Monsanto

FROM (NAME & LOCATION)

DATE: January 3, 1969

FROM: S. Shaw
W. R. Richard - WRICH

SUBJECT: THERMINOL FR SYSTEM EXPERIENCE AND DESIGN CONSIDERATIONS FOR FOOD APPLICATIONS

REFERENCE:

TO : [redacted]

In response to recent correspondence concerning contamination of a food product by chlorinated biphenyl, I would like to review applications on Therminol FR and list important design considerations.

We presently can account for 70 large food processing systems using Aroclor/Therminol FR as a heat transfer fluid. The earliest food processing system we can recall is now in the 15th year of operation. Five systems have been in operation over 13 years and ~30 systems have been in operation over 5 years. In addition, approximately 192,000 electric fry pans are in use in U.S., Canada, and Australia incorporating Therminol FR-3 as a heating medium.

These systems are used to process donuts, shrimp, fish cakes, potatoe chips, corn chips, pizza snacks, meat patties, candy, fatty acids, coffee roasting, and soup stock. The fry pans, of course, are used to prepare food in the home.

We know of two metal failures that allowed Aroclor/Therminol FR to contact the food product. In both incidents, the cooking oil and food product was discarded. The contamination was discovered when the characteristic order of Aroclor/Therminol FR was noticed. These failures were the result of pinhole leaks in the exchanger piping. In one case cooking oil caused the pin holes to occur in mild steel exchanger tubing where Therminol FR-2 is used to heat the cooking oil to ~420°F. In the second case, Therminol FR-1 leaked into a food fryer through a faulty weld site on 304 stainless steel pipe.

Two additional failures in Therminol heated food equipment are noted where the heat transfer fluid did not contact the food product or food contacted surfaces. One failure was due to the expansion difference of two metals, and the other failure was the result of poor design - high temperature and low flow.

It is also interesting to note that not one failure has been reported on the approximately 192,000 electrically heated stainless steel fry pans containing Therminol FR-3.

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Additional information on Aroclor/Therminol FR applications in the Food Industry is attached.

The attachments also show or describe design features of food processing equipment using Aroclor/Therminol FR as a heat transfer medium.

Design considerations of the primary heating equipment using Therminol FR is pointed out in the Design Guide. Of prime importance is the maintenance of flow and heat input to the primary heater to minimize or prevent decomposition of the HT fluid. Since HT fluid outlet temperatures in food processing applications seldom exceed 525°F, decomposition of Aroclor/Therminol FR should be negligible, thus minimizing the formation of the HCL decomposition product that could give rise to stress corrosion cracking of stainless steels. Now, I hesitate to broach the subject of stress corrosion cracking because of general ignorance of this phenomenon, but we have not had stainless failures to date in food processing equipment attributable to Therminol FR.

Food process equipment is heated indirectly by Therminol FR using shell and tube heat exchanger, jacketed vessels, panel coils, immersion tube bundles, radiant panels, and speciality processing equipment such as Votator and Holo-Flite.

In shell and tube equipment, removable stainless or Monel tubes and tube sheet assemblies are used with steel shells. A double tube sheet can be used to isolate leakage as is standard in hazardous or poisonous chemical processing, but we have not observed double tube sheets in use with Therminol FR.

Certain welding procedures are to be followed with stainless steels to assure homogeneous welds. Monsanto's Class II fabrication specification (ASME Code) which is satisfactory for toxic and high temperature (1350°F) service calls for inert gas shielded metal are, submerged arc and metallic arc with coated electrodes full penetration welding. Oxyacetylene welding or cutting is not permitted and surfaces must be machine cleaned. Also welding shall be such as to minimize the deleterious effect of heat on the metal when post weld heat treatment is not specified. The latter is thought to minimize stress corrosion cracking.

In stainless tube exchangers, the tube shall be rolled into double grooved holes in the tube sheet using automatic torque rolling equipment. Tubes can be back welded to the tube sheet to minimize accidental leakage.

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Other stainless fabrication should conform to ASME Code, Section VIII with particular attention to design to minimize stress due to heating and cooling.

Our experience with Aroclor/Therminol FR in food processing applications is excellent, and I'm sure that proper fabrication of equipment will provide isolation of the H.T. fluid without unreasonable fabrication cost.

D. E. Roush

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