



Industrial boiler technology for beginners



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Symbols used in this brochure:



Pencil: this gets complicated. It will be best to get out your note pad and write down what you read; after spending a short time learning it by heart, you will be able to show off your unexpected knowledge at the next family gathering.



Light bulb: here new understanding – similar to a flash of inspiration – is gained about everyday facts, things that we normally don't think about but are nevertheless fascinating.



Background information: interesting, but nothing that needs to be remembered forever. Maybe something else to show off with at a family gathering?

Thermal heat/process heat and fields of application

Heat is the basis of all life. This can be seen when the fridge breaks down and yoghurt comes alive after a short time. If heat came only from the sun's rays, large areas of the earth would be uninhabitable for man. Artificial heating (thermal heat) is therefore necessary, depending on the geographic position and season of the year. In addition to this, there are also a great number of technical processes that are only made possible through heat, for example, cooking, boiling and cleaning processes in the food and drink industry. But in many other branches, too, such as the paper, building, chemical or textile industry, many processes function only with heat (process heat).

Fields of application of industrial boiler systems



Heating



Foods



Paper



Beverages



Building
Materials



Cleaning



Chemistry



Textile

Water and steam as heat carriers

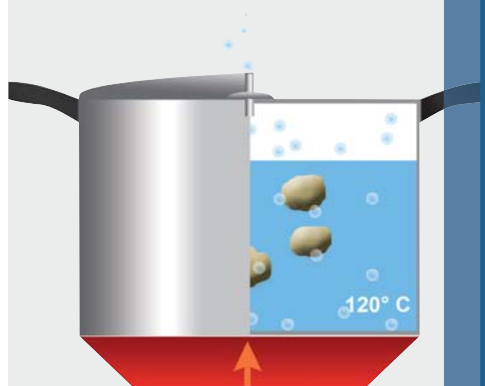
Heat is therefore necessary for heating buildings and for many industrial processes. Now just imagine that every single process or room needed to be heated separately. The frequent dip into one's purse would probably produce more frictional heat than that produced by the many individual heating systems necessary – quite apart from the low efficiency. For this reason, the required heat is usually produced centrally and passed on via a transport medium, the heat carrier. This heat carrier is transported to the respective consumer, there the heat is transferred to the consumer, and the cooled-down heat carrier medium is returned to the central heat producer to be heated up again.

Water or steam as a heat carrier has many favourable properties such as, for example, high energy absorption and easy transportability. It is available everywhere and is not harmful to the environment (unless you try to water your flower bed with boiling water, which the flower bed will probably not survive). Boiling point at atmospheric pressure is relatively low, however. If temperatures higher than 100 °C need to be produced, then the heat carrier can be pressurised, which causes the boiling point to be raised.



Every pressure cooker uses these physical interrelations, for example. The lid gives an airtight seal to the cooker, so the steam produced at boiling point (boiling point is around 100 °C at air pressure of approximately 1 bar) cannot escape. The pressure inside the cooker increases, which at the same time leads to a rise in the boiling point. The pressure is adjusted over a safety valve to approximately one bar above air pressure. As a result, the temperature in the pressure cooker is not just 100 °C, as it would be in an open saucepan, but 120 °C. The food contained cooks more quickly.

A different kind of fast food – 120 °C in the pressure cooker and the potatoes are ready in next to no time.



Design of an industrial boiler

Industrial boiler systems can cope with much higher pressures than pressure cookers. These boilers are welded from thick steel plates that are up to 35 mm thick, making pressures of 30 bar and more possible. A stable, robust design is also essential – if a boiler of this type were to collapse, explosive forces comparable to the explosive power of a ton of gelignite would be released (milk boiling over in a pressure cooker is nothing in comparison to this). A thermal output of up to 38 MW is possible from a single boiler, which corresponds approximately to the power of 500 average VW Golf cars. Up to five boilers can be combined economically. A boiler of this type, filled with water and ready for function, can weigh as much as 165 tons, which corresponds to the weight of 120 VW Golfs.



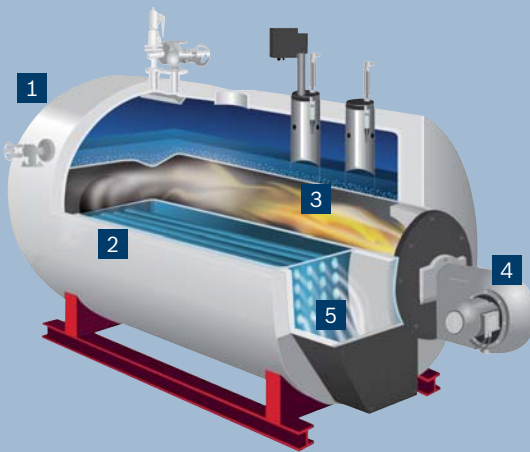
At full capacity a boiler of this size converts 3000 litres of fuel oil or a corresponding amount of natural gas to thermal or process heat every hour. This would be sufficient to heat more than 2000 houses.

Hot water or steam boilers are relatively similar in design (Figure). The boiler pressure vessel is a horizontal, cylindrical tube closed at both sides with an end plate and insulated all around. There is a flame tube (1st pass) in this pressure vessel, which is fired through a burner and an internally situated reversing chamber that reverses the flue gases and leads them back in the 2nd smoke tube pass. On the front of the boiler is an external reversing chamber, which again reverses the flue gases and leads them to the end of the boiler in the 3rd smoke tube pass. Hot water boilers are normally completely filled with water during operation. Steam boilers on the other hand are only 3/4 filled with water; the upper quarter is the steam space.



Because of the huge volume of water and the multi-stage lead-through of the flue gases, these boilers are also called three-pass shell boilers.

Sectional drawing of a three pass shell boiler



- 1 Waste gas connection to chimney
- 2 Smoke tube pass (2nd pass)
- 3 1st Flame tube
- 4 Burner
- 5 Smoke tube pass (3rd pass)

How an industrial boiler system works

The heart of an industrial boiler system is a hot water or steam boiler operated with a certain kind of fuel. The boiler heats up or evaporates the water inside it, which is then transported to the consumers via pipe systems. In case of hot water the transport energy is generated by pumps, in case of steam the transport is based on inherent pressure. The cooled water or the condensed steam returns to the boiler where it can be heated again. Loss of water must be compensated by treated fresh water to avoid corrosion. Flue gases created by combustion are discharged into the atmosphere through a chimney. Particularly efficient systems additionally use the residual heat in the flue gases.

The use of boiler systems in practice

Industrial hot water boiler systems for generating thermal heat are very similar to the household heating boilers in our cellars. The main difference is that industrial boilers are dimensioned significantly larger, so their heating capacity is not only sufficient for a family home but also for hotels, hospitals, skyscrapers, industrial buildings or entire districts. When using process heat generated by steam boiler systems the individual applications are far more versatile. They are used in many industry sectors. But is all this just hot air or what exactly is the steam used for?

Let us choose a few industrial sectors and have a closer look at them.

Laundries and cleaning firms

This is an obvious example of what steam is used for. It is just easier to get rid of spots and dirt when the washing water is heated. Our washing machine at home does the same, however with electrical heating. In large laundries this would be inefficient as electrical energy is too expensive. Steam can also be perfectly used for downstream processes like pressing, using the mangle, ironing or finishing. We know this process from steam-ironing at home; steam simply removes all creases.

Food industry

Food must often be heated or boiled during processing. Thus this industrial sector obviously needs plenty of thermal energy. However, some steam applications are still stunning; a good example is potato processing.



Cold potatoes are filled in a big pressure vessel and hot steam is abruptly injected. The abrupt heat supply causes the potato peels to fall off so they do not have to be peeled by hand any more. Now, isn't it tempting to fetch the old steam cleaner from the cellar and use it as a cooking aid?

Breweries

Most people know that a good and tasty beer consists of hops, malt and water. However, before enjoying the beer there is a complex production process. Malt has to be ground coarsely and mixed with water. The brewer calls this mashing. The mash must be heated to various temperatures in two to four hours. Now guess which heat carrier is normally used for this? That's it, the steam we previously generated with the steam boiler. Subsequently, hops are added and the mixture has to cool down. Then yeast is added and triggers the

fermentation so that the beer gets the desired effect. Depending on the type the beer still has to mature for up to three months until it can be filled in bottles or barrels. Now we get to the most pleasant part and enjoy the good cool drink ... OK, back to the subject. After bottles or barrels have been emptied they are normally returned to the brewery. Of course the breweries first have to clean them before they can be refilled. For this process steam is again required to heat up the water needed for cleaning. Amazing, isn't it?

Building materials industry

Large amounts of steam are also necessary for the production of moulded bricks. The basic materials like sand, lime, water, etc. are mixed and pressed to relatively loose stone compounds. We remember that from making mud pies in the sandbox. Subsequently, the stones are transported to a huge pressure vessel (autoclave) which is then closed and steam is injected. The stones are to harden at a temperature of approximately 200 °C and a pressure of about 16 bar for a certain period of time and can then be withdrawn as finished stones. How stable our sand castles would have been if we could have used this technology!

Sewer pipe rehabilitation

What to do if there is a drain leakage? This problem can either be solved by means of excavation works at the underground pipes and renewal of the sewage pipe systems or with rehabilitation tubes. These tubes are overdimensioned hoses that are inserted in the pipes without excavation work and then inflated with steam. The plastic hose attaches itself to the sewage pipe under application of pressure and temperature and the pipe can continue to be used for many years.

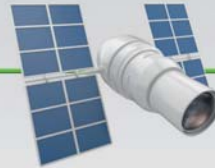
... and many other industries

- | | | |
|---------------------------|---------------------------|----------------------|
| ▶ Agriculture | ▶ Fruit processing | ▶ Slaughterhouses |
| ▶ Animal food industry | ▶ Glass fibre production | ▶ Spinning mills |
| ▶ Automotive industry | ▶ Greenhouses | ▶ Steel works |
| ▶ Bakeries | ▶ Hospitals | ▶ Tank farms |
| ▶ Ceramic industry | ▶ Metal-working industry | ▶ Tobacco industry |
| ▶ Cheese dairies | ▶ Paper industry | ▶ Tyre manufacturing |
| ▶ Chemical industry | ▶ Pharmaceutical industry | ▶ Vulcanisation |
| ▶ Dairies | ▶ Plastics | ▶ Waste disposal |
| ▶ Distilleries | ▶ manufacturing | ▶ Waste incineration |
| ▶ Dyeing factories | ▶ Primary industry | ▶ Weaving mills |
| ▶ Electrical industry | ▶ Print offices | ▶ Wood processing |
| ▶ Food packaging industry | ▶ Refineries | ▶ Wood products |

The use of steam allows for an incredible amount of possibilities. There are many more industrial sectors and applications that use steam. Think about it, some other options will surely come into your mind.

Intelligent and modular boiler systems from Bosch Industriekessel

Teleservice



Boiler control
BCO

BCO

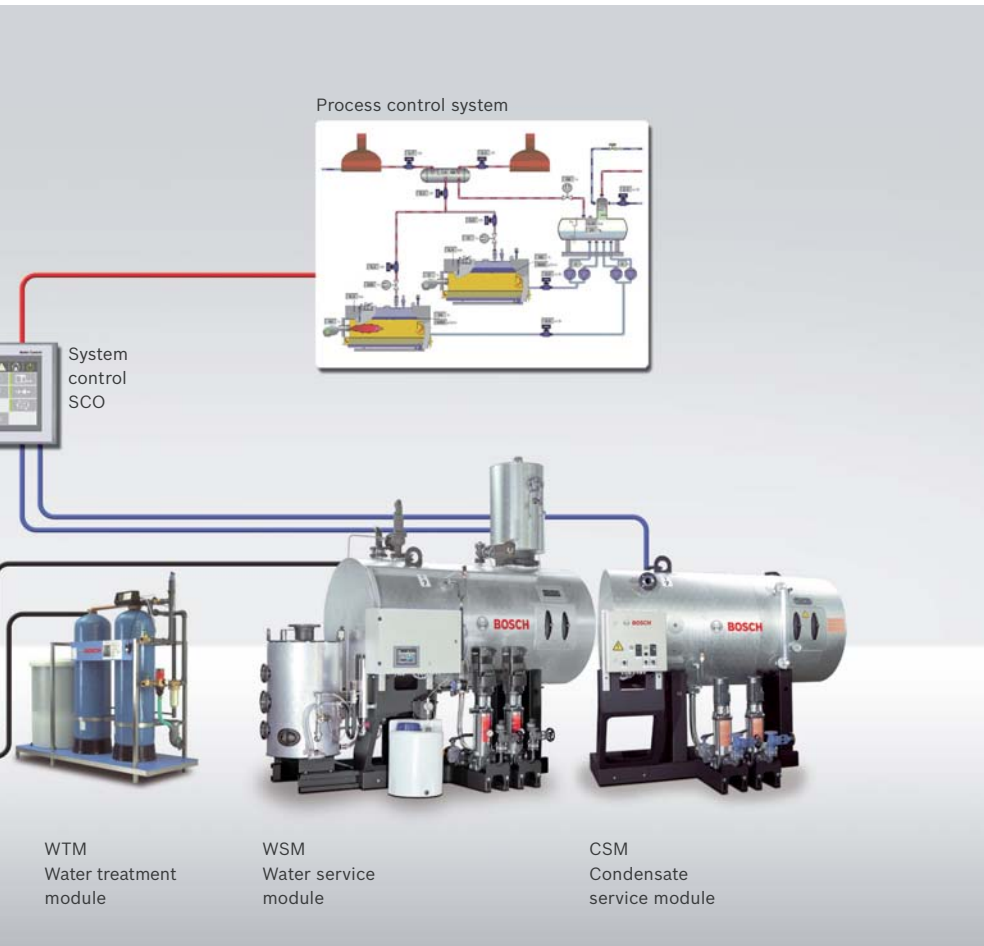


UL-S
UNIVERSAL Steam boiler

WA
Water
analyser

Bosch Industriekessel

Bosch Industriekessel has delivered more than 100 000 industrial boiler systems world-wide. Internationally renowned enterprises like Coca Cola, Nestle, Red Bull, Unilever, Daimler, Volkswagen and thousands of others are among our loyal customers just like the next-door manufacturing company.



Our product range includes steam boilers from 175 kg/h to 55 000 kg/h, hot water boilers for capacities up to 38 MW and heating boilers up to 19.2 MW. Boiler house components in modular design make planning, installation and operation of boiler systems a lot easier.

High-quality equipment with intelligent control systems, modern burner technology and efficient heat recovery devices ensure environmentally friendly, economic and fully automatic boiler operation. The customer service is available around the clock every day of the year. Thanks to the closely knit network of service areas the shortest possible reaction times can be ensured.

Production facilities

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Bosch Industriekessel GmbH
Nürnberger Straße 73
91710 Gunzenhausen
Germany

Factory 2 Schlungenhof

Bosch Industriekessel GmbH
Ansbacher Straße 44
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Factory 3 Bischofshofen

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