03-02: Pellet firing in small-scale district heating…

As pointed out in 03-00, a "small" district heating network would be considered anything with a peak thermal power less than about 5-10 MW, but there is no strict limit.

In chapter 00-01, the relationships between fixed and variable costs as a function of scale were clarified. This is also what decides whether a small district heating system should be pellet fired or fired with wood chips. Generally, one might say that in the low end of the scale, up to about 2 MW, pellets do often come out as the best alternative while only very few, if any, examples of pellet-fired systems may be found at scales exceeding 5 MW.

Economy of scale – choice of fuel
The initial investment in a district heating system will always be significant and if nothing else is known one may assume that the investment in the distribution network is about the same order of magnitude as that for the boiler installation. And the cost for the boiler installation as a whole will be split in four parts of similar magnitude, namely the boiler itself, the boiler house, the fuel storage/handling/feeding system and the control system.

To this comes the cost for the customer heat exchangers, but that cost would typically be paid by the customers themselves once they connect to the system.

The choice of fuel will mainly affect the investment in the fuel handling and storing system so that a pellet system may be significantly cheaper than a system to store and feed wood chips. Also may the boiler itself become cheaper since it can be dimensioned for a fuel of uniform quality. The fuel uniformity may also provide for a lower operational cost due to less stoppages and failures – but with high-quality chips-firing equipment this should only be a marginal problem anyway.

The prices paid by choosing pellets are a loss of flexibility and that the possibility to choose a cheaper fuel in the future is effectively out of question unless additional investments are made. It must also be remembered that the fuel handling system and the boiler in themselves will represent only a part of the total investment while the other parts, the boiler house, the control system and the piping for the distribution net, will be unaffected by the choice of fuel.

Limits to the combustion process
Any fireplace is designed to work best with a specific fuel at a specific firing rate (i.e. thermal output). Good combustion equipment – fed with the correct fuel at the correct rate – will provide a complete burnout of the fuel in combination with minimal amounts of air pollutants. As already pointed out in chapter 00-01, the combustion process is an intricate combination of aerodynamics, heat- and mass-transfer, and chemistry.

With a boiler for district heating applications, the boiler should be equipped with computerized combustion control and might also be large enough to accommodate particle separation from the flue gases. You will find more details about these things in chapter 03-00, but here we shall only touch upon a few things of major importance in case of pellet firing:

- Since the system is basically assumed to be small enough to be pellet-fired, the distribution network is also limited and the boiler central is – by necessity – located in the close vicinity of the customers. Pellets – being of a uniform size and of uniform and low moisture content – can (relatively) easy be burnt without too high emissions of hydrocarbons. Hence, pellet combustion suits well in such cases when the boiler is best placed close to – or in – residential areas.
- Pellets have a high energy density and large quantities of energy are easily stored in fairly compact, cylindrical silos that may be integrated into the overall building structure of the area and effectively hidden away. Though pellets are neither chemically nor biologically inert, they are not a good substrate for mould and rot fungi nor is the risk for auto-ignition overwhelming. Hence, quite large quantities of energy in the form of pellets may be safely stored without risk of sanitary problems. Again, his makes pellets an excellent fuel in case the system is small and the boiler central is placed adjacent to or inside a residential area.
- Pellet feeding is commonly done by screws. The repose angle for pellets is about 40^{o} and this puts a limit to the inclination of the screw. Since wood chips have a much steeper repose angle will a pellet screw – typically – be able to transport chips but then, since the pellets are much denser than the chips will the diameter of the screw often be limiting. Hence will a plant laid out for pellet firing usually not be capable of chips firing, even if the boiler itself would allow it.

Relevant standards

At this scale there are no standards available for the boiler design but one is dependant on individual designs made by the manufacturers. However, EN 15316-4-7 covers the dimensioning methods for building heating systems and may prove helpful to dimension the customer heat exchangers.