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Evaluation of Cimtech D18-02 with M-251

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Project #: 14-281-1325

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Background: Cimtech D18-02 is a light duty synthetic metalworking fluid that is typically used at 5% concentration. The customer is requesting compatibility testing as well as pH, refractometer, and cast iron chip corrosion testing with and without M-251.

Sample Received: The following samples were received on 1/5/15 in ok condition:

1. Cimcool's Cimtech D18-02
2. Cimcool's Cimtech D18-02, pre-diluted to 4-5% concentration

Method: Standard Compatibility Test, CC-013
ASTM-D 4627-86 (Iron Chip Corrosion Test)
Refractometer
pH

Materials: M-251 (batch #08933)
Reichert 10440 Hand Refractometer (0-30 range)
pH meter
Disposable Petri Dishes (35mm by 10mm plastic)
Whatman Filter Paper #934-AH
Gray Cast Iron Drilling Chips
CaCl₂ - 2H₂O (ACS standard)
Di Water

Procedure: The following procedure was followed for the compatibility testing:

- 1) Dilute Cimcool's Cimtech D18-02 to 5% concentration (by weight) using DI water.
- 2) Add 1% M-251 to the solution in step 1, mix the sample thoroughly, and then place in a refrigerator set at a temperature of 7°C +/- 3°C for 8 hours.
- 3) Remove the sample from the fridge, inspect for compatibility, and then place the sample in an oven set at 60°C +/- 2°C for 16 hours.
- 4) After 16 hours the samples are removed from the oven and inspected for compatibility. The 24 hours constitutes as one cycle and the sample is cycled three times for this test.
- 5) The sample is considered fully compatible if there are no precipitates, cloudiness, gelling, separation, or any other incompatibilities.

The following procedure was followed for the pH and refractometer testing:

- 1) Samples were diluted using DI water.
- 2) Measure the pH and refractometer with and without 1% M-251.

- Procedure:** The following procedure was followed for the iron chip corrosion test:
- 1) Prepare a 'synthetic hard water' solution by dissolving 29.4g of reagent grade (ACS standard) $\text{CaCl}_2 - 2\text{H}_2\text{O}$ in 1 liter of DI water.
 - 2) The 'synthetic hard water' solution is then diluted to a concentration of 0.5% in DI. This is the 'hard water' that will be used for this test. It consists of 100ppm CaCO_3 .
 - 3) Using the hard water solution, dilute Cimcool's Cimtech D18-02 to 1-3% concentration (by weight).
 - 4) Place the filter paper in the bottom half of a clean, dry Petri dish. Place the smooth side of the paper down and the rough side up to contact the chips.
 - 5) Weigh 5 grams of each of the prepared sample in the Petri dish.
 - 3) Weigh 4 grams of cast iron chips and sprinkle into the Petri dish. Be sure that all chips are submerged, all air bubbles are released, and all the chips are evenly distributed.
 - 4) Cover the dish with its lid and allow to stand for 20-24 hours.
 - 5) Drain the fluid from the dish and invert the dish on its lid and tap to remove the chips.
 - 6) Rinse the filter paper with running tap water for 5 seconds to remove any discoloration due to the fluid.
 - 7) Visually examine the side of the filter paper that was in contact with the cast iron chips. The results will either be pass or fail. A pass will show white filter paper, a fail will be considered any color change that would have been caused by the rusting chips.

Results: The following results were found for the compatibility testing:

Sample	Cycle 1	Cycle 2	Cycle 3
(5% Cimtech D18-02) +1% M-251	F.C.	F.C.	F.C.

F.C. = fully compatible

The following results were found for the pH and refractometer testing:

Sample	pH	Refractometer Reading
4% Cimtech D18-02	10.1	0.6
5% Cimtech D18-02	10.2	0.9
6% Cimtech D18-02	10.3	1.2
Submitted pre-diluted Cimtech D18-02	9.6	1.7

Sample	pH	Refractometer Reading
(4% Cimtech D18-02) +1% M-251	10.0	1.4
(5% Cimtech D18-02) +1% M-251	10.1	1.7
(6% Cimtech D18-02) +1% M-251	10.2	2.0

Results: The following results were found for the iron chip corrosion test:

Sample	Results
3% Cimtech D18-02	Pass
2% Cimtech D18-02	Fail
1% Cimtech D18-02	Fail
(1% Cimtech D18-02) + 1% M-251	Pass
(1% Cimtech D18-02) + 0.5% M-251	Pass

Interpretations:

M-251 was found to be compatible with Cimcool's Cimtech D18-02, and also increased corrosion protection according to the cast iron chip corrosion test.