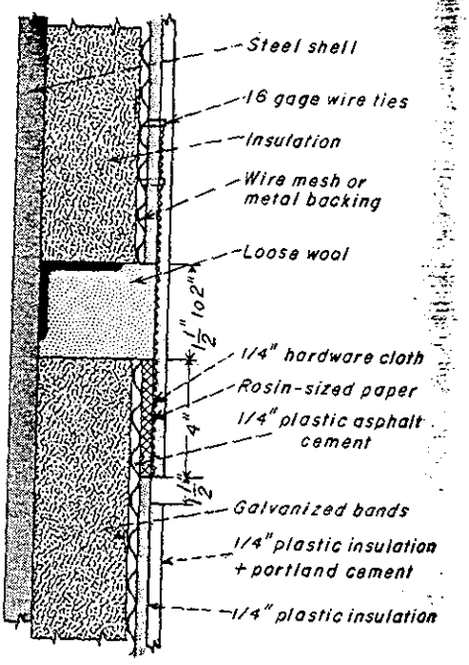
STEAM MAINS being covered with high-temperature insulation



EXPANSION JOINT on a h-t breeching or duct. *Space between sections is packed with fibrous insulation*

Double-layer high-temperature insulation means less maintenance, comfortable working temperatures and no fire hazard. Here's...

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What you should know about

► STEAM PRESSURES and temperatures are rising constantly in order to produce more economical steam-generation equipment. Because of this, more plant engineers are coming to grips with high-temperature insulation problems.

Temperature limits. Insulation development has more than kept pace with increased temperature. Limits recommended by MIMA for normal service are:

Material	*Temperature limit*
85% magnesia	up to 600 F
Calcium silicate	up to 1200 F
Expanded silica	up to 1600 F
Diatomaceous silica	1500 to 1900 F

But selecting insulation by heat tolerance alone oversimplifies the problem. No one insulation is best for all applications. Conductivity or *k factor*, structural strength, resistance to mechanical damage, water resistance, compressibility, ease of application and workability must all be considered for each job.

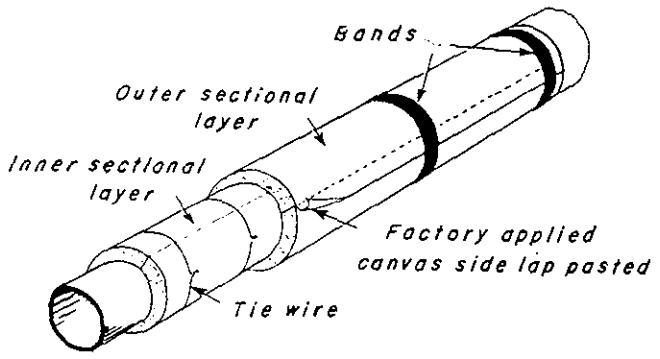
Thermal expansion. One byproduct of high-operating temperature is expansion of equipment and piping. This problem will be with us until someone develops a metal that does not expand at high temperatures.

Insulation problem is generally solved by using double-layer construction with staggered joints, illustration, p 115. Through-joint openings from metal to air are eliminated, since joint separations occur in one layer only.

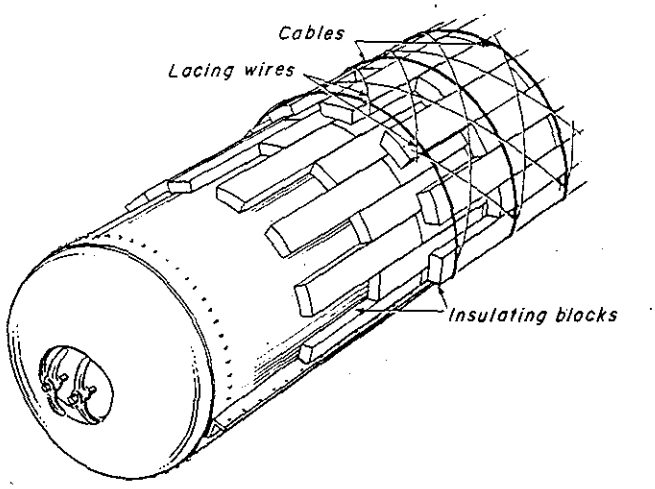
Typical combination is diatomaceous silica and 85% magnesia insulation. Diatomaceous silica is applied to the hot metal in a thickness calculated to reduce outer-surface temperature below 600 F. Then 85% magnesia is applied in thicknesses needed to reduce heat loss to economical level. High heat resistance of diatomaceous silica and low conductivity of 85% magnesia combine to give an excellent insulation.

One vs two layers. Some engineers feel that two-layer insulation is unnecessary with materials like calcium silicate and expanded silica. Both insulations combine high heat resistance and low conductivity in a single layer. In addition, installation cost is lower.

But single-layer construction does not allow for thermal expansion of equipment and piping. In every 100 ft of steel piping at 820 F there is about 8 in. of expanded bare metal between insulation joints. Multiply that by the many hundreds of feet of pipe in the



DOUBLE-LAYER sectional pipe insulation showing staggered joint construction to allow for thermal expansion of the pipe



CYLINDRICAL SURFACE of steam drum using double-layer insulation. Blocks are held by wire laced to anchored cable

h-t insulation

verage plant and you begin to realize hat a lot of heat is wasted.

Insulation jackets or other finishes re scorched and damaged at open oints calling for constant maintenance. xposed hot pipe is a considerable fire azard, particularly in plants handling ammable materials. In many cases, orking temperature is raised to an ncomfortable level.

Expansion joints, like the one on page 114, can solve some of these thermal xpansion problems. But the great numer of joints needed for most piping are xpensive to install and maintain. Best olution is double-layer construction herever there is appreciable thermal xpansion of piping and equipment.

Expansion joints are more often und at elevated temperatures on long ns of ducts or breeching and large pressure vessels. General practice is to leave an inch or two between every second or third insulation block or section for thermal expansion. This space is packed with fibrous insulation and covered by a sliding collar or shield.

Standard thickness is a holdover from the past that continues to plague engineers. It implies that there is a standard thickness for a given size of pipe. Use of this term was common before the days of the superheater when steam was only saturated. Avoid use of specifications that call for standard or double - standard thicknesses. Aside from the fact that they are probably inadequate, they no longer exist.

Simplified thickness. MIMA has adopted new thickness schedules that list four insulation types by nominal half inches for ease of reference. For example, 2½-in. nominal thickness insulation on a 1-in. pipe is 2 21/32-in. thick. Actual thickness is used only for critical engineering calculations.

One advantage is that outside diameter of pipe insulation is then about the same as outside diameter of iron pipe sizes. It can be applied directly to pipe or as a second layer on smaller size insulation.

Another advantage is simplified inventory records for the plant engineer who has to keep a stock of insulation for maintenance. Odd fractional-inch sizes do not have to be stocked.

Outdoor plants. Number of outdoor applications is increasing. Plastic asphaltic compounds with 1-in. wire mesh reinforcement and binder give good protection on smooth insulation surfaces. Flashing is needed to prevent seepage at conical tips of vessels and similar points. Good insulation will withstand repeated wetting and drying. But wet insulation will not effectively prevent heat loss.

Aluminum jackets give good protection and improve plant appearance. But corrosion inside the jacket presents a problem. One theory is that alkaline nature of most insulation has a catalytic effect on the aluminum. Another attributes corrosion to the use of scrap aluminum in producing sheet and/or improper alloy composition.

Extensive tests by both insulation and aluminum manufacturers prove that corrosion is generally independent of insulation type and aluminum quality. All you need is moisture. Since it is almost impossible to keep all moisture out of the jacket, the inner surface must be given a protective coating.

What's ahead? Insulation is available to handle most of today's industrial temperatures. But the trend to higher temperatures in nuclear and critical-pressure power plants spotlights the need for continued research. Since organic materials or binders cannot be used as basic ingredients, research is presently confined to known inorganic substances. Much has already been learned about basic theory of heat flow in insulation and basic materials are constantly examined for their effectiveness in formulating new insulations. Most of this research is based on the fact that the most effective material for barring heat passage is one with countless millions of microscopic air spaces. Efforts are directed at developing products with greater heat resistance, lower conductivity and greater durability.