

FREEZE-THAW EFFECTS ON PARTICLE SIZE DISTRIBUTION AND OIL REMOVAL EFFICIENCY OF ORGANOCCLAY

Executive Summary

A series of laboratory tests were conducted on a CETCO organoclay which was exposed to freeze-thaw cycling. The results showed there was no detrimental impact on their particle size distribution (PSD) and oil removal capability. CETCO organoclay product, a PM-199 analog with the lot number of OB-050604-1, was selected for this study.

Objectives and Procedures

Experimental Objective: The objective of this study is to investigate the impact of freeze-thaw conditions on the organoclay particle integrity and their oil removal performance under the laboratory conditions.

Freeze-Thaw Procedure: A quantity of 250.0 grams of organoclay was thoroughly mixed with 160.0 gram of deionized water in a plastic container. The organoclay was fully wetted, and there was free water observed on the organoclay surface. The organoclay was then transferred to a freezer with temperature ranging from -14°C to -12°C for overnight. The organoclay was removed from the freezer and allowed to thaw completely the next day. The organoclay underwent this freeze-thaw cycling for a total of 10 times before any further analytical tests were conducted.

Particle Size Distribution (PSD) Analysis: The wet organoclay sample exposed to freeze-thaw cycling was dried in an oven at 105°C prior to the sieve analysis study. An “as produced” organoclay sample was used as the control sample in this test for comparison purposes. The ASTM C-136 test method was adapted for this analysis.

Oil Removal Column Study: CETCO internal column study method was used to evaluate the oil removal efficiency of organoclay after freeze thaw cycling. In this study the crude oil (CETCO internal standard) was pre-blended with water to generate synthetic contaminated water. The water was agitated throughout the test. The water was pumped through a column packed with the wet organoclay media which had been exposed to freeze-thaw cycling. The flow rate was calibrated to give a retention time of approximately 6 minutes. The synthetic water influent and effluent were monitored regularly by the TOG (total of oil and grease) measurement using EPA method 413.2. A total of approximately 2 liters of water was pumped through the column

Results and Discussion

Particle Size Distribution: The particle size distribution (PSD) data obtained from the sieve analysis test are summarized in Table 1.

Table 1. Particle Size Distribution for CETCO Organoclay Before and After Freeze-Thaw Cycling

US Standard Sieve Size	% Retained	
	Freeze-Thaw	Control
#12	0.0	0.0
#18	1.6	0.0
#40	64.1	66.5
#50	30.8	31.4
#100	1.8	1.3
passing No. 100	1.6	0.8

The PSD results demonstrate that the majority of granular organoclay particulates maintained their integrity upon the treatment of ten cycles of freeze-thaw. The slight change in PSD could be attributed to the post drying treatment @ 105°C before the sieve analysis and the additional attrition force applied during the sieve analysis test.

Oil Removal Study: The subject organoclay was further evaluated for oil removal efficiency. The column study data is listed in Table 2.

Table 2. Column Study Data for Frozen-Thawed Organoclay

Sample Taken @	TOG (ppm)	
	Influent	Effluent
250 mL	160	4
1,000 mL	160	2
1,800 mL	160	6

The data showed clearly that the organoclay performed efficiently on removal of oil from the contaminated water. CETCO expects this trend will also be applicable to the other families of organic molecules such as PAH and PCB.

Conclusions

The conditions of freeze-thaw cycling had minimal impact on CETCO granular organoclay's particle integrity in term of its particle size distribution. The frozen-thawed organoclay media performed efficiently in removing oil in the column study. We expect that the CETCO proprietary organoclay supplied to field applications either in the form of bulk or in mat will deliver similar performance as determined in this study.