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"Pipe Insulation Processes and Procedures"

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"Pipe Insulation Processes and Procedures"

Gentlemen:

We, Master Pipefitters, more than any other group of people, face the increasingly important and difficult task of providing and installing effective insulating materials aboard Naval Vessels.

Why is this an important and difficult task?

What are we doing about it?

What advances have been made?

What does the future hold?

The manner in which insulating materials is applied, and also the selection of those materials, affects both habitability and operating efficiency of our ships. An otherwise perfectly designed ship would be of little value if heat from steam pipes and machinery was allowed to escape and convert the ship into an immense oven which could bake the crew. We gain little by constructing boilers, reactors and heat exchangers to squeeze the maximum BTU of power from the available fuel and then permitting heat to escape from the system before it expends its energy on the rotor of the turbine.

Comfort of the crew is not a luxury. In order that men arrive at their battle positions in good health, capable of performing with maximum effectiveness, this comfort must be maintained by whatever control we can exercise over living conditions.

The steam turbine is a heat engine. Every conceivable device is built into the boiler to obtain the best possible combustion and to transfer the greatest amount of heat to the water in order to generate the maximum amount of steam per pound of fuel consumed. The steam is then superheated to an even higher temperature to enable it to deliver even greater quantities of heat energy to the rotor of the turbine.

If the boiler steam drum, the valves and piping, the turbines and pumps are not properly insulated, much of the heat energy will be lost to the atmosphere, raising temperatures in the machinery spaces to the point where they become unbearable. This unwanted heat must be removed by large, powerful and expensive ventilation systems. As the blower supplies and the exhauster removes air, wind is generated. As the wind velocity increases,

loss of radiant heat also increases, both from insulated and uninsulated surfaces. This cycle of more blowers to remove more heat to lose more heat to remove more heat is extremely undesirable. Of course, the obvious solution is to insulate efficiently in the beginning.

In every power plant there is a heat loss from all heated surfaces and a heat loss to all cooled surfaces.

Heat loss may occur in three ways; by conduction, by convection, and by radiation.

The manner of he t flow is most important in insulation because it is the low conduction which results in the greatest temperature differential between a hot insulated surface and the atmosphere (as in steam piping insulation), or the relatively warm atmosphere and a cold surface (as in refrigerating plant insulation). Conduction is associated with solids and comparison of materials in this respect is measured by a factor called the "thermal conductivity" which expresses rate of conductivity in British thermal units (BTU) per inch of thickness per hour per square foot of area per degree Fahrenheit temperature differential.

Radiation is the method of heat transfer by which a hot body gives off energy in the form of radiant heat which is emitted in all directions. The surface condition greatly effects the ability of a body to radiate heat. Dull, dark, rough surfaces (such as CHO pipe), are the best radiators.

In order to minimize the transfer of heat from or to a body which is hotter or colder, respectively, than the surrounding atmosphere, thermal insulation is applied. Thermal insulation is a material or materials of low thermal conductivity.

While increasing the economy of the plant, thermal insulation, (as was mentioned previously), reduces the quantity of air necessary for ventilation and cooling requirements and prevents injury of personnal due to contact with hot parts of apparatus. It also insures more uniform heat distribution within equipment. Another function of thermal insulation is to prevent "sweating" of cold surfaces on which atmospheric moisture condenses thus causing undesirable dripping as well as accelerated corrosion of the metal.

I wish to emphasize that insulation must be sufficiently effective to reduce heat losses and lower surface temperatures to a degree which will permit habitable conditions in a specific space of compartment.

Insulating materials must possesscertain characteristics. These are:

a. Low heat conductivity.
b. Noncombustibility
c. Lightweight.
d. Capability of easy molding and application.
e. Moisture repellent.
f. Noncorrosive, insoluble, and chemically inactive.
g. Composition, structure, and characteristics unchanged by temperatures at which it is to be used.
h. Once installed, should not cluster, become lumpy, disintegrate or build up in masses from vibration.
i. Vermin proof.

All of us are familiar with the available forms of insulating materials such as:

a. Molded sectional pipe covering:
   (1) Magnesia
   (2) Diatomaceous earth
   (3) Cork
b. Block
   (1) Magnesia
   (2) Diatomaceous earth.
   (3) Cork
c. Blanket insulation
   (1) Amosite
d. Plastic
   (1) Magnesia cement
   (2) High temperature cement

These familiar materials have been with us and in use on ships as long as any of us can remember.

During World War II a few changes in materials were made. Unibestos, which is amosite in pipecovering sectional form, was introduced. Also, we started using blanket insulation such as glass on ventilation systems. After the carrier Lexington was sunk, as well as because of uncontrollable fires on other battle-struck vessels, we substituted asbestos cloth and glass cloth for canvas as a lagging material.

Until recently, methods of installing insulating materials remained almost the same as always. Probably the most radical change was that of substituting the use of adhesives for the needle and thread in the application of cloth lagging.

Greater efficiency of power plants dictates increases in both pressures and temperatures used. Aside from the problems of metallurgy and fabrication of piping systems Pipe Shops must be increasingly alert to the need for more effective insulating materials and processes.

Developers of insulating materials have, in the last few years, produced many new insulating materials. Many of these lend their characteristics readily and favorably to shipboard uses.

We are familiar with the problems encountered in insulating deck steam lines aboard tankers. Because a loaded tanker in heavy seas has its decks constantly awash, insulating materials such as magnesia, which readily absorb salt water, are of little value. Each time insulation absorbs salt water, salts are introduced into the material. The pipe is heated, water being evaporated and leaving the salts. Each subsequent soaking brings additional salt until the insulation is filled with foreign material and becomes entirely useless.

Any solution to the problem of deck steam piping insulation demands that the insulation be completely water-proofed.

Two solutions offer themselves: the first, and possibly most obvious, would be to replace the catwalk on the deck of the tanker with a waterproof tunnel-like passage from forecastle to poop deck. This would permit personnal to travel the length of the ship in foulest of weather. On its overhead and sides could be placed piping and electrical conduits out of the weather.

The second solution, and the one being employed at Long Beach, is to insulate deck steam piping with a non-absorptive material. We use Foamglass sectional insulation. This is a material which meets all requirements for insulation. However, because of its nature all contact surfaces must be cemented together with a waterproof adhesive. The adhesive which we have been using is not adequate in that it does not set up quickly enough nor is strong enough for our purpose. However, we have discovered an adhesive called Tuff-Bond, manufactured by the Goodlee E. Moore Company of Danville, Illinois, and which apparently will cohere any two substances.

If Tuff-Bond delivers as well as we expect it will solve still another problem, that of attaching insulation fastenings to surfaces to be insulated, such as ventilation ducts.

This material has not received BuShips approval. However, we have requested evaluation from them.

As we all well realize, refrigeration insulation has been problem area through the years. This was a problem area during orld War II because of the acute shortage of insulators who were apable of applying cork insulation properly. The cutting and itting of cork to exact measurements, particularly in confined reas requires considerable skill and is time consuming.

The Foamglass and adhesives which are used on duck steam lines seem to be the answer to the refrigeration insulation roblem.

We have insulated one complete refrigeration system on a estroyer with this material and it proved to be satisfactory.

No appreciable savings in labor costs were realized but he material costs were much less. This is an important factor as nsulation often costs more than the pipe on which it is applied.

We are also applying Foamglass on chilled water lines, nd plan to discontinue the use of cork as an insulating material.

In addition to the chilled water piping, we have many iles of cold water piping such as flushing and fire systems. resent specifications call for the application of blanket type nsulation (Amosite) to cold water piping. This is a dusty, time-consuming chore which requires considerable skill to produce a neat ppearing completed job.

Instead of cork and blanket insulations on chilled water nd cold water systems another material might be used. This is rmstrong's Armaflex. Armaflex is furnished in a variety of sizes p to 2½" I.P.S., as a long cylinder or tube.

In new installations, this material can be slipped over the pipe, pushed back from the joints for sil-brazing, and then returned o position. A fitting cover is installed with contact surfaces emented and the job is complete except for painting. Being lexible, the material can be bent around curved piping easily.

On old installations the tube is slit, slipped over the pipe, contact surfaces are then cemented, and the job is finished.

Using the appropriate larger size material, fitting covers can be fabricated easily.

Probably best of all, in cases of national emergency, with skilled labor unobtainable, new employees could be trained to install Armaflex in a minimum period of time.