20 copies

December 13, 1961

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Report No. 61-22

1 Subject: Pond Sealant Study.

2 Introduction: This program was undertaken to assist Central Engineering in evaluating local clays in Southern Washington County and purchased clays as sealants on the bottom and sides of the wet waste ponds at the Woodbury Dump site. Local clays, if effective, would of course be more economical than purchased clays of the bentonite type. In the area where the wet waste ponds will be placed, glacial drift sand and gravel is overlain by a few feet of topsoil. The ponds will therefore be totally within the glacial sand and gravel, and separated from the water table by 70 to 90 feet of this drift material. [redacted]

3 Conclusions:

4 Recommendations

5 Discussion: Gravel and Clay pits in Southern Washington County near the Dump area were visited and three clays brought back to the lab. Crushed shale from the Decorah formation was obtained from Twin City Brick Co. Glacial sand and gravel was brought in from the ponding area and a 100 lb. bag of South Dakota Bentonite was also obtained. Bentonite prices are as follows:

1 Ton	$40 per ton	bagged at St. Paul Thompson-Haymont
5 tons	$36 " "	
10 Tons	$34 " "	
30 Tons & over	$29 " "	

The local clay price is 10 cents per yard plus loading and hauling costs. A lower price might be negotiated if sufficient quantity were needed.

Exhibit 2715
State of Minnesota v. 3M Co., Court File No. 27-CV-10-28862

Conclusions:

Local Washington County clays alone will not produce an effective seal. Additions of 5% bentonite to the clay will effect a reasonably tighter seal. A 10% bentonite mixture will create a relatively impermeable seal although it probably will not be 100% effective.

Raw sand from the dump site is quite permeable to water although the wet waste material remains standing in the ponds for sometime. Any bentonite addition to the sand below 5% is completely ineffective as percolation through a 2-1/2% bentonite mixture is immediate. Several 5% bentonite - 95% sand mixtures were evaluated and the results varied from considerable percolation to a trace. This indicates that a 5% mixture is the bare minimum and even then extreme care must be exercised in mixing, packing, etc. A 10% bentonite-90% sand mixture appears equal in sealing ability to a 10% bentonite - 90% clay ixture; but the results do not justify a guarantee that a pond so treated would isolate the wet waste completely.

Recommendations:

Sand-bentonite mixtures are equally as effective a sealer as clay-bentonite mixtures so there is no reason to consider Washington County clays. Economically, it is desirable to add just enough bentonite to the sand to retard percolation and add no more than is necessary. An addition of between 5 and 10% bentonite to the dump site sand is suggested; with the margin of safety increasing toward the higher figure. It would be also advisable to exercise extreme care in the mixing and packing of the mixture and in wetting it down with water to allow the bentonite to swell prior to dumping in the wet waste.

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Procedure:

Several funnel and tube arrangements were set up for initial testing. These tests showed that pure bentonite and bentonite-clay mixtures might be used to seal the ponds. These tests also indicated that the Decorah shale was impractical and so it was dropped from the program. Of the three clays brought in only the Bob Duschane clay appeared in the field to be of the quantity necessary so the other two were also dropped.

Three glass tubes 24 inches long and 2 cm in diameter (inside) were set up vertically and a gooch crucible attached to the bottom of each. Two inches of coarse #5 quartz was placed in the bottom and 12 inches was marked off on the outside of the tubing. A constant head apparatus was constructed to provide a two-foot head of water on the 12 inch column of material being tested. Water at about 50°F was used throughout the tests although the All mixtures are by volume percentages. wet weather material is considered the more desirable.

Results:

The first test consisted of one tube filled with raw Duschane clay, one with 95% Duschane clay and 5% bentonite, and one with 90% clay and 10% bentonite. All three tubes were tamped during filling and evened off to a 12 inch column. A little coarse gravel was added to the top to prevent movement and the water head applied.

Complete infiltration occurred in the raw clay in three hours and percolation began in three hours and 15 minutes. After the percolation rate evened off, several one-hour measurements were taken and it was found that the loss through the 12 inch high column of Raw Duschane Clay was 0.3 gal. per hour/per sq.foot.

Complete infiltration occurred in 26 hours in the tube with 95% clay and 5% bentonite. About24 hours later a very slight amount of water percolated through and this eventually stopped. Infiltration in the tube with 90% clay

CLAY DATA

MATERIAL: DUSCHANE CLAY } 12 INCH column, tamped
South Dakota Bentonite } [illegible]

APPARATUS: 24 inch [illegible]
7 ft constant head [illegible]

Hrs	100% Clay	Hrs	75% Clay [illegible]	Hrs	90% Clay [illegible] Bentonite
3	complete [illegible]	2	2½" infiltration	24	2¾" infiltration
3¼	Percolation began	4	4¾ "	36	4
[illegible]½	began Percolation tests	6½	6½" "	168	6" infiltration
	#1, 0.3 gal/hr/sq.ft.	26	12" "		[illegible]
23	#2, 0.3 gal/hr/sq.ft.	36	Trace of [illegible]		
24	#3, 0.3 gal/hr/sq.ft.	42	Percolation		
26	#4, 0.3 gal/hr/sq.ft.				

SAND DATA

MATERIAL: GLACIAL SAND [illegible] [illegible], tamped
South Dakota Bentonite [illegible]

APPARATUS: SAME AS ABOVE

Hrs	100% SAND	Hrs	10% Bentonite 90% Sand	Hrs	[illegible] 98% Sand
0	INFILTRATION & PERCOLATION in less than 30 sec.	120	4" infiltration [illegible]	36	12" [illegible]
				42	TRACE [illegible]
[illegible]	began Percolation tests				
2	#1, 53 gal/hr/sq.ft.				
18	#2, 49.4 "				
19	#3 44.2 "				
20	#4 39.0 "				

	2½% Bentonite 97½% Sand
	[illegible]
	[illegible]
4	6.0 gal/hr/sq.ft.
5	5.5 "
6	5.2 "

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~~Procedure~~ Results, cont'd:

~~xlay~~ and 10% bentonite (after 7 days) was only 6 inches. These results indicate that local clays alone will not be sufficient and that local clays must have an addition of 5 to 10% bentonite to be impermeable.

CLAY DATA

The tubes were cleaned and set up with raw sand from the pond site, raw sand and 10% bentonite, 5% bentonite and 2-1/2% bentonite. Infiltrration and percolation occurred simultaneously within 60 seconds in the raw sand. After one hour of percolation the rate was recorded as 53 gal. per hour/sq. foot with the same 2 ft. head of water. About 48 hours later the rate had diminished to 28 gal. per hour/per sq. ft. indicating that a packing effect took place.

In the 10% bentonite - 90% sand mixture, the infiltration proceeded slowly to a total of about 4 inches in 5 days. Several mixtures of 5% bentonite-95% ~~xla~~ clay were tested and these varied somewhat, the best showing infiltration to be complete in 36 hours and A TRACE OF percolation in 48 hrs. ~~with a rate of~~ The expansion was great enough to crack the glass tubing in several places. It appears that 5% bentonite is about the minimum amount that will retard percolation. However, a 2-1/2% bentonite mixture was tested and infiltration and percolation occurred simultaneously in about 2 minutes. After 4 hours of percolation the rate was 5 to 6 gal per hr per ft. This 2-1/2% mixture also cracked the tubing (upon swelling) which eventually brake.

SAND DATA

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