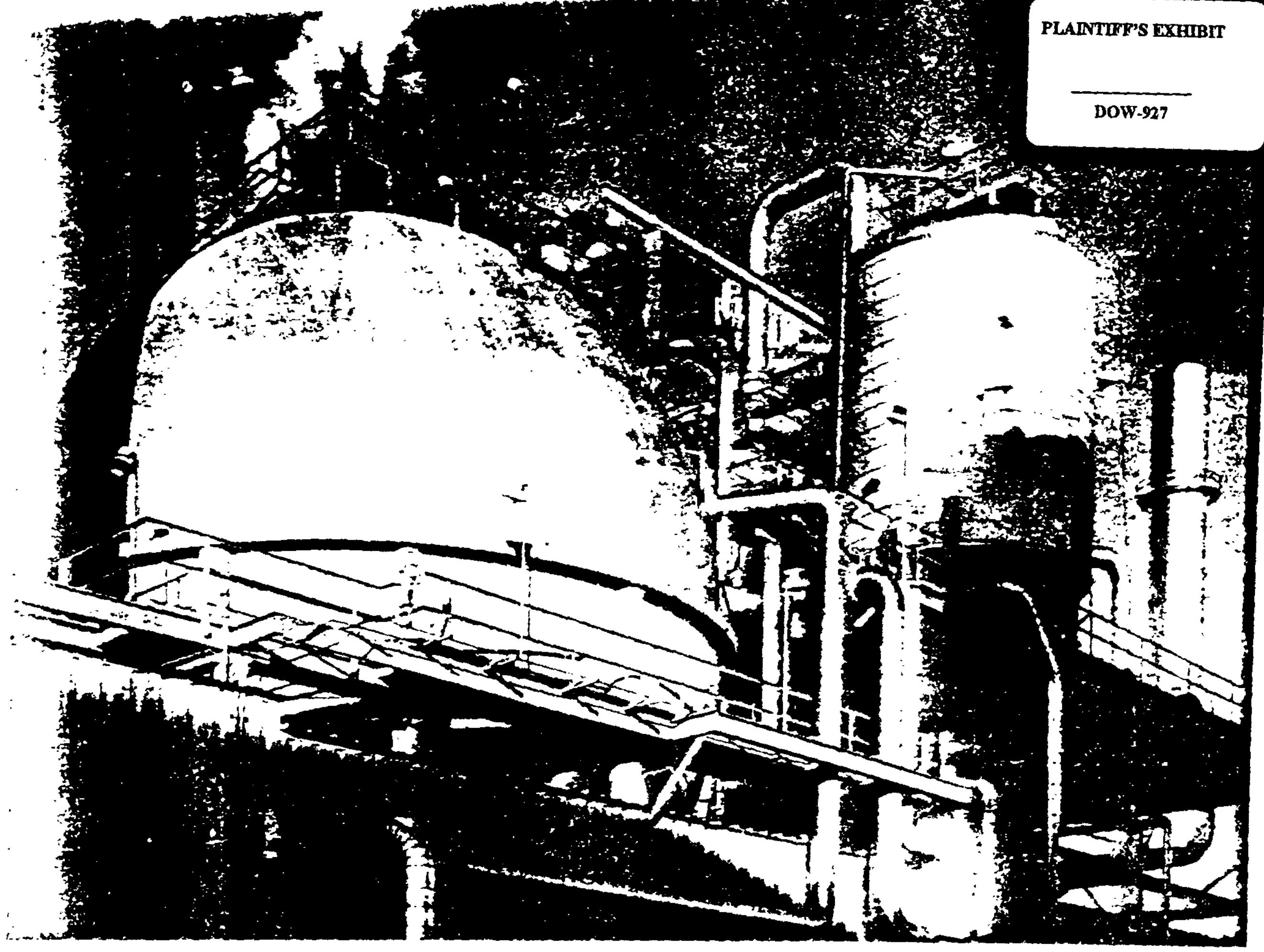

Sphere coated with Vi-Cryl (CP-10), a chemical resistant weatherproofing coating, and tower, deep corrugated aluminum sheets. Also various accessory products—pre-fabricated firrint covers, strapping, a nd wing seals.

Insulation Practices:

Protection of Thermal Insulation

Insulation protection can be provided by metal jacketing, mastic coatings, or a combination of both, depending on the application, service, and economics.

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It has been proven that it actually costs less to properly insulate process vessels, pipes, valves, and flanges, and thereby conserve energy, than not to insulate and supply sufficient additional heating or cooling capacity to cover the loss or gain of heat. Thermal insulation is, therefore, a long term investment. In the present energy crisis it becomes even more, it becomes a definite necessity and an obligation.

In any application thermal insulation requires protection of some type, be it against rain, snow, sleet, wind, ultraviolet solar radiation, mechanical damage, vapor passage, fire, chemical ravages, or any combination of these. Protection can be provided in the form of metal jacketing, mastic coatings, or a combination of both, depending upon the application, service, and economic requirements.

In view of the overall cost of a new facility, and the initial cost of the insulation system as a percentage of

that overall cost compared with the increased operating costs due to inefficient insulation protection, it is common sense to provide only the best protection for that long-term investment, consistent with the appropriate design and economic requirements. This article will outline just that type of protection—that is, the best available for the particular application consistent with the appropriate design requirements.

Metal jacket system characteristics

Prior to the use of metal jacketing systems, refinery and similar pipelines, vessels and tanks were covered with asphaltic roofing papers. This system offered virtually no weather, mechanical, or fire protection. The use of 55 lb. roofing felt held with tie wire did not offer much improvement. Metal jacketing met the requirements of a more efficient, more protective and more esthetic insulation covering.

Aluminum was the first metal to be used as jacketing material. In alloys 3003, 5005, and 5010, and tempers H14 through H19, it is still the most widely used product for general purpose industrial installations, but is not recommended for use in areas requiring chemical resistance under alkaline conditions.

Its advantages are low initial cost and easy workability. Its disadvantages are low chemical resistance in pH range 7-11, low mechanical strength, and low fire resistivity, no load factor at 800°F.—melts at 1,200°F.

Clad aluminum, (Alclad) the result of a mechanical process wherein an aluminum alloy core is coated prior to rolling with an aluminum alloy anodic to the core for its electrolytic protection against corrosion, is a product with slightly better surface chemical resistance than unclad aluminum.

Aluminum which has been chemically cleaned, primed with a corrosion inhibitor and then mill-coated with a polyester or acrylic resin offers greater use, flexibility, and somewhat more protection at a higher cost.

Its advantages are: coating can be selected to suit the environment, offering improved corrosion resistance; its moderate cost, and easy workability. Disadvantages are that the coating can be abraded relatively easily, and polymer degradation may result in failure.

Organosol-coated, electro-galvanized steel (Childer's trade name—Steel Jac) is manufactured from 0.010 in., or heavier, Type 1010, cold-rolled steel. The steel is then chemically-treated, coated on both surfaces with a vinyl acrylic primer and finally top-coated with a vinyl-organosol which is then fused to the metal.

Its advantages include excellent mechanical properties, attractive vinyl finish, chemical resistance, and abrasion resistance. Its disadvantages: it is somewhat more costly than aluminum, and the organic coating, though it will not support combustion, will char at incendiary conditions.

Stainless Steel (T304 and T316) is meeting with wide acceptance resulting in large scale usage. Advantages include high mechanical strength, high fire retardance (melts at 2,600°F.), excellent corrosion resistance, and excellent weather resistance. Disadvantages are high initial cost and susceptibility to stress corrosion cracking in the presence of chloride ions.

Moisture barriers frequently needed

Soluble salts present in most industrial insulations function as a weak electrolyte when the insulation becomes moist. The metal pipe and the metal jacketing function as opposite poles, thus a low-voltage, galvanic cell is formed, detrimental to both poles.

To prevent this attack at the metal/insulation interface, the incorporation of an integrally laminated moisture barrier is highly recommended. Childers Products Co. supplies two types of moisture barrier, each laminated to 100% of the metal surface on the underside of the jacketing: One is "Poly Kraft" moisture barrier, consisting of one layer of 50 lb. virgin kraft paper coated on one side with one mil polyethylene film. The other is a 30-90-30 moisture barrier consisting of a uniform film of pure high-melting, oxidized asphalt, laminated between two sheets of 100% virgin kraft paper.

Two other types of protective jackets are: "GAF®T/NA 100 Jacketing" a tough, flexible, flame-, weather-, and chemical-resistant laminate of Tedlar®, Neoprene®, and asbestos. Where a vapor barrier is required, the addition of one mil film of Saran (polyvinylidene chloride) to the laminate drops the vapor permeability of the system to 0.05 perms, without sacrificing any of the aforementioned properties.

Polyvinyl chloride (PVC) jacketing is another tough, flexible system used mainly for its superior chemical resistance and flame retardance. Its limited service temperature range and lack of dimensional stability detract from its other properties.

Mastic systems useful on irregular surfaces

The choice of the material used to protect the insulation may be governed by the size, shape, and location of the insulated surface to be protected. Materials which cling to the surface by adhesion facilitate the installation of a protective covering to large, irregular surfaces offering no ready means of securement.

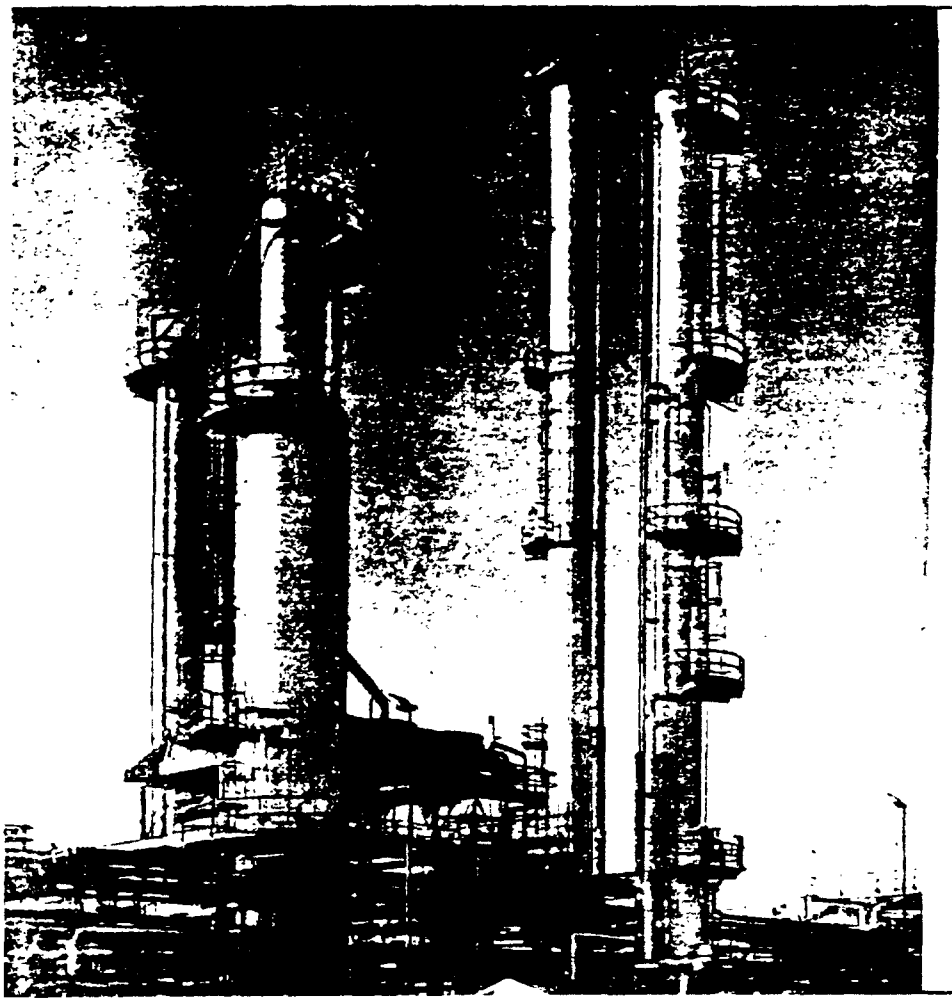
Mastics may be applied by spray, brush, or trowel to large, flat surfaces which will not easily accommodate metal jacketing. They may be used in conjunction with metal jacketing in situations such as flashing between two adjacent surfaces, or around irregular shapes such as fittings, valves, etc., because they lend themselves to easy application in these areas.

A weather barrier coating is applied to the outer surface of thermal insulation primarily to protect it from the ravages of weathering. It is designed to prevent water (rain, snow, sleet, spillage, wash water, etc.) from entering the insulation system. There are, however, many additional benefits. The tough flexible films provided by vinyl acrylic breather coatings (a breather coating is one through which vapors under pressure will pass), also afford protection from mechanical damage, chemical attack, and fire.

Mechanical damage can result from external forces in the form of shear, abrasion, impact or compression, which may occur when a sharp object is dropped, when the surface is walked on, or even from extreme weather conditions. Damage may also result from internal forces due to thermal expansion and contraction, differential movement, or vibration.

An appropriate weather barrier can protect the insulation from chemical attack of acids, alkalis, solvents, and salts, either airborne or from intermittent spillage, as well as from the effects of oxidation, infrared and ultraviolet radiation.

Weather barrier coatings can even be properly formulated and compounded so as to have a minimal contributory effect on the stress-corrosion cracking of austenitic stainless steel resulting from the presence of halogen ions.



Catalytic cracker and alkalation unit at an oil refinery. All piping, vessels, tanks, and towers protected with 3/16-in. corrugated and deep-corrugated aluminum sheets.

"Vicryl," a Childers' product, is used both outdoors in hot, cold, and dual temperature service. It is a breather coating, thus it should be used in cold and dual temperature installations only in conjunction with a vapor-barrier coating, or where the insulation itself is a vapor barrier. In hot service, a breather coating allows the escape of a minimal amount of water vapor resulting from heat applied to the moisture entrapped in the insulation, while still preventing the passage of liquid to the insulation.

Glass cloth and other fabric membranes are generally used as reinforcements for weather barrier coatings. In situations subject to severe abuse, chicken wire and other metal-mesh membranes may be used.

In cold and/or dual temperature service, the equipment operates below ambient room temperature at least part of the time. Water vapor in the air seeks to move from the area of high vapor pressure (room temperature) to the area of lower pressure (the low-temperature equipment). As the vapor passes through the insulation, the closer it comes to the low-temperature equipment, and the colder it becomes. At some point the water vapor reaches its dew-point temperature and condenses to the liquid phase. Closer to the cold surface, if the temperature is low enough, the liquid phase may solidify into ice.

Because the thermal conductivity of water is considerably greater than that of air, and that of ice is even greater, the value of the insulation is substantially reduced by the presence of moisture in any form. In dual temperature service, alternate freezing and thawing of the moisture in the insulation may actually destroy the insulation.

All these problems can be eliminated, or at least minimized, by the proper application of a vapor barrier coating to the warm side (outside) of the insulation. Vapor barrier coatings are formulated to afford maximum protection from mechanical damage, chemical attack and fire, at the same time preventing the passage of vapor to the insulation. These products, whether brushed, palmed, or sprayed, are normally applied with a fabric reinforcing membrane. However, in some applications the use of membranes only at butt overlaps may be satisfactory. In addition to being used as coatings, they may also be used as joint-sealers and adhesives in special applications.

Adhesives, coatings, and sealers must be considered

Lagging is the process of insulating piping and cylindrical or rectangular duct work and equipment and then covering the insulating material with canvas, brattice cloth, asbestos cloth, or a similar fabric.

Lagging adhesives and sizings are generally white, emulsion resin-based systems which adhere the lagging cloth to the insulation and to itself at the lap joint. They also serve to seal the fabric and secure it tightly to the surface.

Combination systems which function both as adhesives and protective coatings are also available. They provide

somewhat greater protection from mechanical damage, vapor penetration, and chemical attack than the previously noted lagging adhesives, and this precludes the necessity of applying another material as a protective coating. The water-based system offers the versatility of a tenacious, permanent adhesive coupled with a tough, highly resistant, yet flexible and attractive coating.

Decorative coating and color-coding products are heavy protective coatings that are used over masonry blocks, canvas, glass cloth, etc. bridging the unevenness of the rough surfaces and giving a smooth, tough, flexible, fire resistive finish.

These coatings may be applied directly to such materials as polystyrene foam, polyurethane foam, cellular glass and fibrous glass. They serve as effective sealer coats over many types of asphalt. Their availability in a full spectrum of colors gives an added advantage of virtually eliminating the need for painting and continued maintenance.

Sealers in insulation work function primarily as water and vapor seals. In many applications, however, they may also function as adhesives and expansion joints with metal, masonry, cellular glass, etc. The requirements for this type of product include low shrinkage, excellent adhesion, and permanent flexibility. Many are virtually 100% non-volatile, and they form a skin by oxidation, remaining permanently soft and flexible under the skin. Others contain polymers dissolved or dispersed in varying amounts of volatile solvents; these exhibit somewhat greater shrinkage and dry by evaporation of the solvent rather than by oxidation.

What a complete system requires

Today there are many governmental and private industry influences specifying, among other things, supplier and user compliance with OSHA, USDA, GSA, and Mil Spec requirements. These specifications include consideration of the following conditions or questions:

Solvent or water based system? Care must be taken that the system will not attack the substrate to which it is applied. It must dry in the time required and under the conditions to which it will be exposed.

Toxicity. What is the threshold limit value of each ingredient, and what steps must be taken to prevent exceeding that level?

What is the flammability of the system (in the wet state), and will it create an undesirable hazard?

What is the flame-retardance of the dry film, and will it meet all the necessary requirements?

Is the material UL (Underwriters Laboratories) listed? What are its Tunnel Test ratings (ASTM E-84)? Flame spread? Fuel-contributed? Smoke-developed?

What is its resistance to various mechanical factors, including expansion and contraction, vibration, shear, abrasion, impact, and compression?

Thermal factors: application temperature limits, freeze thaw stability, and service temperature requirements.

Chemical resistance factors: acid resistance, alkali resistance, and solvent resistance

Method of application: trowel, brush, or spray.

Sample recommendations for eleven different kinds of applications are given in the following.

Petrochemicals operation. 0.016-0.019 in. aluminum; 0.019-0.024 in. deep corrugated aluminum on vertical vessels and 0.024 in. smooth aluminum on horizontal vessels. Type 304 stainless steel is to be used in areas where the atmosphere contains corrosive vapors of a highly acid or highly alkaline nature. All metal jacketing is to have a moisture barrier. "Vicryl" is to be used to give protection to any irregular shape or surface where the application of a metal jacketing system is impractical.

Detergent alkylate unit. Steel Jac with moisture barrier, or Type 304 stainless steel with moisture barrier, is recommended due to aluminum's intolerance for caustics. (Vicryl to be used where necessary.)

Power house. 0.016 in. acrylic-coated aluminum is suggested for improved appearance. Polykraft moisture barrier is recommended. The acrylic coating facilitates washing down the surface.

Food processing. Type 304 stainless steel was once the only recommendation made. However, today more and more aluminum jacketing is being used. T/NA 100 applications are also being used extensively, as are USDA-approved mastic systems.

Urea plant. Steel Jac with moisture barrier, or Type 304 stainless steel with 30-90-30 moisture barrier, is recommended due to the wide range of extremely corrosive acidic and basic process chemicals present (e.g., nitric acid, ammonium nitrate).

Chlor-alkali plants. Steel Jac with Polykraft moisture barrier is recommended due to the high degree of soluble chlorides existing. (Stainless steel is weak under these conditions, and aluminum fails in caustic areas.)

Off-site steam lines. Since only weather protection is necessary, aluminum jacketing with Polykraft moisture barrier, or an application of Vicryl, is all that is required.

Nuclear containment vessels. Type 304 stainless steel used in conjunction with chloride-free, nuclear grade mastics.

Roofing applications over sprayed urethane. A weather-resistant, moisture-resistant, ultraviolet barrier is required to protect the urethane insulation.

SNG/LNG (synthetic natural and liquefied natural gas.) As with all cold piping installations, the application of a vapor barrier coating over the insulation will prevent the passage of moisture vapor from the warm (outside) surface to the cold surface, thereby preserving the integrity and utility of the insulation. Aluminum jacketing will do the job in thicknesses from 0.016 to 0.040 in., depending upon the specific requirements.

Paper mills. Where formerly Type 316 stainless steel was the only recommendation, it has been found that Steel Jac and Vicryl work well under conditions of intermittent spillage in areas of white, black and green liquor make-up and storage. #

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