CAUSTIC SOLUTION REPLACEMENT
(Mud Safe CR)
STABILITY TESTING

Cormetrics Job #: 13-207

Prepared for: Heartland Energy Group Ltd.

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Revision 2

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1. Introduction

A synthetic caustic solution replacement product was submitted for thermal stability evaluation by Heartland Energy Group Ltd. The caustic solution replacement was evaluated in the autoclave apparatus according to the protocol received from Heartland Energy. The product tested is listed in Section 2.1.

2. Test Conditions

2.1. Synthetic Caustic Replacement

Product Name
Mud Safe CR

Table 1 – Synthetic Caustic Product

2.2. Autoclave Test Apparatus

The autoclaves used by Cormetrics Limited are constructed of Hastelloy 276-C and have a capacity of approximately 300mL. The tests were carried out with 200 mL of synthetic caustic product in each cell (approximately two-thirds full).

A Teflon sleeve was inserted into the base of the autoclave. The synthetic caustic fluid was then poured into this Teflon cup. The temperature of the fluid in the autoclave is sensed by a thermistor probe, held at the center of the cell by a Hastelloy sleeve. Charging of the autoclave is by means of an offset Hastelloy tube, fitted with a pressure gauge and sour-service valve. Each cell is also equipped with a pressure relief valve which is used when purging the test liquids directly in the cells.

2.3. Mud Safe CR Stability Test Protocol

The Mud Safe CR product was evaluated at 149°C (300°F) under a Nitrogen gas cap. The temperature was chosen to determine the thermal stability of the product at maximum field temperatures. The autoclave was brought to temperature and held for the test duration of 3 hours. The autoclave cell was then allowed to cool for half an hour prior to venting the pressure. Visual observations and pH measurements were taken on the post-test fluids to determine if they were still caustic.

2.4. Autoclave Pressuring

Once the cell had been sealed it was then filled with 500 psi of pure nitrogen. Once pressurized, the autoclave cell was then placed inside a heating mantle and brought to the desired test temperature via proportional temperature controllers. The fluid was not stirred.

3. Results Summary

3.1. Stability Test Data

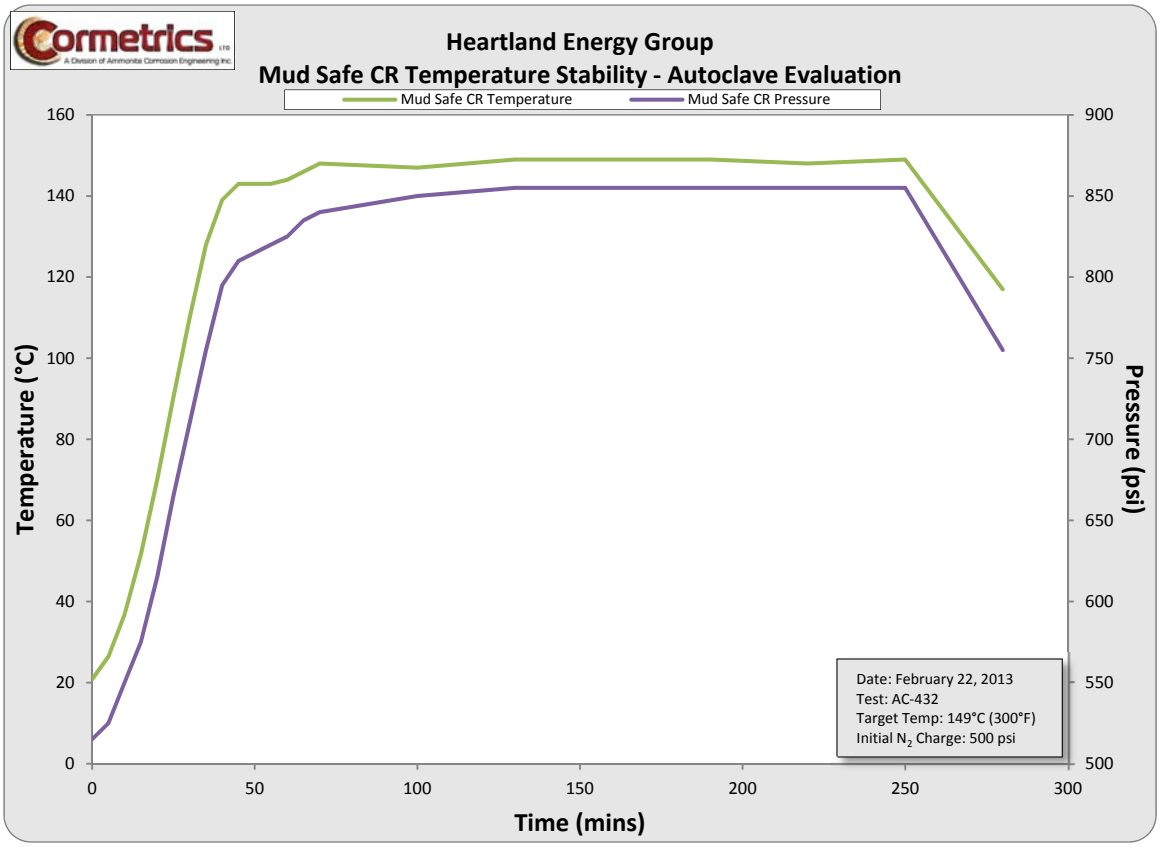

Figure 1 – Temperature and Pressure Data at 149°C (300°F)

3.2. Visual and pH Data

Figure 2 - Fluid Visual and pH Pre-Test at 149°C (300°F)

Figure 3 - Fluid Visual and pH Post Test at 149°C (300°F)

4. Discussion

- The Mud Safe CR product is clear at room temperature with a very high pH. The pH as measured by 0-14 pH strips is fourteen.
- In the 149°C (300°F) test the product reached temperature after an hour of heating. The pressure increased during this heating period to 855 psi. When the cell was at temperature the pressure remained stable. The stability of the pressure at temperature indicates the rise in pressure is due to heating and not due to any changes in the fluid.
- After 3 hours exposure at 149°C (300°F) the Mud Safe CR fluid remained clear. The fluid retained its alkalinity with a pH of 14 as determined by 0-14 pH strips.

5. Conclusions

In the conditions as tested Mud Safe CR is thermally stable and maintains its alkali nature up to a temperature of 149°C (300°F). The thermal stability threshold of this fluid was not reached in the conditions as tested.

Sincerely,

Cormetrics Limited

Mike Koldijk, B.Sc.

Frank Hornsby

Please note, all fluid samples are stored for 6 months prior to disposal.