bcc: AG Eades
GR Buchanan
2nd Street - Don Roush
NEW YORK - H Gilbert
NEW YORK - WE Schalk/AL Klemm

June 1, 1965

Mr. Carl Raman
Lever Brothers
390 Park Avenue
New York, New York

Dear Carl:

I am sorry we missed seeing you during my recent visit with Henry Gilbert in New York. However, I will look forward to stopping by next time in town.

Henry indicated you had some questions regarding stress corrosion cracking. He asked me to write you directly. As I look back over the early stages of your Hammond project, I remember we went through this same question in June of 1962. Based on an additional three years' experience Carl, I again will optimistically state that this type of failure should not be a problem in your new system with THERMINOL as the heat transfer medium.

In reviewing the metallurgical failure on a recent visit to your Hammond installation, your personnel there indicated to me that they were of the conclusion the weld failure was due to poor fabrication, rather than a stress corrosion crack. I do hope this is the same information that was relayed to you from that source. You will recall your concern was regarding the integrity of dimple jacketed vessels and I revealed there were many such installations around the country that had operated successfully. This is also true to date.

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The entire question of chloride stress corrosion cracking is still somewhat nebulous. This is true even though metallurgists have devoted many years of intensive study to this problem. The results of their studies have given rise to the hypothesis that five items must be present for stress cracking to take place:

1) Local stress condition
2) Presence of chloride ions (cracking has taken place with the concentration as low as 3 to 5 ppm)
3) Presence of moisture
4) Presence of oxygen
5) High temperatures

All of these things are necessary at one time to cause a stress crack, though the quantities needed are still somewhat questionable. Ironically, you can have all of these items present and still not reproduce a crack with identical conditions.

I am sure incidents of stress cracking in THERMINOL systems can be controlled by the following general recommendations:

1) Stress relieve components where possible at 1650°F. Lower temperatures are not effective. This temperature is at the upper limit of the carbide precipitation range, and a low carbon alloy should be specified if there is a tendency toward intergranular corrosion. A second preventative measure is to go to a high nickel alloy.

2) Maintain moisture free and full system by:
   a) avoiding water for system cleanout
   b) blowing hot, dry air through the system prior to filling with THERMINOL
   c) draw a vacuum on the system prior to filling with THERMINOL
   d) install desiccator traps on open vents, and
   e) design the system to include a small bypass line from the discharge side of the pump or of the heater to the top of the expansion tank (above the surface of liquid at operating temperature). This will continually flash off any hydrogen chloride and moisture in the system.

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3) Most important, Monsanto's system design recommendations should be followed to prevent thermal stress of the heat transfer liquid.

It should be remembered, Carl, that although THERMINOL is a chlorinated material, the chlorine is tied very tightly to the biphenyl molecule. Ionizable chlorides can only be formed by overheating the fluid..

Perhaps the best way to alleviate your concern is for you to discuss this with American Hydrotherm. I understand they are supplying the heater for the new installation. They have designed installations utilizing THERMINOL, where stainless steel is in contact with the heat transfer liquid. Also, it would be excellent for you to contact Industrial Process Engineers in Newark, New Jersey, specifically Sid Feldman, who has designed many dimple jacketed stainless steel vessels for THERMINOL application.

Also, Monsanto has at least eight stainless installations within our own manufacturing complexes and, to my knowledge, they have not manifested a stress crack even though some have been in operation as long as fifteen years.

I do hope I have made a contribution toward lessening your concern over the cracking problem. However, I wish we could be more profound about the subject. I hope someday this whole problem will be solved. Considering the time and effort being placed on the question of stress corrosion cracking by the International Nickel Company, the nuclear power industry, and others, I am sure it will be solved. For the time being, Carl, our only recourse is control over the items listed before and good design and operation of the THERMINOL system. You know you can count on us to help in anyway we can, including review of the design and continuous surveillance of the operation. I hope you will continue to call on us at every opportunity.

Cordially,

S. Shaw
Market Specialist
Functional Fluids

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