

The advantages of selecting a low temperature heating systems

Radiant floor heating systems can provide substantial heat output at surprisingly low water temperatures. Since radiant floors provide the optimal temperature distribution for human comfort, an average air temperature of around 67°F will provide adequate comfort for most people. At that room temperature an average floor surface temperature of around 79°F will generate a heat output of 20 Btu / (h. x sq.ft.), which is adequate to maintain the indoor temperature for a reasonably well insulated building even during the coldest winter days. With a Vinyl or Tile floor on top of concrete, the temperature the circulating water would only need to be 88°F to provide this output.

In a conventional heat loss calculation, the designer will calculate how much heat is required to maintain adequate room temperatures in a building. Even though there are reasons for adjusting this calculation somewhat for radiant floors - the result will be similar. So when we know how many Btu's are required, why does it matter at what distribution temperature the heating system delivers this heat? There are many arguments in favor for systems utilizing low water temperatures, and this article will discuss some of them.

Heat sources - when water temperatures are low

With increasing energy costs people are becoming more interested in using alternative energy sources, and low temperature systems can make that be a viable possibility.

- Hydronic solar collectors are able to provide much more energy at a low water temperature. Even during mid winter, simple constructions are able to provide water temperatures in the lower 100° F.
- The efficiency of a heat pump is greatly increased when low delivered temperatures are adequate. COP's in the range of 3 are commonly reached in such cases. (COP = Coefficient of Performance; Energy output divided by Energy input).
- The efficiency of a district heating system is greatly improved when low water temperatures can be utilized. There are numerous cogeneration plants and other power stations that currently waste huge amounts of warm water.
- Many industrial processes generate water warm enough to heat the building where they take place, when radiant floors are the selected distribution system.
- There are many examples of grocery stores using the warm water generated by their refrigeration system to heat their floors.
- Geothermal wells can provide much more heat, when low water temperatures can be utilized.

But there are also many possible benefits when more conventional heat sources are used.

- Boilers using wood or coal are typically equipped with storage tanks so they don't need to be fired up so often. A low temperature distribution system will also be able to "squeeze out heat" when the temperature has fallen quite low in such tanks. The result is longer time between charges, and/or smaller storage tanks can be utilized. Undesired heat losses will of course be much lower. These advantages are valid for any system utilizing storage tanks (not only wood or coal fired).

Energy savings by lowering temperatures

Energy saving is another major advantage with low water temperature systems. One rule of thumb says: "You save 1% on fuel consumption for every 3°F lower water temperature required." The exact figure may be challenged, but the fact is:

- Undesired losses from boiler, distribution piping, and other equipment will be greatly reduced at lower water temperatures.
- When low water temperatures are adequate, use of condensing boilers will provide a considerable reduction of flue gas temperatures. Less fuel is wasted heating the outside air. The efficiency gain is in the range 10%-12% at condensing operation.
- Where off-peak rates are available, the thermal mass of radiant slab floors will keep warmth for extensive periods of time. Combined with storage tanks, such systems should never need to be fired at prime rates.

Save the materials - at low temperatures

- All degradation processes go faster at higher temperature. The rate is often increased to the double per each 10°F temperature increase. Corrosion rate increases, life-span of gaskets and O-rings, etc. decreases, sensitivity to slight UV exposure increases, oxygen diffusion through polymers go faster, most corrosion inhibitors are faster degraded, and possible antifreeze need earlier replacement.

Select the low temperature system!

The benefits of heating systems that operate at low water temperatures are staggering! Where concrete slabs are poured it seems irresponsible to not install tubing that can provide heat. Right away - or in a future when its energy cost reduction will require it to be utilized.

Floors with wood joists construction will require higher heating water temperatures than slab and other poured floors. However, the utilization of efficient heat transfer plates or fins can substantially decrease that difference. Simple staple-up of tubing under the floor will require substantially higher water temperatures, and I must believe that such a system selection must be based on lack of knowledge. Energy savings will quickly offset the investment in transfer plates.

Since radiant floors by definition are warm, unhealthy carpeting can be avoided or at least minimized. Each 1/8th of an inch of carpeting thickness may increase the water temperature required by 10°F at design conditions. The benefits of low water temperatures described above should make carpeting thickness decisions to be a simple process.