01-02: Wood pellets as a fuel for domestic heating…

Pellets consist mainly of stem wood either from conifer trees or from broadleaf trees, with or without bark. They will have a diameter of 6, 8, 10 or 12 mm, a particle density for the individual pellet exceeding 1100 kg/m^3 and they will be mechanically robust. They will also have a low moisture content, typically about 12 %, corresponding to an energy content (heating value) about 16-18 MJ/kg or almost 5 kWh of thermal energy per kg. (*to obtain kWh from MJ, divide by 3.6*)

Since wood pellets thus have a smooth surface, a uniform shape and relatively constant properties as a whole, they lend themselves well to automatic feeding and firing systems.

Pellet firing systems for domestic use in single-family houses generally fall into two different categories, namely

- Burners to be mounted in hot-water boilers
- Self-contained stoves for air heating, containing combustion chamber, burner and day storage tank assembled. For some units the day tank might be separate while quite often all the parts are assembled in one physical unit

Both types of system solutions are commercially available as off-the-shelf units. The reliability with the commercial systems is high and the need for maintenance is low.

The household market for wood pellets is rapidly expanding and pellets may be bought in bags as well as in bulk in most places over Europe.

To be considered when installing wood pellet heating

Installing a wood pellet system in a single family house with a central heating system includes installing a boiler with a pellet burner and a pellet store.

For the boiler, it is important that the fireplace is large enough to contain the flames from the pellet burner. Typically, the flames from wood pellet combustion are larger than those from oil or gas firing and the fireplace thus needs be bigger. In case the fireplace is too small, the flames will be extinguished close to the walls, resulting in hydrocarbon and soot emissions, see the text section on the combustion process in chapter 00-02. In some cases, a boiler originally aimed for oil firing can be used also with pellet burners but in most cases it is recommendable to acquire a boiler designed for pellets. Such boilers will also be designed to accommodate a reasonably large amount of ash, thus prolonging the intervals for ash removal. Finally, designated pellet boilers will also be designed to simplify the ash removal.

In case a pellet system replaces old oil- or gas fired systems it is crucial to check the status of the chimney. Pellet firing will result in larger flue gas volumes and the chimney must be able to cope with that. In case a pellet burner is mounted in an old boiler the flue gas temperatures may also become higher.

The burner can be chosen from a number of models and marks, the most important difference between them being that some are upwards-burning and some are forwards-burning. Both systems have their advantages and disadvantages. An upward-burning unit requires a higher fireplace than a forward-burning while on the contrary the forward-burning design demands a deeper fireplace to accommodate the flame.

Most crucial for the functionality is the burner ignition process. Provided the pellet feed works and provided the burner is actually running, it is very scarce that the flame goes out. Instead, stoppages are almost exclusively caused by the burner failing to ignite.

During parts of the year and with a normal on-off thermostat system without an accumulator tank, heat may be demanded on an hourly base. Hence, the burner may start and stop 20-30 times per day. That makes up for almost 200 ignition sequences weekly and if only one of these fails, the system stops.

So the procurement must include a thorough investigation and comparison of the burner reliability with respect to ignition. This market overview must be done on the local market.

Pellets will typically be fed to the burner by screw feeding from the bottom of the fuel hopper to a point above the burner and then by gravitation down into the burner. To avoid back-firing, it is crucial that the physical contact between the pellets is broken in this feed.

In the unlikely case that the burner fills up with pellets and fire spreads backwards to the burner feeding tube, this fire must be hindered from spreading into the feeding screw. If it did, it might finally reach the hopper…

Hence the burner should be equipped with a thermal fuse stopping the pellet feed in case the temperature at the burner inlet exceeds normal operational temperatures, i.e. about 50 ºC. The connection between the screw feeder and the burner should also be made of a material that melts and is destroyed rapidly in case of fire and the distance from the burner inlet and the feeder outlet should be at least 50 cm. The feeder outlet should also be placed a bit to the side of the burner inlet so that flames escaping through the burner inlet can not hit the screw. Such an arrangement eliminates the risk for any back-fire to spread into the pellet hopper.

The size of the hopper will mainly be limited by the space available.

For air-heating pellet stoves, the storage is usually included in the stove as such. Hence, the storage is limited in size and a stove will typically need a pellet refill quite frequently.

Again, and this cannot be over-emphasized, the ignition process is the most crucial for reliability while the simplicity with the ash removal is the most crucial for comfort.