8 STEPS - CONTROL OF HEATING SYSTEMS

Contents

Preface.

Heating a home has always been and still is a basic human requirement. This requirement. This requirement enables us to live and work in locations with low temperaure. In the beginning the solutions were simple. An open fire on the floor of a tent or a simple hut, made it possible to survive in a hostile environment. As civilisation developed there was migration from the countryside to the towns and cities and into bigger and bigger houses, creating a requirement for more elborate heating systems. This requirement stimulated technical development, but also created a problem, namely the use of a finite resource (fossil fuels) with the resulting pollutions from the burned fuels.

The purpose of a good heating system is to create the best environment possible. The construction of the building with a well designed heating system, associated with good automatic controls, minimises the heating requirements and emissions radically.

Definitions.

District heating

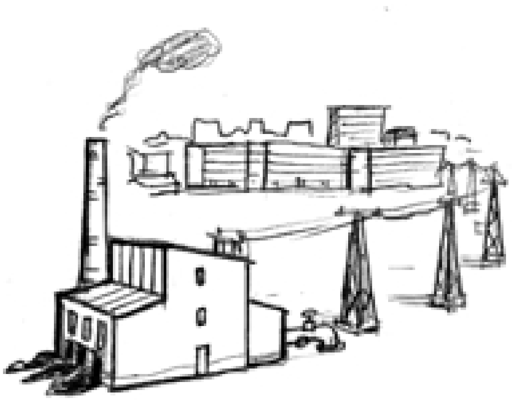
District heating is a system which provides a number of buildings with heat from a central boiler plant through pre-insulated pipes. (Pre-insulated pipes are in fact a modern kind of heat culvert or district heating duct, but since these systems nowadays are pre-manufactured, they will from here on be referred to as pre-insulated pipes.) The smallest systems cover 200-300 houses or a block.

The connection to the secondary heating system can be direct or indirect, i.e. with or without a heat exchanger. Domestic hot water is also produced with the help of district heating. As a result, the heating plants are also in operation during non-heating seasons.

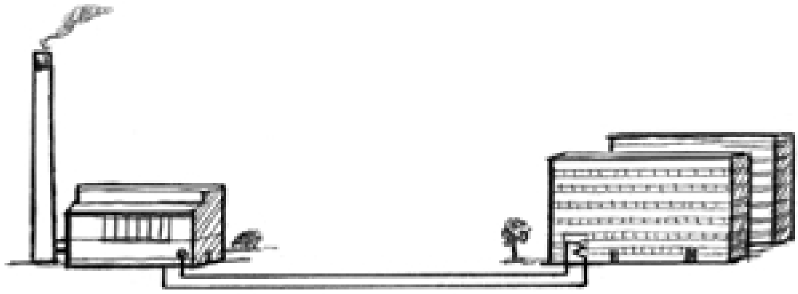
There is a difference between heating plants, pure heat producers and combined heat and power plants. The main purpose of the last-named is to produce electricity through a steam turbine. The connected buildings are used to cool down the condensate to such a low temperature as possible in order to increase the capacity of the steam turbine.

The efficiency for coal-fired power plants is low, 30-40 %. By combining the power production with the heat delivery, the efficiency has increased right up to 90 %, which corresponds to the efficiency of well-kept district heating plants.

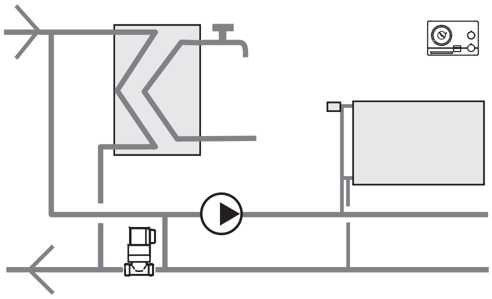
A district heating plant, (the primary circuit), can be divided into three parts:
- Production (central boiler plant)
- Distribution (pre-insulated pipes)
- Consumption (sub-station)



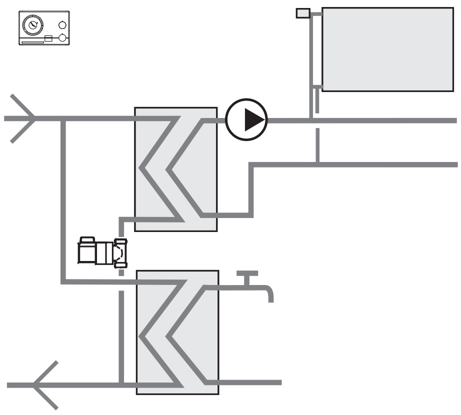
Combined heating and power plant.
Fig. 1:1



Central boiler plant Distribution Consumption
Fig. 1:2



Direct connection
Fig. 1:3



Indirect connection
Fig. 1:4

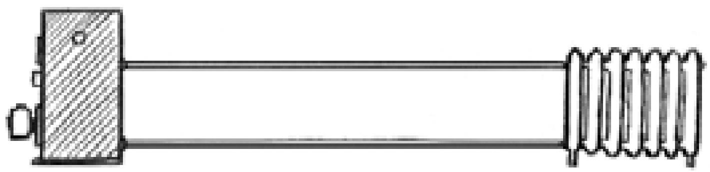
In the production plant, the water temperature is increased to the required level. Distribution implies heat transfer to the consumers with as small a loss as possible. Consumption implies heat transfer from the water of the primary side to the water of the secondary side, and a large temperature drop in the primary water. It may also imply directly connected systems, detached houses for instance, with a differential pressure control as protection against too high differential pressures.

District heating systems with a large production plant, an efficient distribution network and a sub-station with heat exchanger and automatic controls, can be made very effective in respect of consumption as well as pollution.

The choice of material and operating conditions such as static pressure, temperature and water quality are important factors concerning the operation of the system, its maintenance and its durability.

The heating system in a building, (the secondary circuit), can be divided into three parts:

- Production (heat transfer through the heat exchanger)
- Distribution (the main piping system of the building, including the circulation pump)
- Consumption (radiators, convectors, or floor heating for the rooms)



Production Distribution Consumption
Fig. 1:5

In the production plant, the secondary water temperature is increased to the required level.

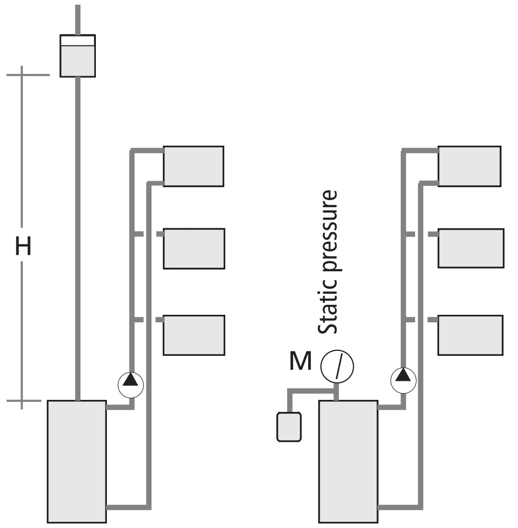
Distribution implies heat transfer to the consumers with the smallest losses possible and small temperature drop.

Consumption implies heat transfer from the water to the rooms and large temperature drop in the water.

Pressure

In district heating systems and heating systems, you make a distinction between static and dynamic pressure. In an open system, the static pressure is equal to the weight of the water column. The word static represents something stationary. The dynamic pressure appears when the water begins to circulate and a circulating resistance is formed . The word dynamic means that something is in motion.

The static pressure has two functions in a distric heating system. It has to ensure that all parts of the system are filled with water (level pressure) and that the water does not begin to boil (steam pressure).



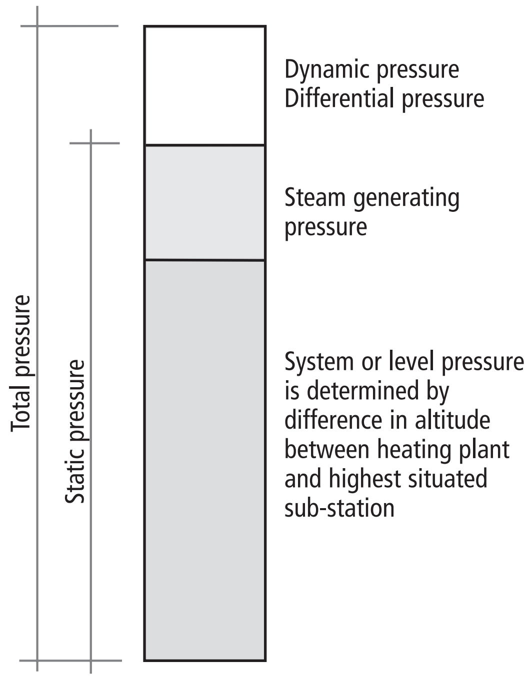
Height in meter is equal to static pressure.
Fig. 1:6

Level pressure

All the parts of a system are filled with water if the static pressure, calculated in meter water gauge, is equal to the level of the system, at its meter. 10m WG = 1 bar = 100 kPa, providing the circulation pump is not in operation. If the circulation pump is placed in the flow line, which is usually the case with the district heating systems of today, the pump will provide a higher total pressure (static + dynamic pressure) in the flow line, when in operation.

Correspondingly, the total pressure is lower in the return line, and lowest at the return connection to the pump. By placing the pump in the flow, you will have an additional guarantee that there is water in all parts of the system.

If the pump is placed in the return line, the case will be the opposite, and the static pressure must be increased by 60-70 % of the pressure increase across the pump in order to get all parts filled with water.



Definition of pressure in district heating systems.
Fig. 1:7

Steam pressure

The boiling point of the water is depending on the current pressure. A low pressure decreases the boiling point and a high pressure increases it. At sea level the water boils at 100°C in an open vessel, and already at 120°C, an over-pressure (the pressure shown on the pressure gauge) of approximately 1 bar, 100 kPa, is required to avoid boiling. An over-pressure of 2 bar, 200 kPa, corresponds to approximately 130°C.

In order to avoid boiling, the over-pressure required must be available in each unit of the system.