How to implement industrial heat recovery equipment

High temperature processes like melting, baking or drying tend to result in a large amount of heat loss. As much as 70% can disappear in exhaust and flue gases. But, you can capture and re-use this wasted energy with a heat recovery system.

The business case

Every situation is different but, as a rough guide, you could expect to recoup the cost of installing heat recovery in two to five years, especially if your plant operates continuously.

Many heat recovery equipment suppliers will work out the costs and savings for you. Their estimates should be based on accurate details of:

- operating hours.
- flue gas and heat recipient temperatures.
- fuel prices, including Climate Change Levy.

You should ask the supplier for references from similar installations to check the scale of savings and likely payback period. In some cases, you could get help from the Carbon Trust to develop your business case.

The technology

High temperature heat recovery equipment is usually based on either:

- recuperation – using a heat exchanger.
- regeneration – using a high thermal mass matrix that's successively heated and cooled.

Regenerators can generally operate at higher temperatures and are more efficient than recuperators, but are much more expensive to install and are far bulkier.

The following tables summarise some of the types of recuperators and regenerators.

Figure 1 *Regenerative burner*

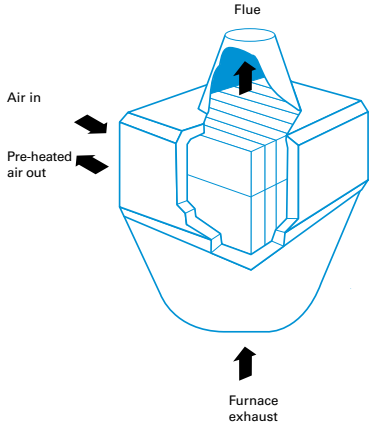

Figure 2 *Ceramic recuperator*

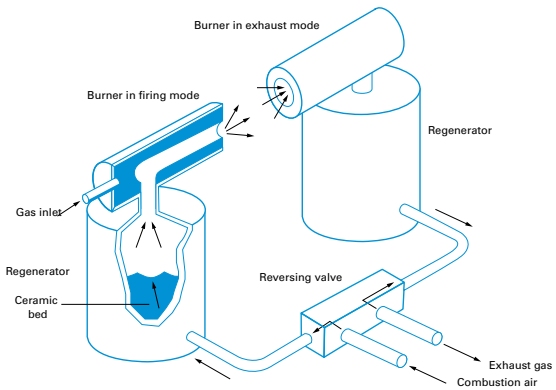

Table 1 Recuperators

Type	Operating temperature (°C)	Efficiency	Resistance to fouling
Plate	800°C	40-60%	Poor
Shell and tube	550°C	70-90%	Moderate
Convection	1,200°C	30-50%	Moderate
Radiation	1,400°C	10-20%	Good

Table 2 Regenerators

Type	Operating temperature (°C)	Efficiency	Resistance to fouling
Static	1,000-1,500°C	70-90%	Good
Rotary	1,000-1,700°C	70-90%	Poor
Compact	1,000-1,500°C	70-90%	Moderate
Burner	700-1,500°C	60-80%	Poor

Applications

Deciding on a heat recovery system is a complicated matter, and you'll need specialist advice from equipment suppliers.

Using waste heat saves energy, but to feel the benefits you need effective maintenance to optimise your combustion and heat transfer efficiency. You also need to take a look at your working practices to ensure your plant is being used to the full and there aren't wasteful idling times.

Basically, though, there are some fundamental criteria for whether you could benefit from a system. The most important are that your plant needs to be working long hours, and that you can match the heat source to a potential use for that heat.

This matching should include:

- the quantities of heat available and needed.
- the temperatures of the heat source and recipient.
- the times when heat is available and required.
- close proximity of the source and recipient.

One of the most common ways to use the heat recovered from high temperature processes is for pre-heating the combustion air supplied to the process itself. It's a sure way of ensuring the heat source and recipient are always precisely matched. This has led to the development of the self-recuperative burner, which combines burner and recuperator in one compact package.

Figure 3 Self-recuperative burner

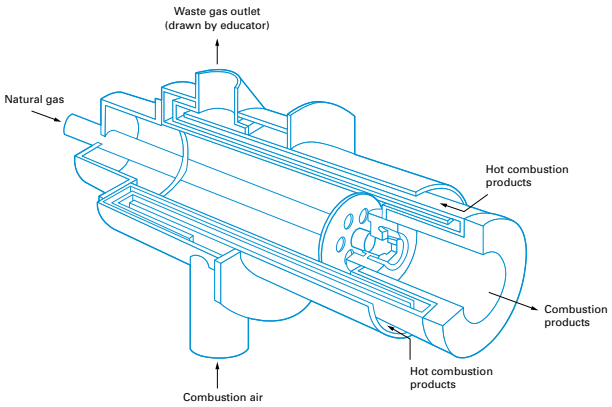

Table 3 Specification checklist

Considerations	Comments
Hot gas	Quantity, temperature, pressure and composition (including contamination).
Hot gas duct size	
Heat recipient characteristics	Timing, quantity and temperature.
Maximum permissible pressure drop	Measured in pascals for the plant to which the heat recovery equipment is being fitted. Ideally, consult the original supplier or manufacturer. If that's not possible, the supplier of the heat recovery equipment should be able to carry out the calculations.
Access	For installation and maintenance.
Provision of bypass	To facilitate maintenance without plant shutdown.
Control requirements	To prevent overheating of heat recipient, for example.
Heat exchanger design and materials	Taking into account operating temperature and the presence of contaminants.
Impact on process plant	Any modifications to accommodate heat recovery.

Specification checklist

The table above outlines the main points to discuss with your supplier when considering industrial heat recovery equipment.

Commissioning procedure

Designing, installing and commissioning high temperature heat recovery equipment is a specialised job that needs to involve the supplier.

Commissioning should include:

- confirming the recovery efficiency of the device.
- confirming all control systems work.
- checking that the performance of the heat source and heat recipient plant hasn't been affected.
- providing operating and maintenance documents.

Common problems

The most common problems with high temperature heat recovery equipment are:

- the effect of the pressure drop on the process from which heat is being recovered.
- the impact of the recovered heat on the recipient plant, for example:
- control systems need modifying.
- burners can't be turned down enough to match the new, reduced loads.
- increased NOx emissions when combustion air is pre-heated.
- longer term fouling or corrosion of the heat recovery device by contaminants from the hot gas stream.

Careful design, choosing the right materials and effective maintenance should help you avoid these problems. In some cases, though, these constraints make heat recovery unfeasible.

Finding a supplier

Some types of high temperature heat recovery equipment come under the Government's Enhanced Capital Allowances scheme. You can see a list of ECA approved equipment at www.eca.gov.uk

You need to choose a supplier and installer with direct experience of your process, so that they are already aware of any potential pitfalls.

Talk to your high temperature equipment manufacturers. They may be able to suggest a supplier. If not, contact a trade organisation.