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Modern Boiler, Tank and Line Insulation

Brief sketch of operating conditions at Salisbury Axle Plant at Ft. Wayne . . . Insulation techniques in covering entire distribution line . . . Advantages of applying insulation in sections . . . Insulation of deaerator, cold water make-up tank and circulating and process pumps . . . Effectiveness of insulation under test

CORRECTABLE defects in the steam system are frequently potent, though silent, money wasters. Few industrial processes are as universally important as the generation and distribution of steam for heat and power, and in most plants the generation of steam and the maintenance of the boilers, lines and auxiliary equipment constitutes an outstanding item in overhead costs.

In recent years the realization has grown that very important fuel economies result through the application of good insulation. The need for fuel conservation during the war served to accelerate the insulation of heated surfaces. All new plants, planned or erected during the war included carefully detailed plans for heat and power generation and distribution in completely protected lines from carefully insulated boilers.

The Salisbury Axle Division of the Spicer Manufacturing Co. erected a new plant in Fort Wayne, Indiana, which was placed in operation early in 1946. The boiler room is a model of efficient layout and detailed planning. The distribution system exemplifies the latest principles. No heated surface has been overlooked. All were insulated with semi-rigid mineral wool pipe forms and surface blocks.

Before describing insulation techniques, let us review the plant layout and determine those elements of the system where heat-loss-control is vital.

The power plant is housed in a separate building located conveniently to serve future plant additions. Isolation of the power plant avoids dispersion of related equipment among production tools—and, by avoiding the cramped quarters of production areas, reduces the number of people involved in operation and maintenance. With the present arrangement four men are adequate to operate and service all power equipment.

Fuel Delivery

A rail spur is available for fuel delivery and ash removal. Fuel consists of Indiana coal which is removed from rail cars with automatic machinery and stored in a silo type storage supply tower. Provision is made for freeing frozen coal by means of heaters at the unloading point which free a dozen car section in 20 minutes or less.

The coal is delivered by chute from the silo to weigh larry distribution buckets which are suspended from a monorail in front of the three furnaces. Weighed charges are placed in the hoppers which feed twin automatic spreader stokers in each unit. The performance of each boiler is continually checked by recording flue gas CO_2 analyzers and by constant check of weighed fuel consumption. Even at minimum demand, correct feeding control yields 13 per cent CO_2. Stack losses are further minimized by recovering fly ash from the rear exhaust and recirculating it through the air blast system. Maintenance and operational uniformity are further controlled by water walls in the sides and rear of the boilers.

The plant not only encloses the boilers, water feeders, deaerators and pumps but also the electric power controls and compressors for supplying compressed air to the various departments.

The power building consists of two main rooms. The larger one contains three 224 hp two drum, bent tube boilers installed by Combustion Engineering Co. Each unit is designed for continuous operation at 15,000 lb per hour of steam at 330 F and 140 psi. The production sections in operation at present require 30,000 lb per hour in the winter but use only 5,000 lb of steam for process loads, when heating is no longer required. When the final section of the plant, now in construction, is placed in operation, the total capacity of the three boilers will be required in extreme weather.

The steam is piped from each boiler to a collector and distributor manifold located on the balcony of the second room in the power building. All control valves for the main lines, to and from the furnaces, are conveniently grouped where they are easily accessible. By generating the steam at 140 lb the size of the pipes, manifolds and valves is reduced—and, of course, the amount of insulation required for control is similarly minimized.

Having briefly reviewed the plant in general, let us now pick up the insulation topic. In addition to line insulation, the feed water pumps (American Marsh Duplex), the deaerator (30,000 lb per hr, Cochrane Corp.), the 8,361

Fig. 1. These pipes carry condensate to the heat exchanger and go on to a hot water supply tank. Pipes and flanges are insulated with 1 in. formed mineral wool. Flange insulation is cut and notched to fit. Flanges and pipes have a protective cement coat and a hard and identifying coating of paint

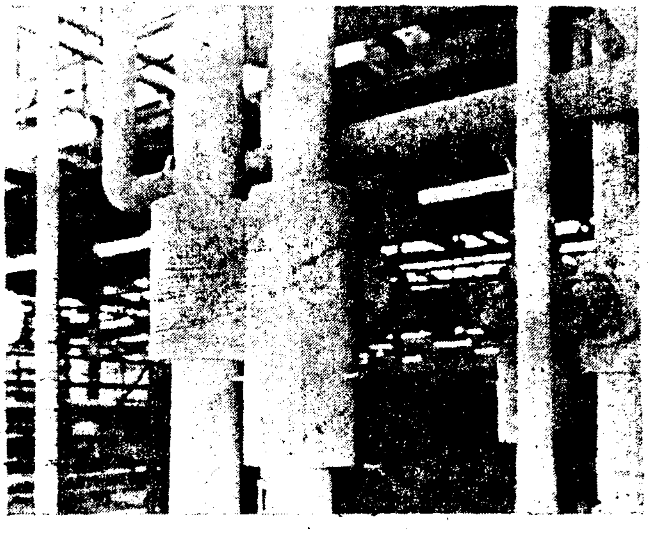
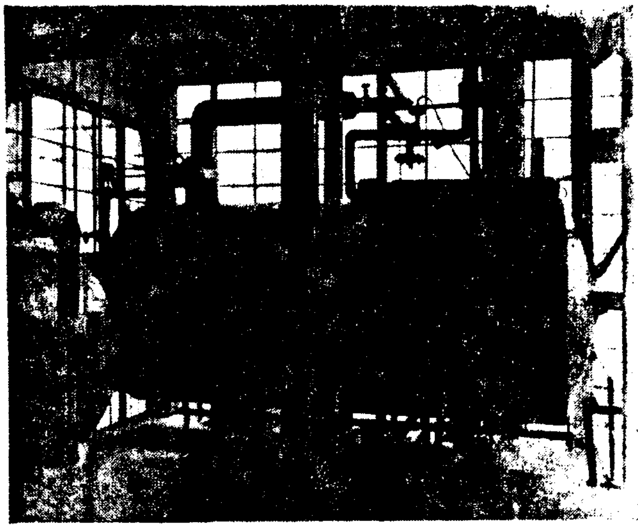


Fig. 2. 30,000 lb per hr feedwater heater and deaerator are insulated with 1 in. mineral wool blocks cemented and banded into place. Blocks are covered with canvas, coated with two layers of sealing compound and finally painted. 8,361 gal capacity tank at right is for chemical treatment of incoming water



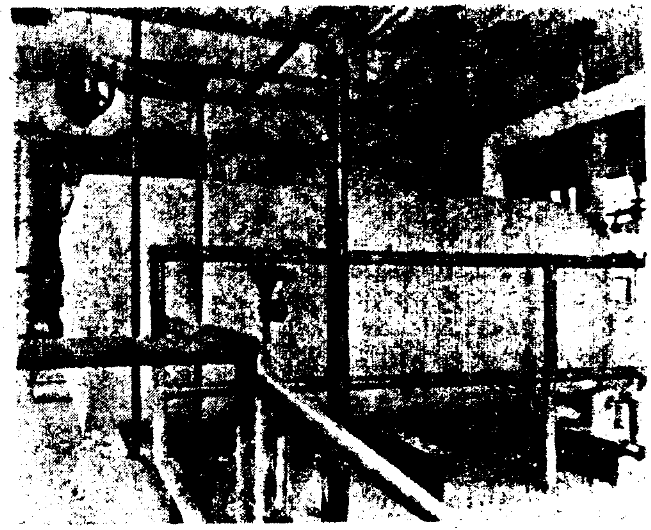


Fig. 3. This 2,000 gal cold water tank is used for well supply storage. It is insulated to prevent sweating, incoming water being considerably less than room temperature. Insulation is 1 in. mineral wool blocks, cement, and paint. Fig. 4—right. This 500 gal tank contains hot water at 180 F and is also insulated with 1 in. mineral wool blocks, covered with cement and paint

gal deaerated storage tank, and feed water heaters (Swartwout single element) are insulated.

Insulation Techniques

The entire distribution line, including all valves, pressure reducers and manifolds is insulated with 1 in. of formed, semi-rigid mineral wool pipe insulation. Application of this type of insulating material is very simple. The preformed pipe insulation is merely cemented and banded in place and covered with heavy canvas duck. The irregular surfaces of valves and manifolds are quickly fitted by notching and sawing the easily worked mineral wool to conform to each contour. The cemented insulation is banded on 12 in. centers with steel straps, covered with duck, banded again, where necessary, and the entire outer surface is painted with sealing compound over which any type of decorative and protective coating can be brushed or sprayed.

By applying the insulation in sections, maintenance and repairs which inevita-

Fig. 5. 12 in. diameter steam collector manifold and supply control valves are insulated with 1 in. mineral wool board insulation covered with 2 layers of canvas and a coating of paint

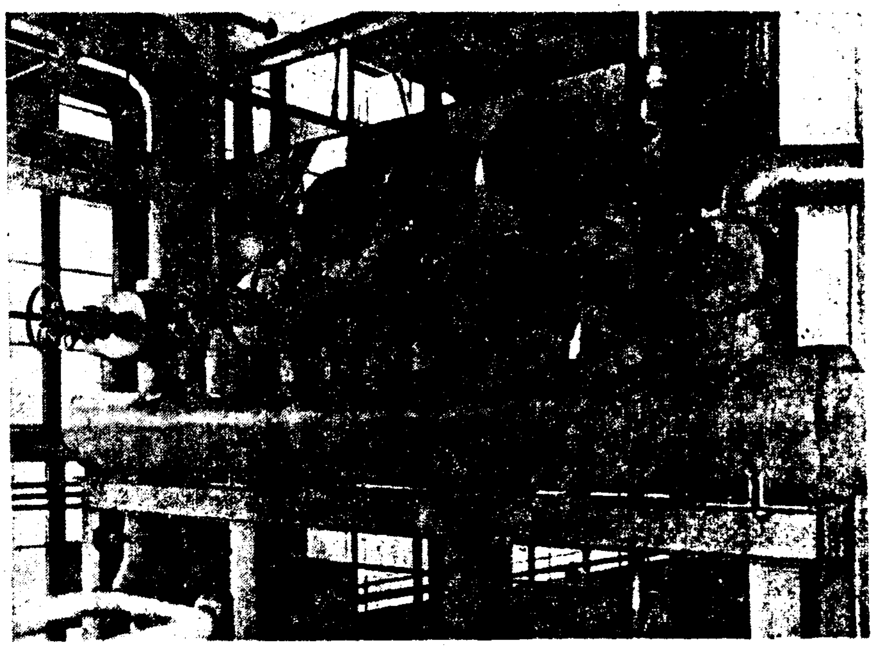
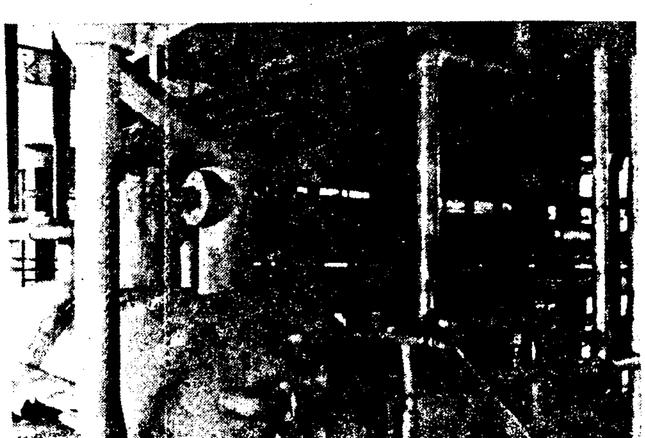
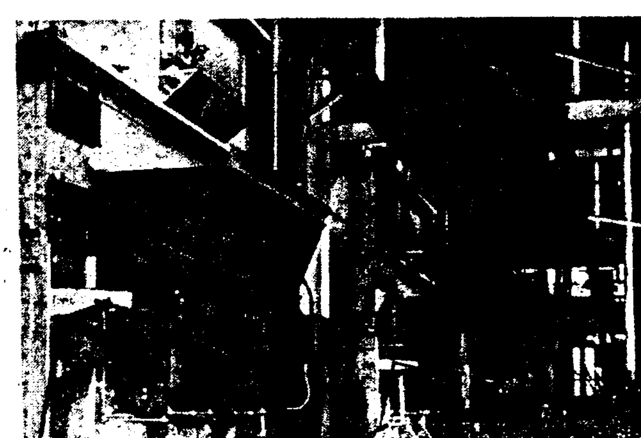


Fig. 6. Steam collection drum is insulated with 2 in. board insulation which is canvas covered, cement sealed, and painted. Steam is at 140 lb and 330 F. Mains are insulated with 1 in. formed pipe insulation and covered in the same manner as the drum insulation. Fig. 7—right. water at 180 F and is also insulated with 1 in. mineral wool blocks, covered with cement and paint





bly must be done on high pressure steam lines, are simplified. Removal of sections does not impair the insulating value of adjacent sections, and the high mechanical strength of mineral wool pipe insulation eliminated the wasteful powdering, sifting, settling and such defects frequently encountered in other rigid pipe insulation.

The deaerator is insulated with 1 in. semi-rigid mineral wool blocks, cemented and banded into place, covered with canvas and coated with two layers of sealing compound and two coats of paint. The deaerator water storage tank is similarly insulated to minimize heat loss in the supply system, as well as to reduce radiation into the work room. A cold water make up tank is also insulated with blocks to prevent sweating. All circulating and process pumps and lines are insulated with 1½ in. of formed mineral wool.

The insulation is so effective that not only is it true that no line is more than moderately warm, running, by test, under 95 F surface temperature, but heat loss is so slight that comfortable working conditions prevail even on the working platforms located between and above the three boilers. No perceptible temperature increase prevails between the floor and the balcony. The 32 foot ceiling clearance minimizes solar radiation through the roof.

The distribution lines are carried from the balcony level in the power building, directly over the rail spur into the ceiling level of the production floor. Strategically located pressure reducers provide steam at 35 or 40 psi pressure for heating and most process purposes. However, the 140 psi lines allow for the use of dry steam whenever it is needed, without the necessity for control equipment.

Condensate Collection

A centrally located condensate collecting system, operating in conjunction with a large heat exchanger unit, performs a multiple function. The heat exchanger is used to heat the hot water for office temperature control, and for wash water purposes. The decision to use hot water heating in the office building was based on the more readily controlled temperatures which result from the use of hot water, rather than steam. However, it also provided a means of recovering residual heat in end line steam, while at the same time controlling the operation of the condensate recovery tanks. Condensate is returned to the power building by pumps located near the heat exchanger system.

The feedwater for the boilers consists largely of returned condensate. Necessary makeup is added directly from the city mains into the deaerated water storage tank. Daily analyses are made by the plant chemist to insure the correct operation of the water treating system and prevent corrosive scale-forming conditions occurring in the internal water of the boilers.

A. D. Connelly, Plant Engineer for the Salisbury Axle Company and E. H. Roper of A. Bentley and Sons Co., Toledo, were jointly responsible for the exceptional layout which exists there. The performance of the equipment, in the brief time it has been in service, has been almost completely free of leaks or other defects. No indications of scale formation have occurred in the boilers. No insulation breakdown has occurred. No conditions of cracking, sagging, powdering or other mechanical failures in the insulation has been encountered. The continuing fine appearance of the system is partly attributable to the mechanical strength of the mineral wool insulation.

The Corliss Engine that was Bushed

Here is a sad tale of the Corliss engine that was kept away from civilization too long . . . Use of the indicator as a cure-all is deplored by the author . . . Pieces cut off each dashpot rod adjusting screw to give the steam valves as much lap as possible . . . After all was running smoothly the important adjustment measurements were punch marked on the engine

By WILLIAM S. WHITE

AWAY UP HERE in Alberta, west of the highway running north and south between the cities of Calgary and Edmonton, and about 65 miles southwest of Edmonton is a large section of country which is in the process of being logged off for the making of lumber. Clearing of land and farming has followed the sawmills. When one leaves the settled farming parts, he rapidly becomes what is called "bushed" and lost among the tall timber.

From these parts, a great many patients are sent to mental institutions, and it is a common expression if one displays any eccentricities, to say he has been "bushed." Perhaps, then, one should not be amazed at the lack of forethought displayed by those who manage and control sawmills, which from time to time are removed and carried further into the forest and bush as the trees are all cut down within reasonable range of the mill.

A sawmill which had been carried back into fresh timber about 65 miles from the nearest telephone, and 200 miles from the nearest machine shop, had acquired a 16 in. by 30 in. double eccentric Corliss, purchased very much second hand. Without having the engine examined or tested they had taken it to the new site, put in a foundation and set it up, along with a 125 hp HRT boiler, which, strange to say, was very well installed and bricked in and in full accordance with requirements of the Boilers Act of the Province. And as far as the foundation of the engine was concerned, a very good job had been made of that, too.

When the new boiler was eventually steamed up, an attempt was made to run the engine, and it was found that the steam pressure could not be held to run the engine alone to say nothing of doing any sawing. It appears that various persons attempted to set the valves on this engine, but with no success. It was then decided that what was needed was an indicator to really achieve something. So, as one of those old fashioned engineers who apparently was the only one in Alberta to have such an instrument, my services were enlisted, and I finally became bushed for seven days, away from any tools or equipment, except for a few small tools I took with me. I had been told, that it was only necessary to indicate and adjust the valves as a final setting.

Great faith seemed to have been built up in the indicator as a cure-all although it should have been obvious that as the engine had not been used for many years, and then left standing, it needed a complete overhaul.

After arriving at the mill we got steam up on the boiler and made an attempt to get some indicator diagrams. But with the strange behavior of the exhaust it was evident that the valve setting would have to be checked mechanically, as the cards that were taken were simply oblong squares. The dashpots worked very erratically. In checking the valve setting, it was found that the steam valves had very little lap with the dashpot closed, and exhaust valves were late. These were set too close at 2 in. from the end of the stroke. After the valve setting adjustments were made the engine was started up and immediately came up to speed until the governor stopped the valves from lifting together. The engine continued to increase in speed, and it was necessary to throttle her to where the hooks would occasionally lift the valves slightly. The cards taken by the indicator showed that steam was leaking badly through the steam valves, and in effect the opening and closing of the exhaust valves kept the engine running without the steam valves opening at all. It was decided to give the steam valves as much lap as reasonably possible when in the closed position.