COMPATIBILITIES AND INTERACTIONS

SECTION B9
COMPATIBILITY WITH OTHER MATERIALS

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CABOT

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B9.1 Compatibility with glass

Formate brines should never be prepared, stored, or otherwise come into contact with borosilicate glass equipment. Formate brines cause dissolution of the glass, quickly releasing chemicals that may affect laboratory measurements of (inter alia) corrosion, formation damage, and crystallization temperature. To avoid creating misleading laboratory artifacts it is essential that formate brines never come into contact with any laboratory glass equipment.

B9.2 Compatibility with tank lining

Coflexip Stena Offshore Limited has tested the compatibility between cesium formate brine and its Coflon series of tank-lining material [1]. Coflon tank-lining materials were compatible with formate brine, and can be used without limits other than the normal supplier-recommended application limitations.

International Marine Coatings has tested compatibility of high-density formate brines with some of its tank-lining products [2]. The brines tested were concentrated potassium formate brine, concentrated cesium formate brine, and a 50:50 (w:w) cesium / potassium formate brine blend. The following four tank-lining products and schemes were tested:

- Interline 704 at 2 x 125μm dft
- Interline 904 at 3 x 90μm dft
- Interline 925 at 1 x 300μm dft
- Interline 994 at 3 x 100μm dft (ambient cure)

The above were applied by airless spray and cured at 23°C / 73.4°F. Panels were immersed in the test brines for 84 days followed by one day venting and 15 days immersion in seawater. Testing was carried out at 23°C / 73.4°F.

No failures were observed in any of the tests. Based on these results, Interline 704, 904, 925, and 994 are suitable for carriage of formate brines.

B9.3 Compatibility with subsea control fluids

The subsea control fluid, Oceanic HW740R, has been tested for compatibility with a 2.20 g/cm^3 cesium formate brine [3]. Oceanic HW740R was tested with cesium formate in the proportions 10:90, 25:75, 50:50, 75:25, and 90:10 for seven months at room temperature. No incompatibilities were found between the HW740R control fluid and the cesium formate brine.

B9.4 Compatibility with thread compounds

Four thread compounds have been tested for compatibility with a 1.92 g/cm^3 / 16.0 lb/gal cesium / potassium formate brine [4]. The thread compounds tested are shown in Table 1.

Based on API Recommended Practice 5A3 on Thread Compounds for Casing, Tubing, and Line Pipe, two modified test methods were employed:

- TEST A (Application/adhesion test)
- TEST B (Formate leaching test)

Based on test results, the following conclusions can be drawn:

- The formate brine did not exhibit any noticeable change in appearance when contacted by the thread compounds.
- Formate brine did not leach out any significant levels of chemical species from the thread compounds.
- Results of TEST A indicated that the formate treatment did not significantly affect brushability of the thread compounds.

B9.5 Compatibility with flowline gate sealant

A simple test was conducted to test a silicon sealant for compatibility with formate brine. The actual sealant tested was VALLANCE – Premium All-Purpose Sealant, which is routinely used to seal off gates in pit rooms prior to using cesium formate brines.

Table 1 Thread compounds tested for compatibility with cesium formate.

Manufacturer	Product	Features
Bestolife	2010 NM	Low-temperature grade, metal-free
	2000	Cu-containing alternative to API Modified
Oil Center Research	Lube-Seal	API Modified thread compound (1.85 g/cm^3)
	Eco-Seal OCR-325-AG	Bio-degradable, non-metallic petroleum, hydrocarbon & PTFE free (1.18 g/cm^3)

The test involved sealing two metal surfaces together and allowing them to contact the formate brine for a period of three weeks. No penetration or deterioration of the silicon sealant was observed during this time.

It is believed that any general purpose silicon sealants would perform just as well in this application.

B9.6 Compatibility with subsea cables

Total Norge has carried out compatibility testing between Metrol subsea cables and a cesium / potassium formate brine blend [5]. As it was planned to have this brine present in the marine riser during a DST operation, compatibility between fluid and cables had to be confirmed. Testing was conducted with a Hydrobond (Hytrel-sheathed) and a TEC cable system to verify their compatibility.

The testing was carried out according to test procedure JN1171-018B. Two cables were tested:

1. Hydrobond Yellow (Hytrel) cable, temperature rating unknown.
2. TEC complete with encapsulation, rated to 150°C.

Each cable system was tested in the formate brine for two and five days at 110°C / 230°F and for eight days at ambient temperature.

B9.6.1 Hydrobond Yellow (Hytrel) cable

The manufacturer had previously advised that the test temperature (110°C / 230°F) was too high for a five-day exposure of the Hytrel cable and connector assembly. Testing in cesium / potassium formate brine for two and five days confirmed this. Failure occurred at the polyurethane molding / connector interface within 48 hours. No failures were detected during the eight-day exposure at ambient temperature. Hydrobond has not given an exact temperature limit for the Hytrel cable, so any potential user of this product with formate brines should always test the cable for integrity maintenance at the predicted operational temperature.

B9.6.2 TEC complete with encapsulation

This cable, rated to 150°C / 302°F, is composed of an Incoloy 825 control line with polypropylene encapsulation. The complete TEC cable with encapsulation was tested for two and five days at 110°C / 230°F and for eight days at ambient temperature. The TEC encapsulation showed no signs of failure or breakdown in any of the three tests. There was also no apparent degradation of the Incoloy 825 in the TEC control line.

References

[1] Coflexip Stena Offshore Limited: "Formate Brine", report # CSO/JWA/901/01.

[2] "The Carriage of Formate Brines in Tanks Coated with International Paints Marine Tank Linings", International Marine Coatings test report, August 1996.

[3] Mac Dermid Offshore Solutions: "Compatibility of Oceanic HW740R and Caesium Formate", 27 February 2004.

[4] Westport Technology Center International: "Compatibility of Thread Compounds with Cesium-K-Formate (FA0030-2)", September 1999.

[5] Total engineering report R301-003A: "Fluid Compatibility Testing of Subsea Cables in Caesium Formate Brines", April 2010.