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## Preliminary testing of the long-term efficiency of geosynthetic clay liners

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Geosynthetic clay liners (GCL) are factory-manufactured hydraulic barriers consisting of a mineral (bentonite) and geosynthetic component (geotextile or geomembrane). Over the last several decades, their application has increased intensively in various engineering projects for environmental protection purposes, including landfills. In Croatia, there is also a significant number of landfills with GCL incorporated as an integral part of protective systems, most often as the landfill final cover. Since protective systems have to fulfil their designated function over a longer period of time, usually, laboratory tests of the GCL durability and landfill monitoring are being implemented in order to identify long-term functionality of GCL.

This study presents laboratory tests carried out on 23 samples of GCL that were installed at one real landfill near Zagreb between three and nine years ago, as well as sample of manufactured bentonite in its original state left over after installation. Following analyses were performed: XRD, ICP-MS, cation exchange capacity, pH, electrical conductivity, moisture, colour, index properties (free swell index, water absorption capacity by Enslin-Neff test, fluid loss) and hydraulic conductivity.

Montmorillonite is predominate mineral followed by quartz, K-feldspar, plagioclase, goethite, anatase and micaceous material. CEC ranged from 51.96 meq/100g to 75.47 meq/100g. Index properties for all samples are summarized in table 1. It can be concluded that the properties of all samples were deteriorated with time in comparison to the reference sample test results. Moreover, none of them fulfils the required values according to some recommendations nowadays. However, conclusions about the influence of the cover layer thickness and the time passed since the installation date cannot be precisely divided yet. Therefore, some additional investigations will be carried out.

Table 1: Test results

Installation date	Liquid limit (%)	Plasticity index (%)	Free swell (ml/2g)	Water absorption capacity (%)	Fluid loss (ml)
2004	125-146	82-92	12-17	208-324	16-89
2009	112-190	67-157	8-13	163-293	52-86
2010	149-205	114-173	11-13	213-268	51-64
Ref. sample	420	382.4	27	453	20
Required*			>20	>450	<18

\*DGGT (2002): Empfehlungen zur Anwendung geosynthetischer Tondichtungsbahnen EAG-GTD, Ernst&Sohn.