Kuwaiti Insulating Material Manufacturing Company
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Attention: Dr. Kailash Chandra

TESTING OF KIMMCO THERMAL INSULATION

PO# Pre-paid
Laboratory Ref. #G610289 (Revision 3)
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BODYCOTE TESTING GROUP

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Samples will be retained for a period of three months prior to disposal.

1.0 INTRODUCTION

A sample of thermal insulation was received from Kuwaiti Insulating Material Manufacturing Company (KIMMCO) for testing. The sample was to be tested generally according to ASTM C 692-05, "Test Method for Evaluating the Influence of Thermal Insulations on the External Stress Corrosion Cracking Tendency of Austenitic Steel" using the "Drip Method". The sample was also to be analyzed according to ASTM C871-04, "Chemical Analysis of Thermal Insulation Materials For Leachable Chloride, Fluoride, Silicate, and Sodium Ions." The results of the C871 analysis were to be assessed according to ASTM C795-03, "Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel".

2.0 INVESTIGATION AND RESULTS

The deviations from the ASTM C692 standard were that the pipe used for the Drip Test Procedure was made from 316L stainless steel rather than Inconel and was electrically heated rather than steam heated.

Test specimens (U-bends) of 304 stainless steel were prepared according to the standard by a commercial supplier of corrosion testing materials. These specimens were from a lot of U-bends that had been qualified previously according to the standard. Four specimens were placed on the pipe. Four pieces of the insulation sample were cut according to the standard and placed on the U-bend specimens. Distilled water was fed to the centre of each insulation sample. The water was fed at a rate of 250±25 mL per day once the pipe had been heated to 100°C. The exposure was continued for a total of 28 days, with time added to ensure delivery of the full complement of water to account for a power failure and for the interruption of the water feed to one specimen.

At the conclusion of the test, the U-bend specimens were removed from the pipe, cleaned and inspected for cracks. The specimens were straightened and re-bent. The legs were squeezed toward each other and the specimens were inspected under a binocular microscope at 10-30X magnification. None of the specimens was observed to have cracked.

The results of the analysis of the insulation according to ASTM C871 are listed in Table 1. This analysis was reported in Report Number 06-02978-1, Revision 1; dated May 16, 2007.

Table 1

Results of the Insulation Analysis

Parameter	Result (µg/g = ppm)
Chloride*	124, 125
Fluoride*	1.24, 1.30
Sodium,	3359
Silicate as SiO_3	4855
pH (units)	9.79

* duplicate results

The graph provided in FIG. 1 of ASTM C795 shows a line that starts at $Na+SiO_3$ = 50 ppm, rises vertically to Cl = 20 ppm, then goes on an angle to $Na+SiO_3$ = 9000 ppm, Cl=600 ppm and continues horizontally along Cl = 600 ppm. There are arrows pointing above and below this line. Near the end of the arrow from the angled line, the area above the line is labeled "UNACCEPTABLE ANALYSIS" and the area below the line is labeled "ACCEPTABLE ANALYSIS". The point where the line drawn along the chloride result of 125 ppm intersects the line drawn along the $Na+SiO_3$ result of 8214 ppm falls within the acceptable area. The maximum chloride concentration that would still keep the intersection point below the "UNACCEPTABLE/ACCEPTABLE" line would be a bit below 600 ppm at about 560 ppm for the sodium plus silicate concentrations in the insulation. Therefore, the chloride and sodium plus silicate concentrations in the insulation are such that cracking in the ASTM C692 test would not be expected. A scanned copy of the graph showing the intersection is shown in Figure 1.

The pH of 9.79 meets the requirement of ASTM C795 that the pH of the leach water be greater than 7.0 but not greater than 11.7.

3.0 CONCLUSION

None of the 304SS coupons cracked when tested according to ASTM C692, the ASTM C871 analysis fell in the acceptable region of the graph in ASTM C795 and the pH of the ASTM C871eachate was within the range required by ASTM C795. Therefore, the insulation meets the requirements of ASTM C795.

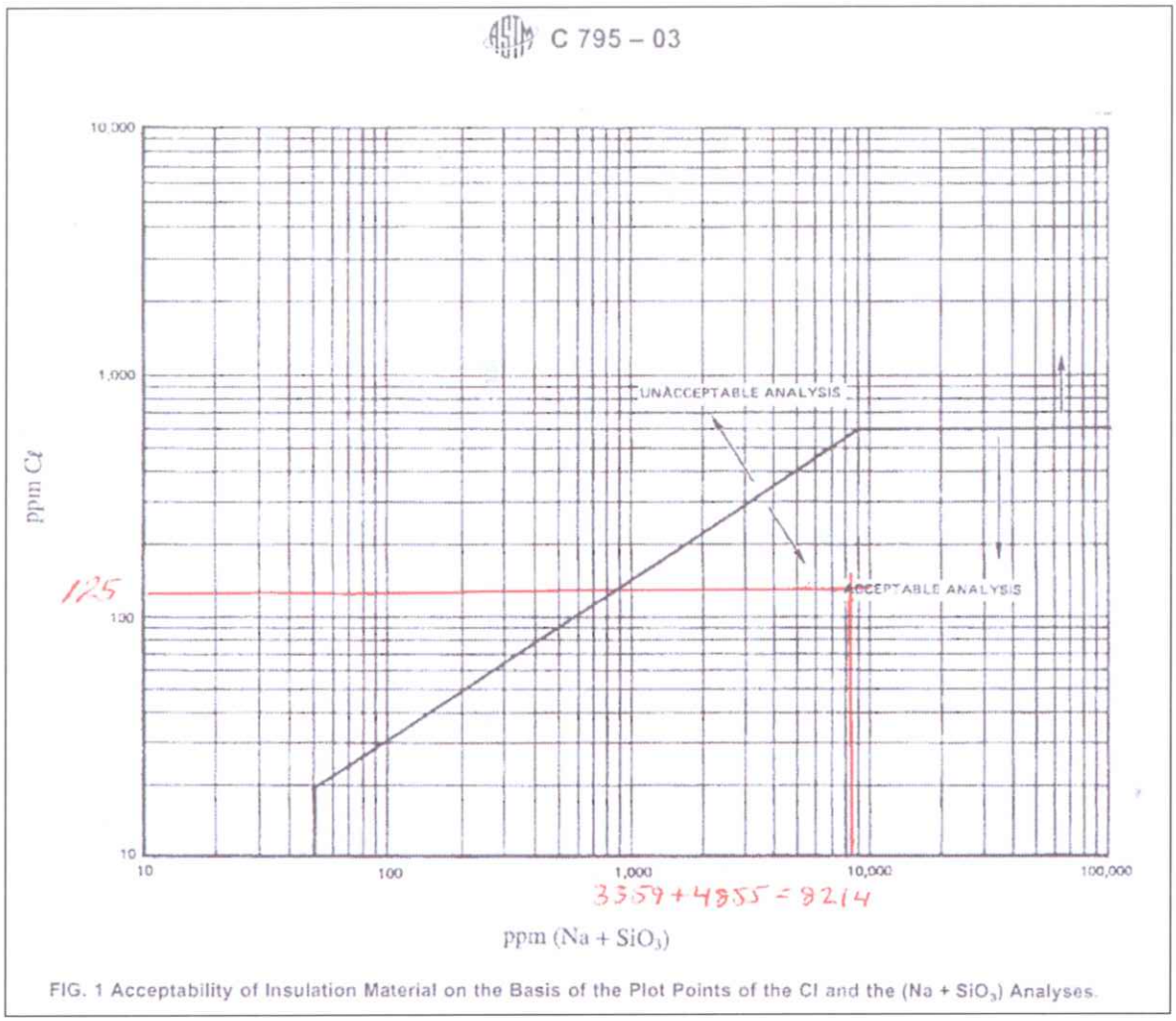


Figure 1: Results of the ASTM C871 analysis for chloride and for sodium and silicate plotted on the graph from ASTM C795 showing the analysis to fall in the acceptable region.