



Water Tube vs Fire Tube

While both fire tube and water tube boiler technologies have developed throughout their life, there are certain inherent advantages and disadvantages of each design. This article is intended to highlight these points for clarification and application into the future.

Water Tube

Advantages

The water volume in a water-tube boiler is significantly less than what would be present in a fire tube boiler. This means that there is faster response available to adapt to varying temperature conditions, i.e. swing loads. To be noted, this accounts for wider capabilities in output ranges as well. Since the water volume is in a water-tube significantly less, the startup times are also less than what a typical fire tube unit would have.

Central burners found in water tube models typically allow higher temperature outputs for more demanding process loads. The higher temperatures comes with the inclusion of higher pressures, which are able to be passed through the water tube units with respect to the typical design.

With the use of water passing through the tubes in multiple iterations one can extend the surface area internal to the heat exchanger as well as externally for added efficiency. This efficiency is rated at actual operating conditions as opposed to a fire tube model which is rated at peak conditions, not necessarily able to be supported by the constant use of the unit.

With less water passing through the heat exchanger at any given time the overall footprint of a water-tube model can be significantly less than that of a fire tube model.

Disadvantages

Due to the centralized fire tube design required by the water tube model, the concern of fouling is greater than a multiple tube design like the fire-tube. This also requires continuous flow during its operation, so the hot spots in the heat exchanger do not decrease the life of the unit.

A smaller volume of water could result in the inability to immediately accommodate large peaks in hot water demand, which would be easier to accommodate in a fire tube design. This can be remedied with the inclusion of an external storage tank.

Water treatment of a water tube boiler is important for the efficient operation of the unit and prevent scale. Scale build up in a water tube design can progress at a faster rate over the fire tube design because of the lower water mass and multiple passes. Minimum flow rates are typically higher in a water tube design to compensate for the reduced water volume.

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Fire Tube

Advantages

The water volume of a fire tube model is 4-8 times that of a water tube design. This means that it is optimal in scenarios where there are high peaks in demand once or twice a day and relatively no demand for the remainder of the day. Due to this volume it can overcome surges in demand at any rate quicker than that of a water tube design.

Generally speaking due to the number of tubes present it is easier to maintain hot water demand even if one tube has failed. Also, because of the sheer water volume the effects of poor water quality may take longer to manifest and develop performance issues.

Due to their design and simplicity, it is perceived that the fire tube units are less expensive.

Disadvantages

With the larger volume fire-tube design and lower flow rates it is harder to adapt to rapid temperature change since it simply takes longer to heat the large volume of water. This also can mean that generally speaking the turndown capabilities are less and the startup times are increased since one has to take into account the volume of water. The overall capability of a fire tube boiler is measured at peak demand, and can have negative affects if the application calls for constant water demand at these peak conditions since it would be unable to accommodate consistently.

The overall footprint of a fire-tube design is also greater than that on a water tube which could make it difficult to place in every application.

With the low flow design, flows can become laminar which can detract from the overall efficiency of the unit.

Since the entire vessel contains water, generally speaking the pressure of the vessel will be less than that of what the water tube design are capable of.