

Heat Recovery – How it works?

General considerations for installing a heat recovery system

As energy prices keep rising consumers are increasingly interested in using energy as efficiently as possible. In bakeries are a lot of opportunities in this area. Baking ovens produce considerable amounts of waste heat and large amounts of the waste heat of the burner's flue gas and the ovens baking vapour can be recovered. This recovered waste heat can be used to save energy in other areas, e.g. heating the building or service water.

Systematic Approach

When planning a heat recovery system there are a number of questions that need to be answered. The most important decisions must be made by the baker himself and therefore he or she needs to have at least a basic understanding of the process.

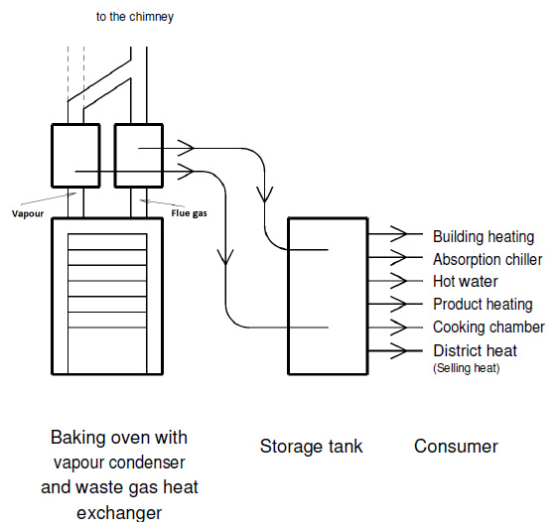
How to use the recovered waste heat?

The recovered heat may be used in the company or external, e.g. in an adjacent residential building.

Specific ways to use recovered waste heat

- Service water heating: for making doughs, dish washers, crate washers, showers and washing facilities, for cleaning, company apartments and private homes, etc.
- Heating buildings: via radiators, floor heating, panel heating or air heaters, e.g. for delivery halls
- Heating cooking chambers: electric heating can be replaced with hot water heating
- Further uses: swimming pools, greenhouses, community use

For all intended applications it is always necessary to have at least an estimate of the energy requirements.



The principle of heat recovery in bakeries

Estimating the Energy Requirements

In older buildings, the heating requirements of the building can be estimated by looking at the size of the effective area and the year of construction (as a reference point for the quality of the thermal insulation). New buildings are insulated in accordance with the Heat Insulation Ordinance (WSVO '95). The calculation of the heating requirements is laid out in DIN 4701 and is the responsibility of the architect or the planning office.

Which sources should be considered for heat recovery?

The heat requirements have to be calculated before deciding reasonably which heat sources to use. Possible heat sources are directly fired baking ovens as well as ovens that are fired indirectly with thermal oil including the corresponding boilers. Precious heat is contained in flue gases and, in particularly high quantities, in baking vapour. The most efficient way to recover this heat is to use separate heat exchangers for flue gases and baking vapour. The baking vapour of electric ovens can also be used for heat recovery. Whether each heat source needs an individual heat exchanger or one heat exchanger can be used for several heat sources depends on their setup, the position of the chimneys, the operating times as well as the special conditions.

At this point it is also necessary to consider which heat exchangers are suitable. Heat exchangers for baking ovens must be of course made of stainless steel; heat exchangers for baking vapour, so-called vapour condensers, must also be made of the high-alloy material 1.4571.

A detailed description of the supply on the market and the relevant differences in this supply would go beyond the scope of this article and has to be looked into another time.

The waste heat of a bakery's cooling units can also contribute considerably to the heat supply if the cooling units are equipped with water-cooled liquefiers. If the cooling units are exclusively cooled with air, it is not efficient to use the waste heat that is dissipated into the ambient air.

How is the heat stored?

If the first two questions are clarified it is time to think about heat storage. Usually the recovered heat cannot be used directly. Therefore it is often necessary to store the heat. Water is usually used as a storage medium due to its low cost and high storage capacity. Latent heat storage systems are expensive in comparison. The service water used in the production plant is only suitable to store small amounts of the heat. The main part of the recovered heat may be stored temporarily in storage tanks until it is needed. They are simple steel containers which only have to withstand the pressure in the heating system of at most 2.5 bar. A service water storage is exposed to the higher pressure in the water system and also has to be protected against corrosion. Therefore, a service water storage of the same total size is considerably more expensive than a storage tank. Furthermore, large amounts of service water should not be stored over a long period of time due to the risk of legionella.

Dimensioning of the Heat Storage

The dimensioning of the storage tank depends on several factors: The most important factors are the available heat, the demand for hot water and the heat for the heating system as well as the temporal distribution. Once you have determined the optimal storage size it is time to look for a suitable location, which is mostly a difficult effort. First the storage should be close to the ovens or the thermal oil boiler, but every square meter is precious in a bakery. Also a storage tank does not fit into any corner of the building due to the required height. A storage tank has to be at least twice as high as it is wide to ensure the necessary temperature layering inside the storage tank.

If there is no space inside the building, the storage tank(s) can also be installed outside. In this case the storage has to be insulated very well and should be covered with a casing, preferably made from stainless steel.

What type of chimney is suitable for installing a heat recovery system?

The flue gases cool down significantly inside the heat exchangers. Therefore chimneys made from shaped stone or brickwork are not suitable. They would become clogged with soot very quickly due to condensation. Chimneys made from stainless steel (material 1.4571) and glazed ceramic tubes are condensate-resistant. If the temperatures are permanently low, type-tested pipes made from plastic may also be used. In this case please follow DIN 4705 Part 1.

It is also possible to insert stainless-steel pipes from above into existing chimneys made from shaped stone or brickwork. After such a restoration, the chimney can also be used for flue gases with low temperatures. Furthermore, the chimney has to create a sufficient draught to make sure that the ovens supply baked goods of the desired quality.

In addition to the draught required for the oven, the pressure loss of the flue gases inside the heat exchanger has to be considered. One indication for a sufficient chimney draught can be found in the certificate from the chimney sweeper after the annual flue gas measurements. Alternatively, a chimney building company may perform a calculation of the chimney draught.

If structural changes, such as increasing the height of the chimney, do not create a sufficient draught, a flue gas accelerator or fan installed on the chimney cowl may also ensure the required draught.

In any case, before making any modifications, please consult your responsible chimney sweeper or building management and get their approval to avoid any unpleasant surprises during the first inspection after the renovation.

Who can install a heat recovery system?

Several handicraft businesses are involved in installing a heat recovery system. At least a heating installer and an electrician, often also a company for building chimneys are necessary. Therefore it is advisable to hire local handicraft businesses.

For larger systems, it is absolutely necessary to hire a planning office for planning, commissioning and supervising construction. The baker usually does not have the time to deal with the many details. He/she has to take care of baking and should not make false economies. Good professional planning is highly valuable and therefore worth spending some money on.

Last but not least

As a building owner, the baker has to decide who coordinates all the steps, who supervises everything, who bears the responsibility. Everyone involved has to know at all times where all the information comes together and where to go for information. Taking care of these topics reduces the typical problems associated with building projects to a minimum and ensures a satisfying result.

Status 21 Sept 2017