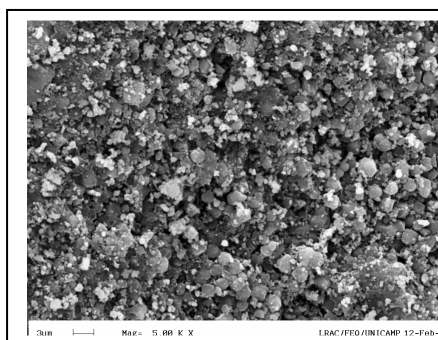


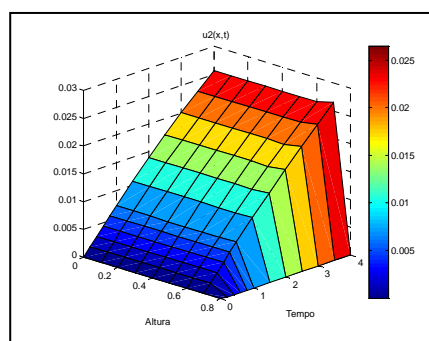**Figure 1:** MEV of a grain of the X-type zeolite 5000 times bigger.



**Figure 2:** Perspective in 3D of adsorption simulation in equilibrium of concentration, bed hight and time. .

### References

[1] J. D. SEADER; E. J. HENLEY; **Separation process principles**, 5 ed. New York: John Wiley & Sons, Inc., 1998, pp.799-855.
[2] C. BÉCHAUD; S. MÉLEN; D. LASSEUX; et al.; Stability analysis of a pressure swing adsorption process. **Chemical Engineering Science**, v.56 3123-3137 p., 2001