REDUCING STACK LOSSES

During the present period of high fuel costs and inflation the oil heat industry must provide two services--a conscientious, well trained service department and extensive knowledge of energy saving systems and equipment. We can no longer believe what we hear when it comes to the best and most efficient way to do something. We must question and be certain we have the fundamental knowledge of our trade. So we will know in our own mind we are doing the right thing.

There are thousands of devices on the market today which claim to save energy. There is no doubt in my mind that every one of them will accomplish their goal. However, not every device is suitable for every job. We must be able to distinguish which item will provide the most energy savings for which customers.

Last month we examined the trend of filling in the fire box. I cited an example where we had a total of .9% efficiency loss through the brick work on a typical fire box. This month I was going to further examine the heat loss through radiation of a boiler by going into greater detail. Upon investigating further I found if would be of no value to go into this detail, as 1% is a commonly used radiation loss.

In the report "Measuring and Improving Boiler Efficiency" presented by Herbert M. Eckerlin and Albert S. Boyers, Mechanical and Aerospace Engineering, North Carolina State University they report as follows:

> The heat loss from a boiler due to radiation cannot be measured exactly, but it can be estimated with sufficient accuracy so as not to introduce a serious error in the heat balance. The actual heat loss is almost constant (it does not vary with the load) and the percent loss thus varies inversely with the load. Well insulated boilers operating at design capacities usually have a radiation loss of about 1% associated with them.

The 1% radiation loss is the total loss from radiation, fire box as well as the boiler itself.

As I illustrated last month by trying to save 1% or less of our Btu loss, we may greatly lower our combustion efficiency as well as put undue strain on the boiler itself.

The area I believe we should investigate is stack temperature. Emphasis is put on stack loss by engineers. I do not believe, however, we are practicing what they are preaching. I cannot count the number of boilers we see every year without draft control. We discussed this in an earlier article. We must aim for as low a stack temperature as soon as possible, without lowering our combustion efficiency. Simply underfiring a unit is not the answer.

We do not have to get involved in a modulating damper control on small installations, but there should be at least a barometric damper installed. As draft increases, we speed up the rate at which the gases flow through the boiler. This in turn shortens the amount of time the heat has to transfer into our water. If we slow down the flow of gases through the boiler we will give more time for the heat to transfer into the water. If we over do it, however, and hold too much heat in the boiler, we may cause damage to the boiler itself.

We must be particularly careful with four pass boilers. If our boiler is fired properly and our stack temperature is around 300°F, draft is not a problem. We cannot lower our stack too much or we will cause condensate to form in the breeching and stack, corroding the metal. When we are running a 450°F stack temperature or higher, draft control is a necessity.

There are other things we may do to help our heat transfer in the boiler, thus lowering our stack temperature.

Soot

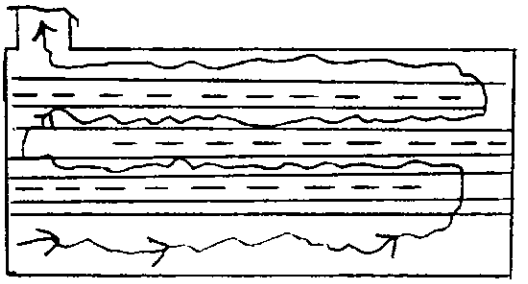
Our first step naturally is to be certain our boiler is clean. Our burner must be adjusted so as not to cause rapid soot build up on the heat transferring surfaces of our boiler. A 1/32" deposit of soot will raise our stack temperature 80°F. A common estimation of 1/8" of soot will drop the thermal efficiency of a unit by 25%. A regular cleaning schedule should be set up to avoid this enormous loss in valuable Btu's.

Baffles

A baffle is a plate or wall for deflecting gases or liquids. In this case it is used to deflect gases.

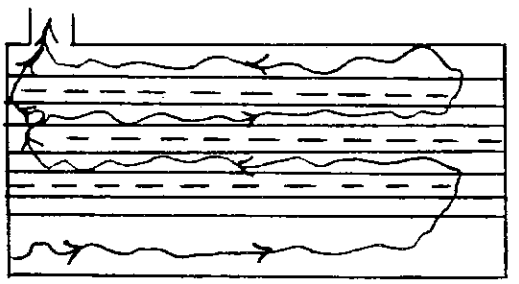
In water tube boilers baffle tiles are laid on the tubes in such a manner as to assure the gases make a complete and even pass through the boiler (Figure 1). The number of layers of baffle tile will determine the number of passes we will make through the boiler before exiting.

Figure #1.



Check to be certain the baffles are in good condition. All broken or cracked tiles should be replaced as they may cause short cycling (Figure 2). The gases will take the path of least resistance, which will be the shorter route to the stack. This will greatly raise your stack temperature.

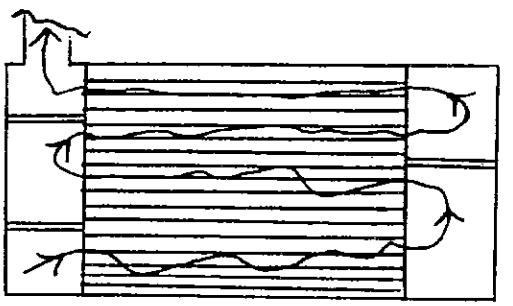
Figure #2.



A fire tube boiler will also have baffles except they will only be found in the front and rear of the boiler, in the form of a shelf (Figure 3). These shelves must seal tightly when the doors are closed. Any space or crack will cause short cycling as in a water tube boiler.

Gases
Tubes
Tiles
Baffels

Figure #3.



Retarders

Retarders are manufactured in many sizes and shapes. Many times in cast iron boilers there will be "I" shaped retarders placed in the blue passages.

Retarders work wonderfully on two and three pass scotch marine fire tube boilers. They accomplish two functions. First they slow down the flow of the hot gases through the boiler, giving more time for the heat to transfer into the water. Secondly, they shape the course of the gases through the tubes.

There are two basic types of retarders used today--spinners and turbulators. A spinner is no more than a piece of flat metal twisted to take the form of a spiral. The spinners are placed in each tube and spin the gases through the tube. The only problem with this is the heavier gases spin to the outside of the tube where the heat transfer takes place. The heavier gases are the cooler ones. If you look close when you remove a spinner, you can see a line down the center of the spinner. This line is caused by the hotter gases.

The second type of retarder is a turbulator. Instead of twisting the metal it is bent several times taking a zig zag effect. This bounces the hot gases off the wall of the tubes thus getting all of the gases in contact with the heat transferring surface.

Incredible results, regarding stack temperature, may be obtained with the installation of retarders of any type. We must remember again that if our stack temperature is below 300°F, we should not concern ourselves with any of these items.

Another very important factor is our over-the-fire draft. If our burner is already firing against our maximum over-the-fire pressure, we should not further restrict our exit gases so as to increase our over-the-fire draft above the burners limits. If we do, we will suffer a loss in combustion efficiency not to mention the problems in shaping our flame--impingement, etc.

Many factors should be taken into consideration before we install any piece of equipment. Whatever we decide on as energy saving devices we must start at the beginning, the boiler.

Correct water level & pressure

Our next concern will be with the feed water valve. Are we feeding unnecessary cold city water into the boiler system? If so, why? Usually it is because of leaks in the system. Remember, if we feed 60°F water into the system, we will have to heat it to our operating temperature.

Be certain the boiler is not flooding. We get the same effect when we try to get a tea kettle to boil that is too full of water. It will take longer to get a head of steam.

How is the condensate pump operating? It should be controlled by a float on the boiler. It should never be controlled by a float in the condensate tank itself. We want to maintain the water level in the boiler, not the tank. In order to do this we must have the controller on the boiler itself.

The following is inevitable if we try and control the pumps with a float in the condensate tank. If we light off with the proper boiler water level, it will drop considerably before our condensate has a chance to go through the entire system and return to the condensate tank, starting our pumps. During this period we will be feeding city make up water, having to heat it up to our operating temperature. Also our burner may shut off on low water many times before our system is equalized causing more of a loss in efficiency.

Once our system become "equalized", meaning we have as much condensate returning as we do steam leaving the boiler, we should operate fine. However, if we shut the boiler down for any reason our condensate will continue to return and be pumped into the boiler. Our burner is off so we are not making steam, or using water. Consequently, we will flood the boiler. If we do not drain the boiler to the proper level, we will have the over-filled teakettle effect. If we do drain the boiler to the proper level before starting it up, we will feed city water until our system is again equalized. Either way we will be unnecessarily wasting valuable Btu's.

The condensate tank float system is an old system but with the cost of fuel today, it should be converted to the boiler float system. The problem is that with the condensate tank float system we usually have a small receiving tank. It may have to be enlarged to hold enough water to keep our boiler running until we get the system equalized. On the

other side it must have enough space to hold the excess condensate when the boiler shuts down, no longer requiring more water.

A feed water float should also be installed in the condensate tank to prevent the tank from running dry, possibly damaging our pumps. Here again we must be careful of excess feeding of city water.

Remember, any water which leaves the system whether it is from excessive blow down, leaking valves, etc. will have to be replaced with cold city water. Therefore, if a valve is leaking it should be repacked. Small preventive maintenance measures may save large losses in Btu's.

Water Treatment

Water should be chemically treated and should be checked periodically. As soot insulates the tubes so does the scale inside the boiler. Be certain boiler blow down is regularly scheduled and your boiler water is being treated properly.

Energy efficiency does not consist of just one "super duper" item. It is a series of items and programs all tied together into an Energy Efficient System. Start with the burner/boiler and then progress to more elaborate ways of saving energy. Do not, for example, install a night setback device on a boiler which is dirty, running a 700°F stack temperature and a 75% combustion efficiency, with no dampers. Naturally, you will save fuel, as we do any time we shut off the heat, but you are putting the cart before the horse. Sell total energy efficient systems with knowledgeable service personnel. Our competition does not have that to offer.