California Science Center

CALIFORNIA STATE SCIENCE FAIR
2001 PROJECT SUMMARY

Your Name (List all student names if multiple authors.)
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S0814

Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9)
An Evaluation of Na Bentonite Clay in Geosynthetic Clay Landfill Liners When Exposed to Simulated Landfill Leachate

Division
_ **Junior (6-8)** X **Senior (9-12)**

Preferred Category (See page 5 for descriptions.)
5 - Earth Sciences/ Planetary Sciences/ Physical Environments

Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.)
Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.

Objective: Geosynthetic Clay Liners (GCLs) are used as hydraulic barriers between the municipal landfill waste, which results in leachate, and our environment. The liner is composed of a thin layer of granular Na bentonite clay. The GCL's design criteria stems directly from from the Na bentonite's structural and chemical composition. As the clay is saturated, because of its structure and cation exchange capacity, the clay will expand due to hydration causing its permeability to slow. However, because of the clay's chemical composition, it will swell to different degrees depending upon the permeated solution, thus changing the rate of permeability. Another important factor that is often overlooked when designing GCLs is whether the clay's ability to swell is dampened by an applied load, which would be the weight of the landfill. By experimenting with all these factors in combination, a more acurate evalution of the effectiveness of a GCL can be obtained, thus allowing improvements in their design to be made, and by improving their design, contamination within our environment can be prevented.

Method: Throughout the experiments, #30 granular Na bentonite was used. The first experiment combined the factors of varing applied loads and the clay's hyrdration when exposed to different solutions. Three different loads were applied to 1/4" thick layers of bentonite with a diameter of 2 1/2" (this is the thickness of an actual GCL). These samples were then inundated with a Harsh Leachate, a Mild Leachate, Tap Water (the Ca and Na contents were determined), and a Hydrocarbon (Kerosene). The change in height due to hydration was recorded. The clay's cation exchange capacity and the expansion pressure that the clay exerts with expanding was also determined.

Results: For a general trend as the applied load increased the clay's ability to expand decreased. The clay inundated the leachates swelled less than with the tap water. The most significant result was that the bentonite clay does not expand when exposed to hydrocarbons, so that the permeability of the clay acts more like the permeability of sand. The cation exhange capacity for bentonite is high, which means the permeability of Na bentonite will decrease to that of Ca bentonite, and as the deflection of expansion of the clay increases the pressure that is exerts also increases when inundated with tap water.

Summary Statement (In one sentence, state what your project is about.)
This project evaluates the landfill liner design and implementation criteria as to prevent environmental contamination from landfills, such as groundwater contamination by hydrocarbons.

Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4.
Lab equipment and Kleinfelder Inc. (Fresno Office) was used.