PLIBRICO ENGINEERING *and* INSTALLATION DATA

Issued by Plibrico Jointless Firebrick Co., Chicago, Ill.

May 9, 1946

BULLETIN NO. 109

THE RELATION BETWEEN BOILER PRESSURE AND FURNACE MAINTENANCE

In connection with our work on boiler furnaces we very often hear the statement "my boiler is operating only at low pressure and so there is not enough heat in the furnace to require a refractory material like Plibrico. If I had a high pressure boiler the picture would be different as then I would no doubt need to use your material because of the more severe service." This statement is entirely wrong and is no doubt caused by a misunderstanding of just what pressure means in relation to heat required to do the job.

In order that we may all better understand just what takes place in the generation of both high and low pressure steam, the following analysis is given:

First let us consider a 150 hp. boiler, operating at normal rating, generating steam at 150 lbs. gage pressure with feed temperature at 200 deg. F.

Considering our atmospheric pressure at an easy figure of 15 lbs. and a boiler horsepower as being 34.5 pounds of steam, this boiler operating at normal rating will be generating 150 x 34.5 = 5175 lbs. of steam per hour. The heat input to the steam then becomes:

Total heat of steam at 150 lbs. gage pressure	=	1195. B.t.u.
Heat in the feed water at 200 deg. F.	=	167.94 B.t.u.
Total heat that must be supplied per pound of steam	=	1027.06 B.t.u.

1027.06 B.t.u. x 5175 lbs. steam generated = 5,315,035 B.t.u. per hour required.

If the unit is operating at say 65% overall efficiency, then we must burn enough fuel in the furnace to generate at least 8,176,970 B.t.u. of heat, which is the equivalent of about 682 pounds of 12000 B.t.u. coal.

Now let us take the same boiler, with the feed water still at 200 deg. F, and reduce the gage pressure to 5 lbs. Let us then study just what takes place to produce the same amount of steam at this reduced pressure.

We will still be evaporating 5175 lbs. of steam per hour but simply at lower pressure which, according to our general misunderstanding, should require much less heat if the service in our furnace is to be less severe than when the boiler was operating at 150 lbs. gage pressure. Let's look at the actual situation under the new low pressure condition.

Total heat of steam at 5 lbs. gage pressure	=	1156.20 B.t.u.
Heat in feed water at 200 deg. F.	=	167.94 B.t.u.
Total heat that must be supplied per pound of steam	=	988.26 B.t.u.

988.26 B.t.u. x 5175 lbs. steam generated - 5,114,245 B.t.u. per hour required.

If the unit is operating at the same overall efficiency of 65%, we must then burn enough fuel in the furnace to generate at least 7,868,070 B.t.u. of heat, which is the equivalent of about 656 pounds of 12000 B.t.u. coal.

Now comparing the high pressure operation with the low pressure operation, we find it requires only 26 lbs. of coal more per hour to produce the same amount of steam at 150 lbs. gage pressure than it does to produce it at 5 lbs. gage pressure.

This we find is only 4% more fuel and consequently it should follow that we have only 4% more heat in the high pressure boiler furnace than in the low pressure boiler furnace, which means that both furnaces are subject to just about the same service.

A complete understanding of the above analysis should dispel forever this misunderstanding of the relation existing between boiler pressure and furnace maintenance if both the high and low pressure boilers are generating the same amount of steam.