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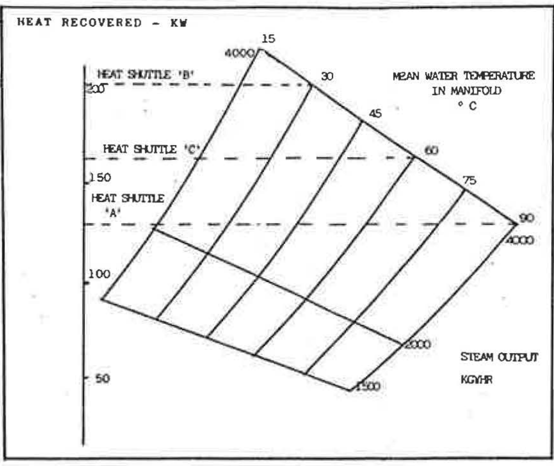
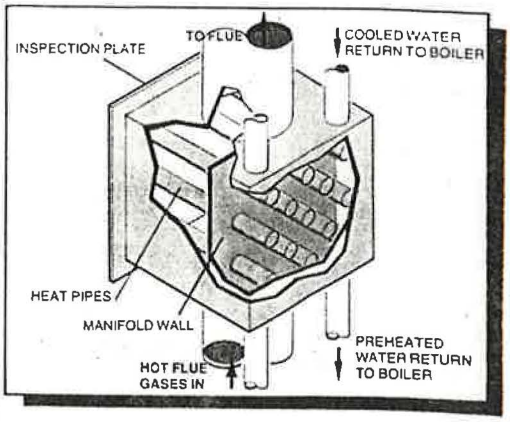
Far right: diagram showing how a heat pipe recovery unit is fitted in the flue. Right: graph indicating the variation in recovered heat relative to the manifold temperature. Case 'A' corresponds to a situation where there is 100 per cent ondensate return with the unit installed on the pressure side of the feed pump. Case 'B' refers to a situation where there is a total loss of steam and no condensate return. A low pressure unit with a manifold temperature of 30°C can recover nearly 200 kW. With heat shuttle 'C' there is partial condensate return.





More than pipe dreams

After years of failure, is heat recovery finally about to become accepted in the UK market? *Hugh Scurrah puts the case for heat pipe economisers

Heat recovery schemes of any form can have tremendous financial and environmental benefits, why are they so often shelved?

Part of the reason for lack of "take off" is the way in which financial directors look upon energy consumption as a fixed overhead rather than a floating liability.

For example, most companies would be overjoyed if their production was generating a 20 per cent return of capital. Yet, when you talk to them about energy conservation with anything over a two year payback (representing a 50 per cent return on capital) it is rejected as being uneconomic. No wonder that the biggest inroads in the economiser market have been with health authorities, which take a four year payback (or 25 per cent return on capital) as a maximum.

This article shows how the normal method of application for economisers inhibits their efficiency and hence reduces sales. By looking at the graph it's clear that placement of the economiser after the pressure pump means it recovers less heat that it should. Getting the most out of heat recovery equipment is an essential part of expanding the market.

If you think of a boiler as a cross flow heat exchanger with well mixed heating fluid at uniform temperature, it follows that however efficient the heat exchange surfaces may be the products of combustion can never be cooled below the maximum temperature of the fluid. In practice the exit gases with a temperature of 50°C at full load are typical.

The consequence of this is that the practice of installing economisers between the pressure pump and the boiler limits the available additional heat transfer.

Modern economisers consist of an array of finned tubes connected by headers at each end to effect flow and return of the water extracting heat from the flue gases. They can be very effective with clean fuels but do not lend themselves to cleaning, and are easily fouled up between fins.

Corrosion of the surfaces of the heat exchanger is usually attributed to the temperature on these surfaces. If the flue gases are at all corrosive, as with heavy oil, the cooling water in direct contact with the heat exchanger reduces the flue product temperature to condense out acids. These are normally built into a bypass system so on firing with fuel other than gas, the flue products are bypassed to waste in order that the heat exchanger surfaces do not become fouled.

There is a need for an economiser that can:

- Be used with all fuels, eliminates the need for bypass.
- Can be easily cleaned.
- By keeping the surface temperature high, eliminates cold surface, reducing or eliminating corrosion.
- With less corrosion, copper with superior thermal characteristics can be used resulting in a smaller heat exchanger, reduced in weight and cost.

A heat recovery unit using heat pipes to extract the heat from the boiler flue products can be designed to have all the advantages itemised above.

Heat pipes are evacuated, hermetically sealed tubes containing a volatile working fluid contained within a wick. When heat is applied to one end of the heat pipe the working fluid is evaporated taking in latent heat of vaporisation and travels to the other, colder end of the pipe where it condenses back into the wick giving out the latent heat of vaporisation. The condensed liquid then returns to the source of the heat by capillary action through the wick.

When applied to the flues of boilers the heat pipes act as super heat conducting rods, part exposed to the flue products and part exposed to cooling water to take away the recovered heat. Whereas a normal economiser requires two manifolds to effect the flow and return of the cooling water, a heat pipe economiser or heat recovery unit requires a single manifold. The heat pipe by necessity is at a higher temperature than the cooling water, so much so that condensation on the heat exchange surfaces is reduced.

Because the heat pipes in a heat recovery unit are not finned but plain it becomes even easier to effect cleaning. There is no problem firing on oil, residual fuel oil or even coal.

In analysing the merits of use of an economiser the nature of steam generation and its uses should be inspected. Often in total condensate loss situations the feed water can be injected with process steam to eliminate dissolved oxygen, prior to the feed pump, economiser (if fitted) and boiler. This is an application, when an economiser used in low pressure environment can be used to eliminate (or at least reduce considerably) the steam injection requirement.

The unit does not have to be manufactured to pressure vessel codes nor be subjected to regular insurance inspections. It also effectively provides more efficient heat transfer because the feed water is initially cooler.

It is much cheaper to manufacture. These remarks hold equally well if a separate tank of process water is heated by a low pressure economiser.

Case histories give an insight into the merits of heat recovery and its costs: in the region of £40 to £100 per kW recovered, compared with wood, coal and nuclear power generation £500, £1000 and £1500/kW respectively.

Our biggest problem in selling heat recovery equipment is the education of potential clients' personnel. They must start thinking in an unblinkered way.

However, now that Babcock Robery, Beel Industrial Boilers and NEI Shell Boiler division are all recommending the equipment we have more credibility.

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