

# TEST REPORT #15

## Drop Test of Cap Material Blended With Two Forms of Organoclay

### Background and Purpose of Testing

Stokes Law states that solids of varying size and density will fall at varying speeds through a liquid of a constant viscosity (water). This law suggests that placing a blended granular cap material through a water column will result in a layering effect of the material at the bottom of the column based on the size and density of the particles.

A series of column drop tests were done in order to illustrate the relative difficulty, as predicted by Stokes Law, of achieving a uniform mixture of materials within an as-placed capping layer. The drop tests were performed using an existing specification for blending organoclay materials into a granular cap. A photo of the granular cap material is shown below.

The specification used is from the West Branch Grand Calumet Roxana Marsh and Reaches 1 and 2 project. This project calls for 2.5 lbs of organoclay per cu ft of granular cap material. This is stated in Section 35 42 00 sub section 2.2 of the specification.



U.S. Sieve Size	Percent Passing
1 in.	100
¾ in.	90 – 100
½ in.	60 – 90
No. 4	35 – 60
No. 30	12 – 30
No. 200	5 - 12

The two different forms of organoclay tested were Granular Organoclay, and AquaGate+Organoclay. The goal of this testing is to illustrate the effect of Stokes Law on the mix of organoclay blended with this granular cap material.

### Methods

Water columns 5-feet in depth and 4-inches in diameter were used for all tests. The blended samples were dropped into the water columns through a funnel with a 5.5-inch opening; the material fell 12 inches prior to entering the water.

The quantity of organoclay required to meet the specified active loading of the 6-inch thick chemical isolation layer was calculated based on bulk density and percent weight.

As Granular Organoclay is 100% organoclay, 0.106 lbs satisfies the 2.5 lbs/cu ft requirement. AquaGate+Organoclay contains 30% organoclay by weight and therefore 0.36 lbs was used to fulfill the requirement.

### Observations and Results

For both drop tests, the water column became very cloudy (high turbidity) immediately after placement. The blended material began to separate at a point no less than 18 inches below the surface of the water. The largest particles separated almost immediately upon hitting the water. Smaller particles became suspended in the water column, descending at a slower velocity.

Over the first two minutes, some of the suspended material could be observed settling to the bottom, resting on top of the larger particles. Within 5 minutes, the water began to regain transparency.

There is a clear separation of the size ranges, appearing as if they were added in sequence as opposed to dropped as a blended mixture. The photo on the right shows how evident the separation of large and small particles is during descent.

The Granular Organoclay settled mostly in the top one to two inches of the amended/reactive capping layer. A few particles ended up being in the middle of the layer with virtually none ending up any lower.

The AquaGate+Organoclay exhibited the widest dispersion, with particles mixed throughout the lower two thirds of the amended/reactive capping layer. As a result of this the AquaGate+Organoclay drop test left virtually no particles incorporated with the fine grained material at the top of the amended/reactive capping layer.



### Conclusions

Both column tests demonstrate that the materials in the granular cap proposed in the project specification, as well as the organoclay aspect of the capping layer separate almost immediately upon entering the water column.

These separations lead to a distinct layering of the amended/reactive capping layer according to grain size. It appears as if the mixture was added in sequence as opposed to being dropped as a blended mixture.

The Granular Organoclay behaved similarly to the smaller particles from the granular cap material.

Of the two drop tests, AquaGate+Organoclay enabled the placement of the highest percentage of organoclay throughout the entire amended/reactive capping layer. This is shown by the red circles in the photos below.



Red Circles Indicate the Location of Organoclay within the Reactive Cap Layer



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