



“Gheorghe Asachi” Technical University of Iasi, Romania



---

## SUITABILITY OF A CRETACEOUS NATURAL Na-BENTONITE AS CONSTRUCTION MATERIAL FOR LANDFILL LINERS

Telma Belén Musso<sup>1,3\*</sup>, Franco Matías Francisca<sup>2,3</sup>, Gisela Pettinari<sup>1</sup>, Karl Ernst Roehl<sup>4</sup>

<sup>1</sup>*Departamento de Geología y Petróleo, Facultad de Ingeniería, Universidad Nacional del Comahue,  
Buenos Aires, 1400, 8300 Neuquén, Argentina*

<sup>2</sup>*Departamento de Construcciones Civiles, Universidad Nacional de Córdoba, Av. Vélez Sarsfield 1611, 5016 Córdoba, Argentina*

<sup>3</sup>*CONICET, Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina*

<sup>4</sup>*Institute of Applied Geosciences, Technische Universität Darmstadt, Schnittspahnstrasse 9, 64287 Darmstadt, Germany*

---

### Abstract

A natural Cretaceous sodium (Na) bentonite from North Patagonia, Argentine, is considered a potential construction material for landfill liners. It is studied alone and in mixtures with sand. Physical and chemical properties of the Na-bentonite were determined to verify the suitability of this material for the construction of low permeability mineral liners. Hydraulic conductivity measurements were conducted on pure bentonite and on mixtures of poorly graded sand with 3, 6, 9 and 12% of Na-bentonite. Compaction and hydraulic conductivity tests were performed using deionized water and a 1000 mol/m<sup>3</sup> CaCl<sub>2</sub> solution to determine the effects of a high concentrated saline solution on the hydraulic properties of compacted sand-bentonite mixtures. The experimental results confirm that the pure powdered bentonite meets current specifications to be used as part of a geosynthetic clay liner (GCL), and that ageing effects may affect the hydraulic behavior of this material. Compacted sand-bentonite mixtures required a minimum bentonite content of 6% in order to achieve hydraulic conductivities lower than 1 x 10<sup>-9</sup> m/s which is a regular requirement for hydraulic containment liners. However, in contact with a strong saline solution (1000 mol/m<sup>3</sup> CaCl<sub>2</sub>), the permeability of the mixtures increased between three and five orders of magnitude. This indicates that a higher percent of bentonite is required to reach an acceptable hydraulic conductivity value when the mixtures are permeated with a CaCl<sub>2</sub> solution. The results show that a new applicability was found for bentonites of regional provenance as well as high reserves which have a naturally very high amount of sodium.

*Key words:* clay liner, GCL, landfill liner, Na-bentonite, sand-bentonite mixture

*Received: March, 2012; Revised final: July, 2013; Accepted: July, 2013*

---

\* Author to whom all correspondence should be addressed: E-mail: [telma.musso@fain.uncoma.edu.ar](mailto:telma.musso@fain.uncoma.edu.ar), [telmamusso@gmail.com](mailto:telmamusso@gmail.com); Phone: +6088 320765; Fax: +6088 320876