# Plant Evaluation of Deflocculant Products

| | |
|---|---|
| Date Performed: | Example Evaluation |
| Performed by: | BCS Personnel |
| To: | ---- |
| Company: | ---- |
| Location: | On-site at Customer Location |

## Introduction

Tile manufacturers use deflocculant in their milling process to create high-solids body slip for feeding into atomic spray dryers. The deflocculant must maintain the viscosity of the approximately 70% solids body slip such that the slurry can be fed into the spray dryer at a constant rate without clogging the nozzles, even in the event of over-dosing deflocculant.

BCS personnel assessed product performance of several BCS deflocculant products at a manufacturing facility, under the guidance of plant body slip and laboratory personnel. Using plant process water to make down the slurry, the dispersing qualities of the BCS and the incumbent products were evaluated by ladder dosing the deflocculant and measuring the resulting viscosity and density of the milled slip. Tests were performed promptly after initial milling while slip was “hot”, and after a 24-hour holding period when the slip had reached room temperature and was “cold”. The products tested in addition to the incumbent product were BCS 4210, BCS-TB-E, and BCS-TB-SS; the BCS 4210 is straight sodium polyacrylate, BCS TB-E is a blend, and BCS-TB-SS is straight sodium silicate. Several of these produced favorable viscosity results at cost-efficient dosages, while maintaining an average density comparable to that in the plants – 1.73 grams per cubic centimeter. The plant water used had varying solids that settled out quickly if not agitated, creating the variation in the density values of the samples. The dosages for the “cold” slurry were comparable to those of the freshly-milled, warm slurry – indicating that in the event of downtime in the plant, the slurry would not become unmanageable due to high viscosities. Residue tests were run

on a couple of the samples to get an indication of particle size, and the values fell between the desired 1.1-1.5 grams of residue (see Table 2 in Appendix B).

## Experimental Methods

A blend of materials currently used in the plant processes was used as the test slurry. The blend's raw materials were dried in the oven before blending the samples, so each component was added on a dry percentage basis. Each test batch was 500 grams of the raw material blend, 230 grams of process water, and approximately 600 grams of aluminum silicate grinding media. This initial amount of 230 grams of water was too low due to the high percent of solids in the process water, so 55 additional grams of process water was added to each mill to achieve a more acceptable density range amongst the samples. These materials were combined in a grinding mill along with the initial dose of deflocculant determined in preliminary testing to provide satisfactory viscosity values (see Tables 3-14 in Appendix B for dosages) and milled for 30 minutes. Viscosity was assessed by recording the length of time required for a sample of the milled, dispersed slurry to flow from a #4 Ford Cup. Density was evaluated with a stainless steel density cup and weight scale. The residue of two samples was evaluated by rinsing 100 mL samples of slip through a #320 sieve and recording the weight of the particles remaining in the sieve after drying.

The first set of samples was allowed to remain undisturbed overnight to conduct the viscosity and density tests on "cold" material. Using the ladder-dosing system, after each viscosity and density measurement, deflocculant was incrementally added to the slurry, milled for 30 seconds, and the viscosity and density measured again. These steps were repeated until the viscosity began to rise noticeably. Viscosity and density tests with ladder dosing were repeated on "warm" material directly after the initial milling and again on a second set of "cold" samples. Residue was measured on two of the samples from this second set of "cold" samples.

## Discussion

Many manufacturers currently use sodium silicate blends; the most similar product to these incumbents would be BCS-TB-E. BCS 4210 is solely sodium polyacrylate and is successfully used in slurry as a deflocculant at much lower dosages than the blends. BCS-TB-SS is sodium silicate that was tested for comparison/data gathering purposes, but not necessarily as a proposed option to offset the incumbent.

The evaluated products created acceptable viscosity curves, as seen in Figure 2 in Appendix B, with BCS 4210 creating the most favorable. BCS 4210 reached a

minimum viscosity that is 16.9% lower than the minimum viscosity reached by the blend, BCS-TB-E, at the same dosage, and 22.5% lower than that reached by the incumbent product at a higher dosage. To reach the same minimum viscosity of the BCS-TB-E blend with BCS 4210, a dosage of BCS 4210 at 33% less than the blend can be used. When compared to the incumbent blend product currently used, the same minimum viscosity can be reached with BCS 4210 at approximately 60% less than the incumbent material's minimal viscosity dosage. Another observed benefit of the BCS 4210 is the ability to maintain the lower viscosity well past the point that the sodium silicate blends causes increases in viscosity.

The desirable viscosities produced all occurred at a constant density within the range of densities comparable to those in the plant (1.710 – 1.750 grams per cubic centimeter).

## Conclusion

The BCS products performed satisfactorily during this test, providing minimum viscosities in the slip while maintaining acceptable average densities. BCS 4210 proved the most efficient with its significantly lower minimum viscosities at a lower dose rate. As a direct offset to the incumbent product, BCS-TB-E out-performed the incumbent to reach minimum viscosity at a lower dosage; this is attributed to the slightly different method of polymerization used in the BCS sodium polyacrylate versus the competitor. All of the sodium polyacrylate solids in the BCS product are active polyacrylate solids, while the solids in competitive products contain a certain amount of salts in addition to the polyacrylate. BCS recommends consideration of the BCS 4210 and BCS-TB-E products as replacements for the incumbent product.

## Appendix A: Formulas

Includes raw material blend components and percentages, along with any necessary charts for residue or viscosity calculation.

## Appendix B: Viscosity, Density, and Residue Data

**Figure 1.** Viscosity Curves for BCS and Incumbent Products

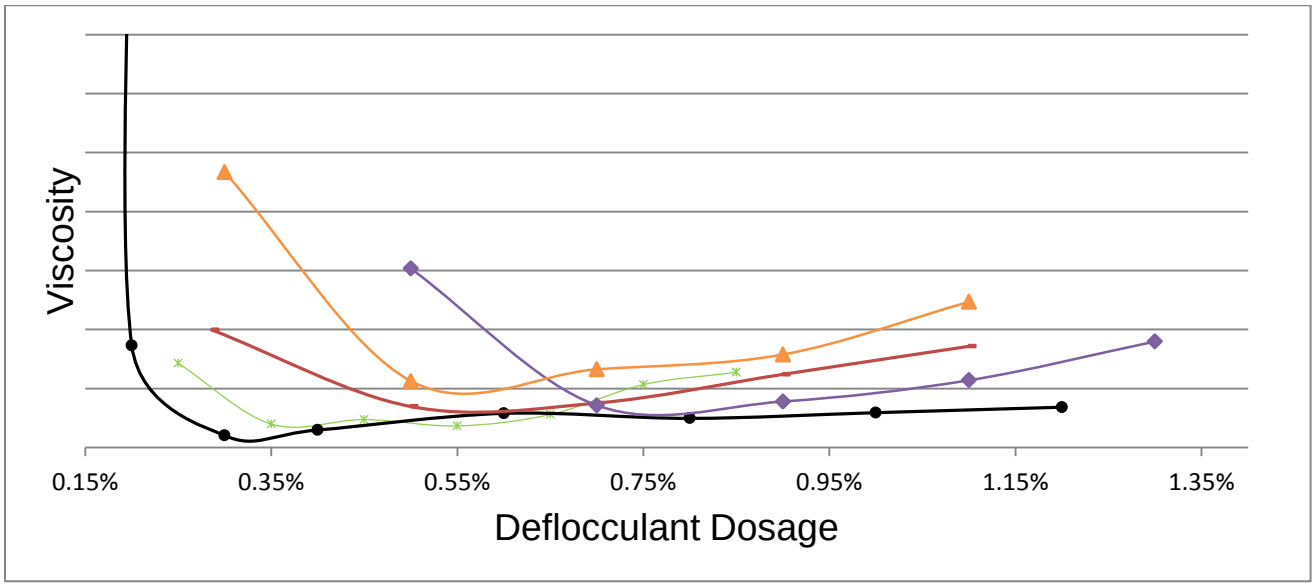
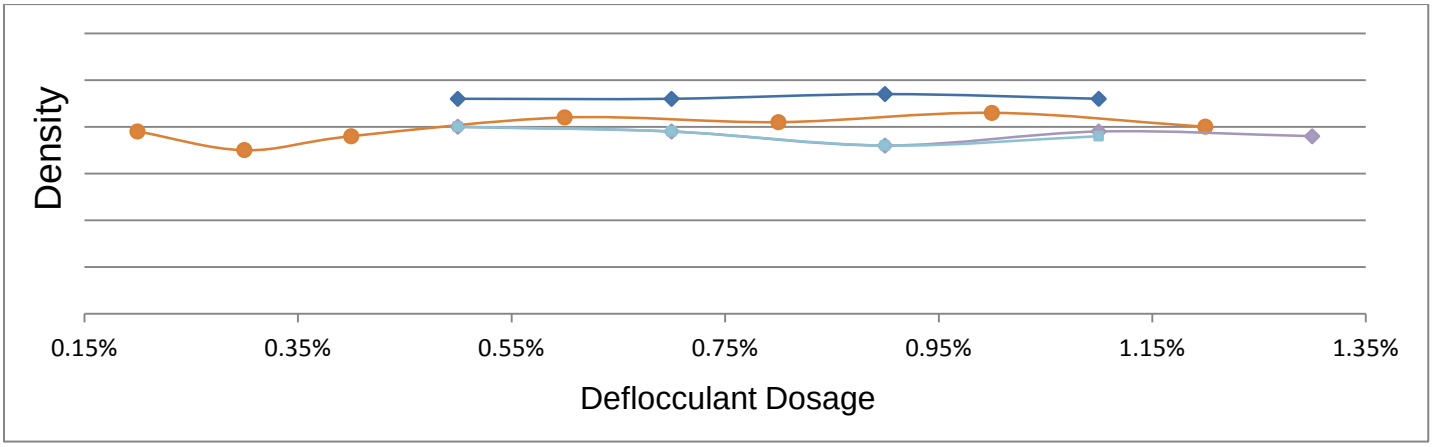



**Figure 2.** Density of Slip throughout Testing

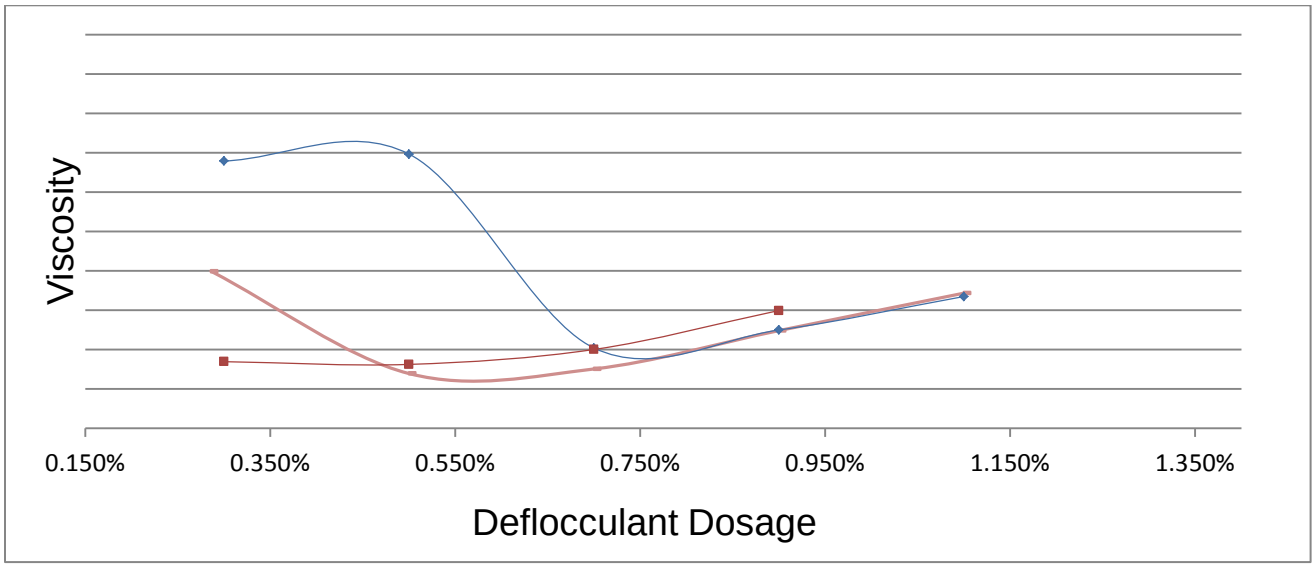


**Tables.** Individual Deflocculant Product Data from Various Hot and Cold Tests

| | | | #4 Ford Cup | |
|---|---|---|---|---|
| | **% Dispersant** | **Density, g/cc** | **Time, s** | |
| **Product Name "Cold"** | 0.286% | 1.720 | 16.92 | < 24-hour lapse |
| Date Performed | 0.286% | 1.733 | 17.49 | |
| | 0.50% | 1.730 | 14.13 | |
| | 0.70% | 1.731 | 14.28 | |
| | 0.90% | 1.730 | 15.54 | |
| | 1.10% | 1.732 | 16.77 | |

| | **% Dispersant** | **Density, g/cc** | **Time, s** |
|---|---|---|---|
| **Product Name "Hot"** | 0.30% | 1.752 | 21.11 |
| Date Performed | 0.50% | 1.746 | 21.34 |
| | 0.70% | 1.746 | 14.97 |
| | 0.90% | 1.747 | 15.56 |
| | 1.10% | 1.746 | 16.66 |

**Figures.** Individual Viscosity Curves for Each Product Tested




## Appendix C: Raw Data

Lab data sheets attached to each report.