

PLAINTIFF'S
EXHIBIT
DUP-2242

A. D. Bedsole → J. B.

EN-1029



E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

WILMINGTON, DELAWARE 19898

ENGINEERING DEPARTMENT

June 4, 1976

DEPARTMENTAL ENGINEERS

CORROSION OF PIPING AND EQUIPMENT UNDER INSULATION

Significant corrosion of carbon steel piping and equipment has been observed recently under wet calcium silicate thermal insulation at Old Hickory and Sabine River before turnover of new facilities to Operations. Some surface cracking under insulation was also observed on stainless steel equipment which had been in operation for a number of years at Sabine and East Chicago.

An ad hoc committee has been formed within the Engineering Department to review this situation for possible Company-wide implications. The first objective of the committee is to determine if this problem is widespread and, if so, to recommend appropriate remedial measures. Corrective measures will have to be based on consideration of the number of failures reported compared with the costs of minimizing corrosion of carbon steel or chloride stress corrosion cracking of austenitic stainless steel.

The committee requests your assistance in making this determination by having your plants answer the questions on the attached questionnaire (Appendix A) which relate their experiences with corrosion and stress cracking of piping and equipment under insulation. Include in your response the results of inspections made as the result of this inquiry. If answers to these questions suggest that there is a significant problem, we will come back to you for more specific information on conditions incidental to the failures. Please return the questionnaire by August 16, 1976.

As a precaution against possible metal failure and to help define the scope of this problem, we suggest that plants undertake a preliminary or exploratory inspection program to discover possible corrosion under insulation. An inspection procedure (Appendix B) is attached. The inspection should include a representative sampling of critical hot carbon steel and stainless steel piping and equipment. For carbon steel, review items which have been in operation for a number of years along with any items which have been insulated but not yet put into service. Carbon steel which has not been primed and which has been insulated and is outdoors should be of particular concern.

CC: Constr.: Managers
FPM's & Resid. Engr.
ESD: Material Engrs.
Design: Process & Spec. Mgrs.
DPM's

DATE:	6/14
3	INFO. WD
	CD. W. AR
	STEVEN, RP
2	Grube
4	TEPE, JB-LAS
	NO. 100, 101
	DIS. 100

Hand for
return

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June 4, 1976

Departmental Engineers

For austenitic stainless steel piping and equipment operating above about 140°F, we also suggest that you undertake a preliminary or exploratory inspection program. Of concern is stainless steel which has been subject to significant water exposure, particularly if it was insulated prior to about 1963 when inhibited insulation was not always used. Insulation which got wet before startup but then was protected from further water exposure is believed to be not a serious problem.

The purpose of this survey is to develop data leading to low cost, reliable solutions to these problems. In the meantime, precautionary measures should be taken to keep water out of insulation as outlined in Appendix C.

DESIGN DIVISION

Consultant & Development Section



H. E. Huckins

Section Supervisor

HEH:cpr
Attach.

DUP 0827193

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Appendix A

TO: H. E. HUCKINS
ENGINEERING DEPARTMENT
LOUVIERS BUILDING

FROM: _____
Name

Plant

CORROSION OF PIPING AND EQUIPMENT UNDER THERMAL INSULATION

1. How many failures caused by corrosion of metal from the outside have been observed on insulated piping or equipment? Include only instances where pipe or equipment had to be replaced or repaired because there was a leak or crack in the metal which originated from the outside under insulation.

NUMBER OF FAILURES THAT OCCURRED

	<u>Within a Year of Turnover</u>		<u>More Than One Year After Turnover</u>	
	<u>Piping</u>	<u>Equipment</u>	<u>Piping</u>	<u>Equipment</u>
Carbon Steel - Primed	_____	_____	_____	_____
- Unprimed	_____	_____	_____	_____
Stainless Steel	_____	_____	_____	_____

2. Keeping water out of the insulation would prevent corrosion of carbon steel; however, more rigorous control techniques during and after application of insulation could be costly. Priming of all carbon steel would offer protection against corrosion prior to startup, but this protection would diminish with time after exposure to elevated temperature. Priming would be an added cost; however, it has been common practice to prime carbon steel equipment.

In your judgment, do the problems which you have observed justify any of the following:

- a. Protective coating or priming for carbon steel pipe before insulating. _____
- b. More rigorous control measures during application and to minimize inleakage of water (See Appendix C). _____
3. Other comments or observations related to this matter; include results of recent inspections?

H. E. Huckins
June 1976

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INSULATION INSPECTION PROCEDURE

The following procedure has been developed for making a rough determination of the moisture content of calcium silicate insulation. This can be used for preinsulated items not yet in service, or any other insulated items where moisture content and corrosion is of concern.

Using a battery powered drill with a 1/8-inch bit, penetrate the jacket and insulation. Scrape the insulation off the drill bit and rub the insulation particles between the thumb and forefinger to evaluate the degree of wetness. Assign the wetness in accordance with the following arbitrary wetness scale.

- 0 - Powder dry
- 1 - Essentially powder dry
- 2 - Earliest detection of moisture
- 3 - Damp, feels moist when rubbing sample between fingers
- 4 - Near saturation, sample quickly becomes slippery when rubbed between fingers
- 5 - Saturated, water extrudes when insulation is cut

NOTE: Patch and seal insulation after sampling.

Previous investigations indicate that corrosion of carbon steel may be prevalent under insulation having a wetness scale above 3. Carbon steel under this insulation should be inspected for corrosion. Corrosion pit depth should be determined with piping specialists to determine possible need for repair or replacement.

For stainless steel which operates above 140°F, if wet insulation is found, or if it is suspected that there has been significant exposure to water, the following action is recommended:

- For stainless steel items insulated before 1963, inspect the outside surface of piping or equipment for presence of chloride stress corrosion cracking.
- For stainless steel items insulated after 1963, when inhibited insulation was available, send samples of insulation to ESD Materials Engineering Section, Louviers Building, for analysis of inhibiting effectiveness. An indication of inhibiting effectiveness will be evaluated by either gravimetric chemical analysis of soluble sodium silicate and chloride ion, or by an accelerated chloride stress corrosion test. G. E. Lang, ESD (Louviers ext. 3435), will be coordinating the analysis program and should be contacted for information on sample size and to arrange for the analysis.

The ESD Materials Engineering Group can provide limited service assistance in this program on existing budgets; however, some additional funds may be needed to carry out the chemical analysis, stress cracking test, and evaluation depending on the scope of effort.

H. E. Huckins
June 1976

DU 0827195

PRECAUTIONARY MEASURES TO PROTECT AGAINST
CORROSION UNDER INSULATION

- . Prime carbon steel if project painting specifications call for priming. The normal practice is to prime all carbon steel equipment; however, carbon steel piping normally is primed only if justified by an evaluation of service and local environmental conditions.
- . Do not store preinsulated items outdoors without adequate protection to prevent water from entering the insulation. This could include storage under cover and on supports to keep insulation above any possible flooding during heavy rains. Store piping in an orientation which allows the insulation jacket to shed water.
- . If a project delay appears likely, all insulation work in progress should be adequately sealed against water before work is halted.
- . Do not apply jacket or finish over wet insulation. If it is impractical to dry out the insulation by heating with steam or by air drying, remove the wet insulation and replace it with dry material.
- . Check the integrity of insulation finishes, weather barriers and caulking. This is important even when the piping or equipment is hot, because water in-leakage can cause local corrosion or chloride stress cracking.