9 As hydrocarbon fuels become scarcer, and the cost of extraction from the earth increases, it is essential that all of us become efficient energy managers. In most factories, offices, apartment blocks and homes, energy is wasted, usually in the form of hot fluids. Heat recovery is not a new technology, but it is a technology which needs wider application with particular emphasis on smaller units.

There are various types of small scale recuperators in which the fluids exchanging heat are separated by a dividing wall. Some examples are parallel flow, counter flow, cross flow, multipass, mixed flow and extended surface.

Explain the basic operating principles of recuperators and indicate which is most advantageous for small scale application.

A recupurator is a heat exchanger that removes heat from a waste fluid and adds it to another fluid where it will be useful.

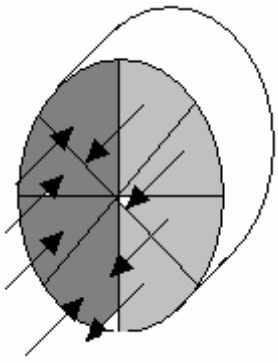
On large boiler plant they are used to remove heat from flue gas and add it to the air supplied for combustion. This could be applied to central heating boilers or boilers supplying process heat. The capital cost is high and hard to recover through the economy made.

Factories with a large amount of waste heat may find it economical to recover heat. Waste steam is relative easy to recover by condensing it and recycling it using it for space heating

Hot waste air and other gasses are more difficult to recover and recuperators are often better than other forms of heat exchangers for this purpose.

In domestic and office situations they are more likely to be used to remove heat from stale air being removed from the building (e.g. from kitchens venting the fumes from cooking) and added to the fresh air being drawn into the building hence saving on cost of heating the building.

The regenerative type is a rotating drum with half in the path of one fluid and half in the path of another. The hot fluid passes through a heat absorbent material in a drum. The drum rotates and the heated material rotates into the path of the cool fluid and warms it up.



Others work by conduction of heat from the warm fluid to the cool through metal plates with the maximum exposed surface area possible.

Heat pipes contain a fluid that transports heat from one fluid to the other and makes use of the latent heat of the fluid to transport large quantities of heat. These are very effective.

THE FOLLOWING IS TYPICAL OF INFORMATION THAT CAN BE FOUND ON THE INTERNET BY SIMPLY SEARCHING FOR RECUPERATORS.

Heat Recuperators

It is also possible to use the recuperated heat to heat water for cleaning purposes or air for heating rooms. In the following only preheating of the drying air is discussed.

In principle, there are two different recuperating systems:

- Air-to-Air
- Air-Liquid-Air

Air-to-Air Heat Recuperator

In the heat recuperator type air-to-air, see Fig. 98, the drying air is preheated by means of the outgoing air passing counter-currently over the heat surface of the recuperator. This surface is formed as a number of tubes, inside of which the outgoing warm air is passing while the cold air is passing on the outside.

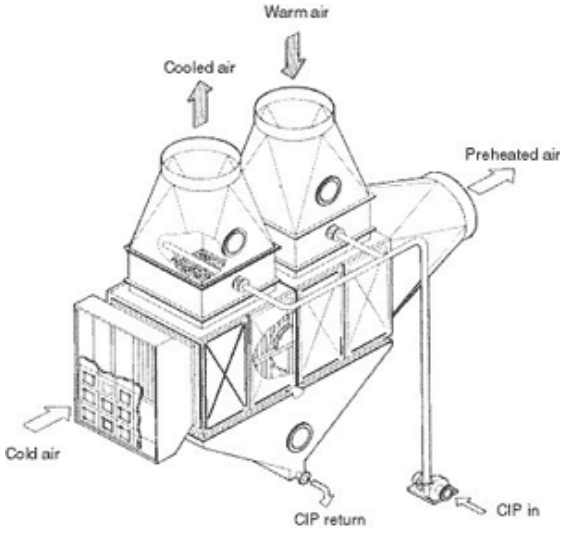


Fig. 98 Heat recuperator type air-to-air

The incorporation of this equipment in an existing plant may prove difficult and ex-pensive, as it may require large and long air ducts from which part of the recuperated energy is lost due to radiation, if the ducts are not insulated. In new installations it is easier to incorporate this type of heat recuperator, as the arrangement can be optimized with short air ducts. See Fig. 99.

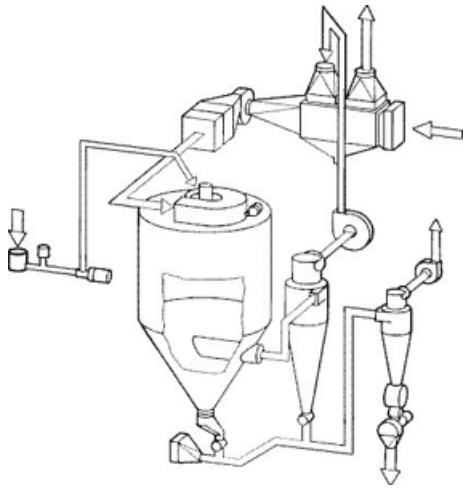


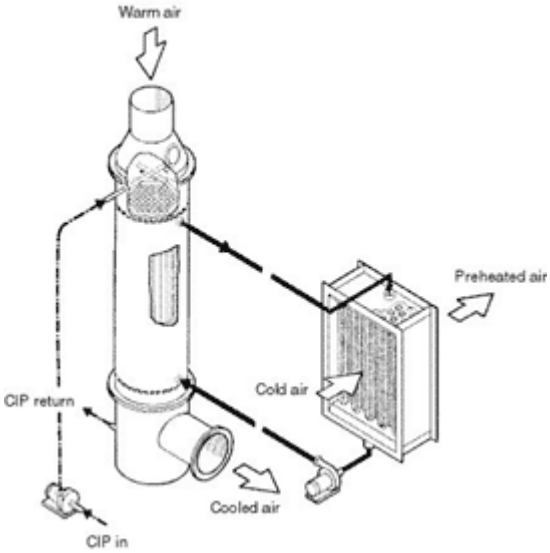
Fig. 99 One-stage spray dryer with hear recuperator type air-to-air

The temperature to which the air can be preheated depends upon the temperature of the outgoing air. Therefore, this type of heat recuperator is most beneficial in combination with a one-stage spray dryer where the temperature of the outgoing air is high. The figures mentioned below are based upon a one-stage plant as mentioned in the table on page 139.

Ambient	air	preheated	from	10ºC	to	52ºC
Outgoing	air	cooled	from	93ºC	to	51ºC:

Air-Liquid-Air Heat Recuperator

Another system, more flexible regarding the installation, is the air-liquid-air heat re-cuperator, see Fig. 100. This system is divided in two heat exchangers, in between which a heat transfer liquid is circulated, for example water. See Fig. 100a. If, due to low air temperatures during winter, it may be expected that the temperature of the water gets below zero, an anti-freeze agent is added to the water. As the heat transfer co-efficient is higher for air-liquid than for air-air, this system is more efficient than the air-to-air heat recuperator despite the fact that two heat surfaces are needed.



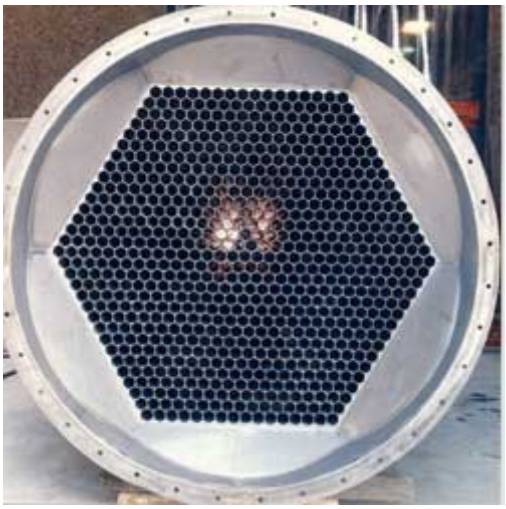


Fig. 100 Heat recuperator type air-liquid-air

The heat transfer surface placed in the outgoing air is formed as a bundle of tubes inside which the dust-loaded air is passed. On the outside of the tubes the water streams counter-currently. The heat transfer surface placed in the inlet air is a normal finned tube heat exchanger. Water is recycled by means of a centrifugal pump.

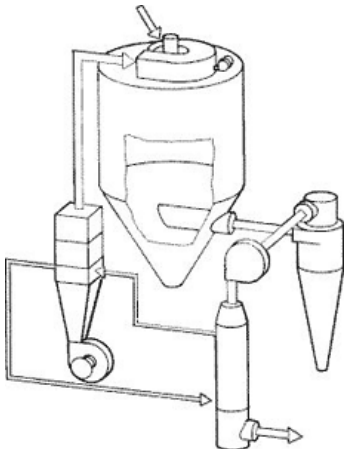


Fig. 100a One-stage spray dryer with heat recuperator type air-liquid-air

If indirect oil- or gas-fired air heaters are used, the heat transfer liquid can - after the passage through the exhaust air heat exchanger - be passed through a heat exchanger placed in the combustion air duct, whereby even further savings can be achieved.

Tubular Heat Recuperators

Exothermics Tubular Heat Recuperators (THR) are air-to-air heat recovery units that effectively reclaim heat from catalytic incinerators, furnaces, thermal oxidizers and many other high temperature process and environmental applications.

But that's just the beginning. They also help you lower energy costs, easily and effectively control process air temperatures and reclaim a fast return on investment.

No other company manufactures a more effective Tubular Heat Recuperator than Exothermics. Our units are installed in hundreds of sites around the world, and we are quickly becoming the preferred choice for high temperature heat recovery equipment. Here's why:

Our Tubular Heat Recuperators are accepted and endorsed worldwide because they simply perform better. Features include:

Boundary Layer Breakdown

Exothermics Tubular Heat Recuperators have a proprietary tubular core design in which the placement of the heat recovery tubes assures a breakdown of air boundary layers in and around the tubes. The design creates a turbulent movement of the hot gas and process airstreams, resulting in more efficient heat transfer and optimum heat recovery.

Multi-Pass Designs

Crossflow and multiple pass designs are available. Multiple pass designs are used when the application requires greater effectiveness. Units can be manufactured so that the multiple passes are on the shell side, where the gas stream passes over the tubes several times before exiting the recuperator. Other applications may require a multiple tube pass design.

Insulation

Various options are available. Our Tubular Heat Recuperators can be ordered without insulation or with external insulation when a hot flange connection is required. Where cold flange connections are involved, the unit is designed with internal ceramic fiber insulation.

Rugged Construction

Exothermics Tubular Heat Recuperators are all welded assemblies constructed from stainless steel or other high temperature alloys. Each unit is custom engineered, then carefully fabricated and quality tested by certified welders and experienced craftsmen. Where required, a mechanism for accommodating thermal expansion is provided. And because our tubular heat recuperators are of all welded construction, internal cross contamination is virtually eliminated.