HYDRAULIC CONDUCTIVITY OF BENTOMAT® CL UNDER HIGH HYDROSTATIC PRESSURE

Bentomat CL was tested under high hydrostatic pressures to determine the hydraulic flux and its durability under these conditions. A visual inspection was also performed on the specimens to determine any signs of cracking or rupturing.

Specimens were placed in a pressurized chamber, and increments of 10 psi were applied until the desired pressure was reached. Specimens were kept at the desired pressures of 30 psi and 60 psi for approximately 12 hours. Flow volume measurements were then monitored to calculate the flux value of the GCL under the pressures applied to the laminated GCL.

Results indicate that Bentomat CL has hydraulic flux values of $6x10^{-11}$ to $8x10^{-11}$ $m^3/m^2/s$ at a hydrostatic pressure of 30psi and $3x10^{-10}$ to $7x10^{-10}$ $m^3/m^2/s$ at a hydrostatic pressure of 60psi. Inspections of the Bentomat CL after testing indicate no visible cracking or rupturing of the specimens. Further testing of Bentomat CL under 90 psi is planned upon modification of the test apparatus.

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To:	Bob Trauger
Firm:	CETCO
From:	Cuneyt Gokmen
Project No.:	Laminated GCL Testing
Date:	8/5/2000

MESSAGE:

Dear Bob,

Attached please find the typical photographs of the testing for evaluation of visual deformation and hydraulic flux of Bentomat CL GCL product under high hydrostatic pressure conditions.

So far we have completed two tests with hydraulic flux measurements at 30 and 60 psi. Unfortunately, beyond 70 psi both these tests showed leakage problems through clamping area preventing us from continuing hydraulic flux measurements at higher test pressures (i.e., 90 psi). However, for one of these tests we have minimized the leak as much as possible and increased the hydrostatic pressure up to 90 psi to obtain at least visual observations of the sample after 90 psi, especially at around the localized stress point above the stone. And upon the breakdown, we have not seen any visual cracking or rupturing of the material. The preliminary results of these tests indicated that the flux values were approximately 6-8E –11 $m^3/m^2/s$ and 3-7E-10 $m^3/m^2/s$ for hydrostatic pressures of 30 and 60 psi, respectively. Please note that test procedures in summary consist of the following steps:

- Setup (Figure 1 through 3)
- Upper pressure chamber filled with water and water pressure applied on the sample with 10 psi increments at approximately every two hours until 30 psi and later 60 psi levels are reached.
- At 30 and 60 psi levels the pressure is kept constant for approximately 12 hours.
- After 12 hours at the 30 and 60 psi, the hydraulic flux values are calculated based on the periodic inflow volume measurements for approximately 4 to 8 hours time period.

During the testing the inflow volume measurements were checked occasionally at various pressures including the intermediate pressures at different time intervals. It is noted, as expected, upon the application of the pressure the inflow volume measurements yield higher flux values. However, it is also observed that with a downward trend the hydraulic flux values decrease significantly in time, potentially due to the hydration of Bentonite component of the GCL. Please note that the tests performed on unsaturated/partially saturated GCL specimens. It is also possible that the flux values may continue to decrease until steady conditions are reached (we do not know at this moment what is the required duration for this to happen). During this testing program, the flow measurements were obtained approximately between 12 to 20 hours after the 30 and 60-psi pressures were applied.

No visual cracking or rupturing of the material was observed upon the completion of these tests.

We will try to modify the test setup to prevent any leaking at the clamping area, which hopefully allow us obtain flux measurement at 90 psi.

Please do not hesitate to contact us if you have any questions or require additional information.

Thanks,

Cuneyt Gokmen

Figure 1 – Base soil with an angular stone 1-in. above the soil surface as localized stress point.

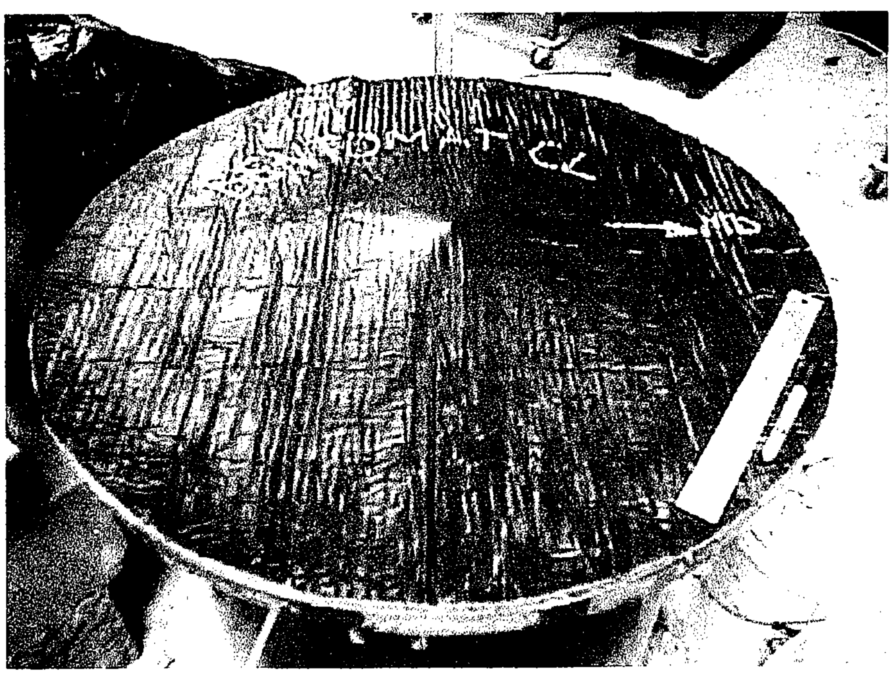

Figure 2 – Placement of Bentomat CL GCL over the base soil and stone.

Figure 3 – Typical setup for evaluation of visual deformation and hydraulic flux of Bentomat CL GCL under high hydrostatic pressure conditions.

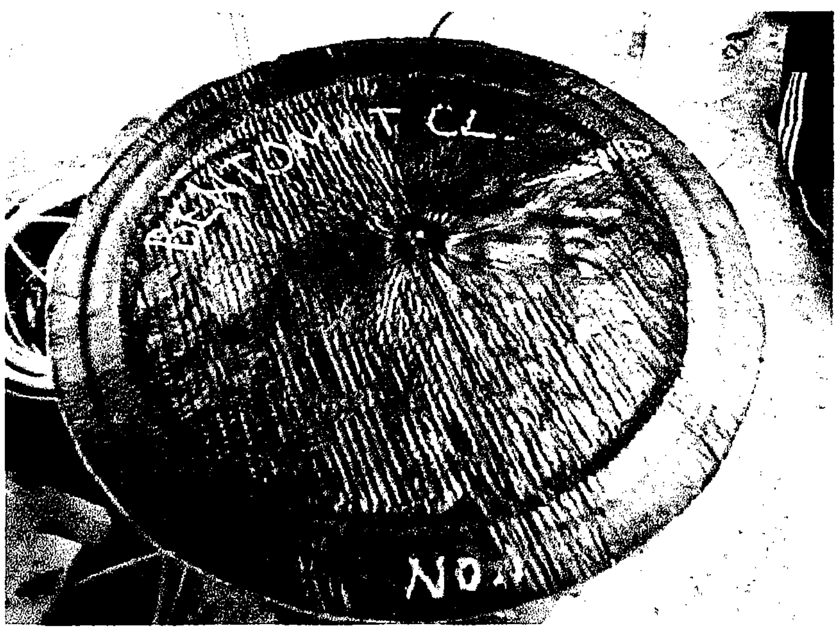

Figure 4 – Typical Bentomat CL GCL test specimen after tested under hydrostatic pressures of up to 90 psi (top view).

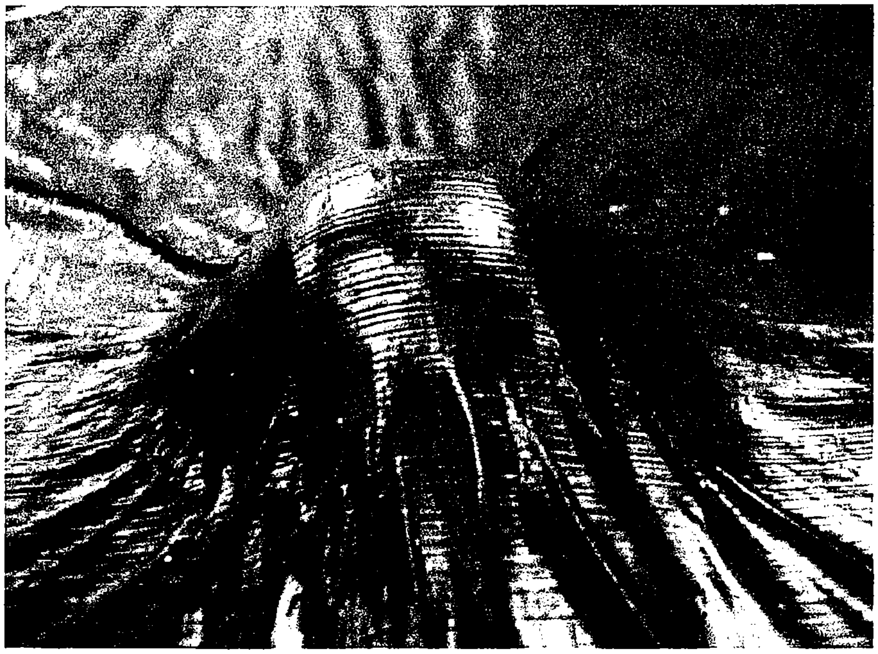

Figure 5 – Typical deformation at the localized stress point above the stone (top close-up view).

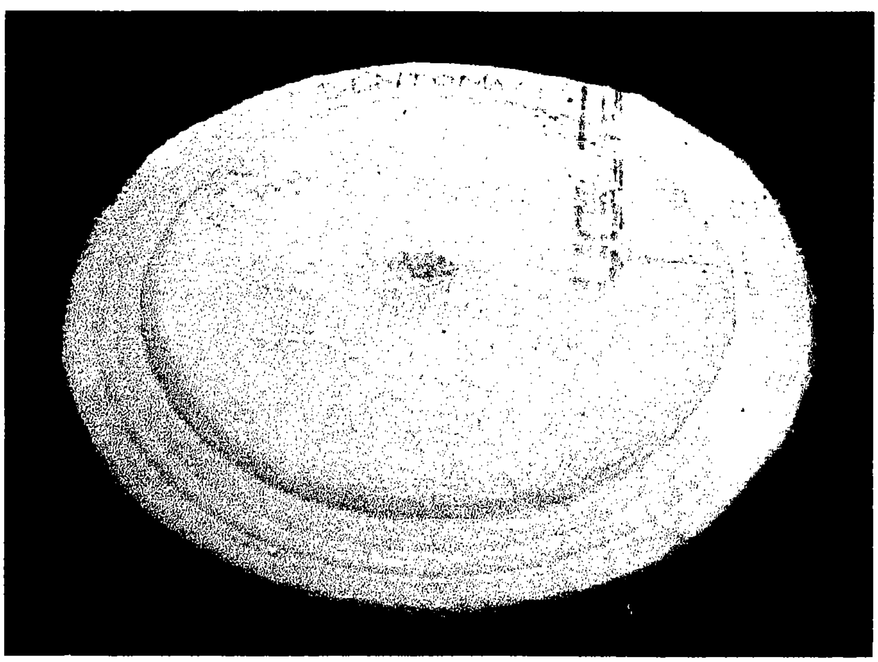

Figure 6 – Typical Bentomat CL GCL test specimen after tested under hydrostatic pressures of up to 90 psi (bottom view).

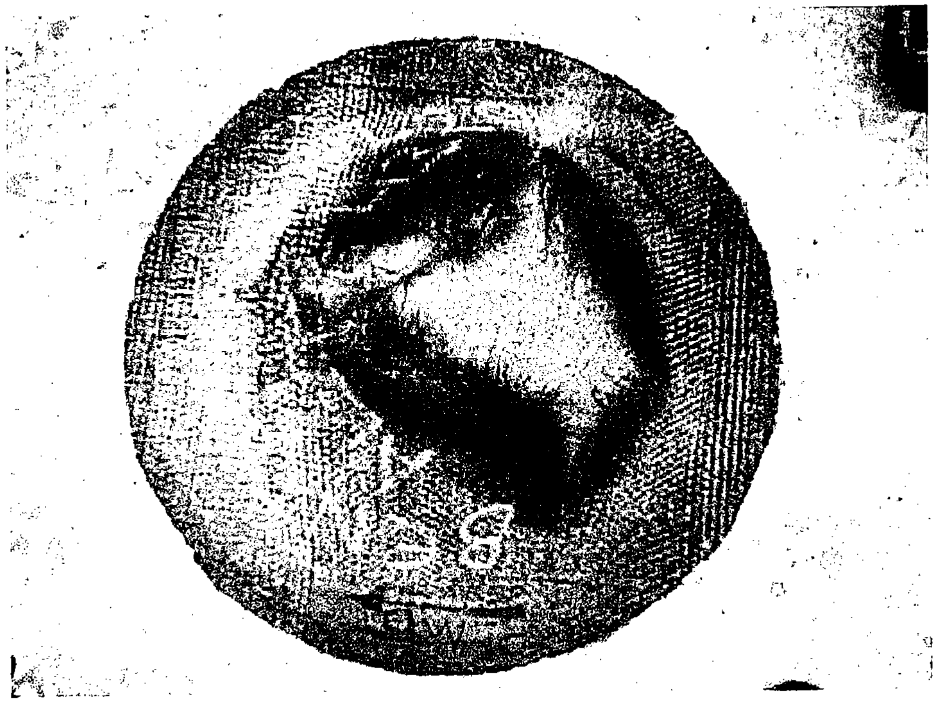

Figure 7 – Typical Bentomat CL20 GCL test specimen after rupture (bottom view).

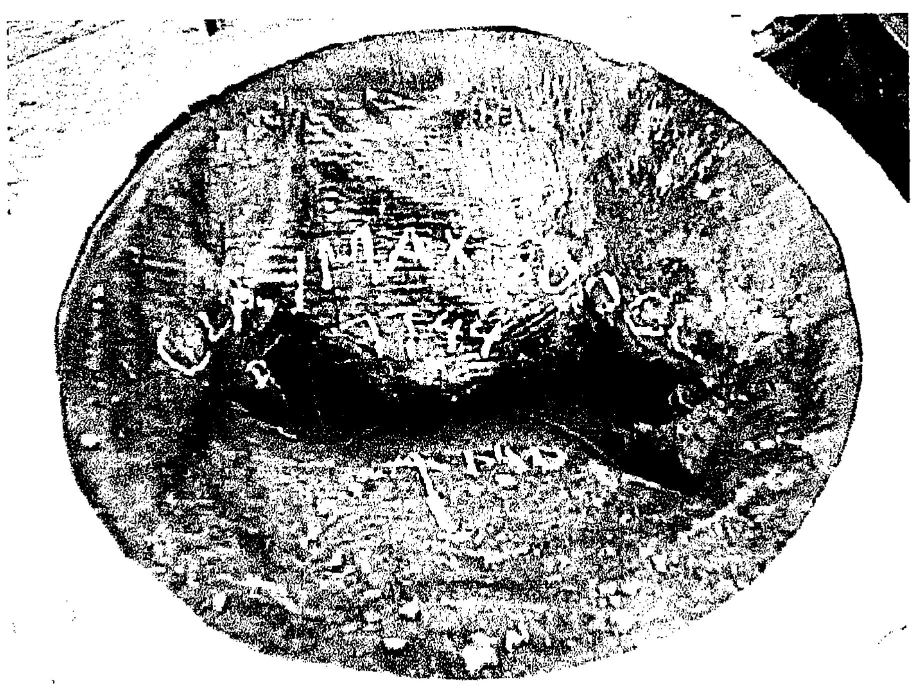

Figure 8 – Typical Claymax 600CL GCL test specimen after rupture (top view).

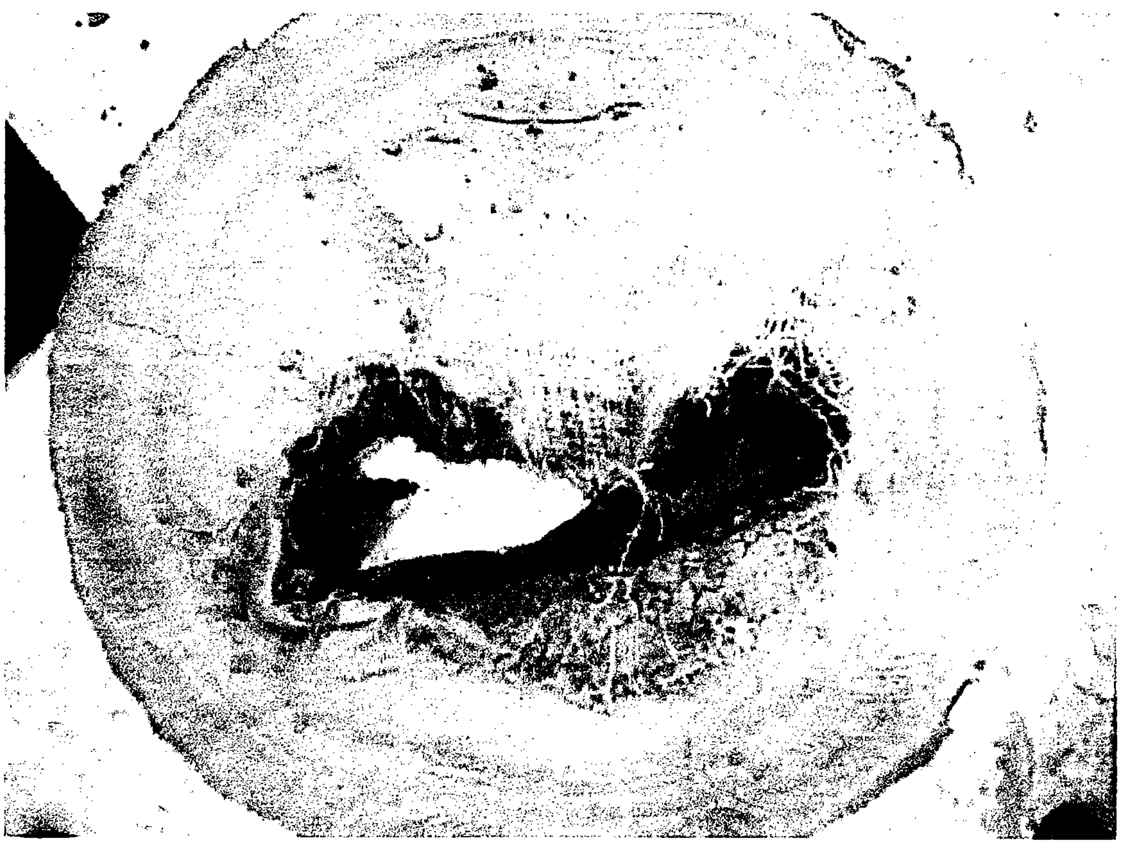

Figure 9 – Typical Claymax 600CL GCL test specimen after rupture (bottom view).