PSX Application Profile

Application: Inline Process Heating with Direct Steam Injection

Inline process heating has many applications in a variety of process & utility applications. many industries such as Food, Chemical, Pulp & Paper, all make use of inline process heating for water, slurry, sludge, and aggressive fluid heating applications. ***Direct Steam Injection*** for Inline Heating is a very good choice for a variety of applications. One of the fundamental principals for efficient and reliable steam injection is the ability to produce and deliver high velocity steam. High velocity steam is what assures rapid and complete condensation & mixing of the steam in the fluid. Often people will look at all forms of steam injection as the same and them make a investment decision based on price.

Internally Modulated vs. Externally Modulated Steam Control

There are two distinct design types of Direct Steam Injection, relative to steam control and they can have a significant impact on the steam injection heater's performance.

Externally Modulated Steam Control - Externally modulated steam control has been a common approach for Direct Steam Injection heating. This approach uses a remote steam control valve (PRV) to throttle (reduce) the steam pressure prior to a fixed opening steam injection point. Typically the steam pressure needs to be reduced at least 50% to control the amount of steam for temperature control. As the steam injection point has a fixed opening area, the ***reduced steam pressure*** also reduces the velocity (***sub-sonic flow***) of the injected steam.

Issues: Effective steam condensation rates are dramatically reduced as steam velocity is goes down. When low velocity steam injection occurs, sub sonic steam conditions exist. This results in:

- ***Low velocity steam*** leads to uncondensed steam bubbles, which tend to collapse against the pipe walls (Fig. 1). This is what leads to the vibration & steam hammer.
- ***Uncondensed steam*** can also travel past the temperature sensor which results in temperature control issues such as over heating.
- ***Process upsets*** are common and damage to equipment can occur from the steam hammer.
- ***Maintenance Issues*** result when steam collapses on the surface or in the steam injector, which leads to excessive wear which Increases maintenance costs and reduces reliability.

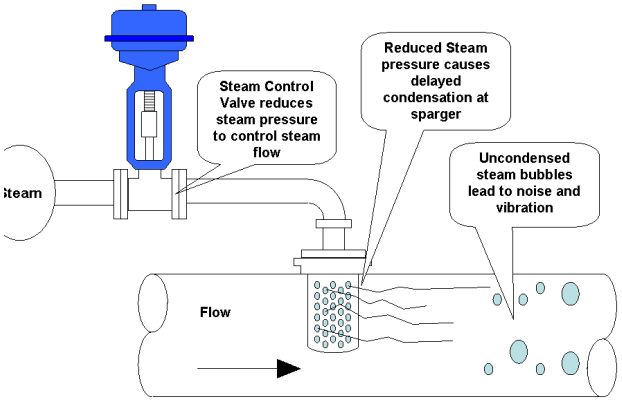

Fig 1 – Externally Controlled Steam Sparger

Ultimately problems arise when the steam pressure has been dropped to a point where the steam flow is no longer choked and is ***sub-sonic***. This can be seen most often at start up and shutdown of externally modulated steam injectors in the form of noise, ***vibration and hammering***. With an external steam valve, there is always a pressure drop before the steam reaches the injector. Some sparger devices use passive springs and tube assemblies that tend to stick, resulting from scale build-up, causing temperature control problems. The use of external steam control devices to control the steam flow by modulating the steam pressure can lead to ***excessive steam hammer & vibration***. Steam hammer and vibration often result from poor mixing and condensing of the steam.

The Importance of Internally Modulated Steam Control

As stated above, efficient and reliable condensation of steam is directly dependent on steam velocity. By using a steam pressure reducing valve for control, steam flow will become sub-sonic. The way to overcome this problem is to inject steam at choked flow conditions. ***Choked flow*** conditions allow steam to be injected at ***sonic flow velocities***.

ProSonix' unique method of steam injection utilizes an internal steam control to precisely deliver the appropriate ***mass flow of steam,*** and not the pressure, for the required heating. This is achieved via and integral Pneumatic Actuator, and a ***variable position stem plug*** in the steam jet diffuser. We do not throttle or regulate steam pressure. This design offers a precise method of steam control through a choked flow control delivery of the steam.

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Choked flow is the phenomenon of accelerating a vapor to maximum velocity by creating a pressure differential through an engineered nozzle. By establishing choked flow, the steam mass flow can be metered to precisely control the heating of the liquid. This produces predictable results based on position of the stem plug. Through a ***variable area steam diffuser***, steam flow is metered at the point where steam and liquid first contact and mix. Internally Modulated DSI heating controls the mass flow of the steam and not the pressure.

Key Benefits of Internally Modulated Steam:

No Process Upsets - *High velocity steam flow optimizes the steam mixing and condensation with the liquid and eliminates problems with vibration/steam hammer.*

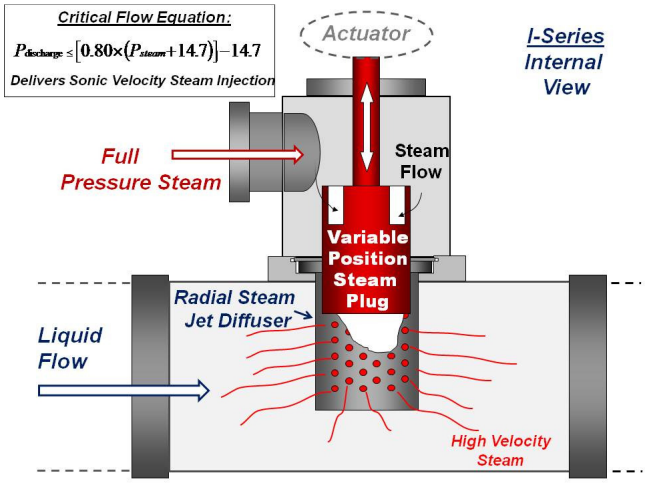
No Steam Control Valve (PRV) Required - *This method eliminates the need for an external steam control valve or downstream mechanical mixing devices.*

Reliable Temperature Control – *Rapid and complete condensation of the steam allows for temperature reliable control of +/- 1 ℉.*

Self Cleaning Design – *High velocity steam also is self cleaning and eliminates debris along scale & mineral build-up on the steam diffuser.*

Lower Maintenance Costs – *Proper condensation of the steam eliminates excessive wear*

Low Pressure Drop – *Typically 1-2 psig reduces pump demand and energy consumption.*



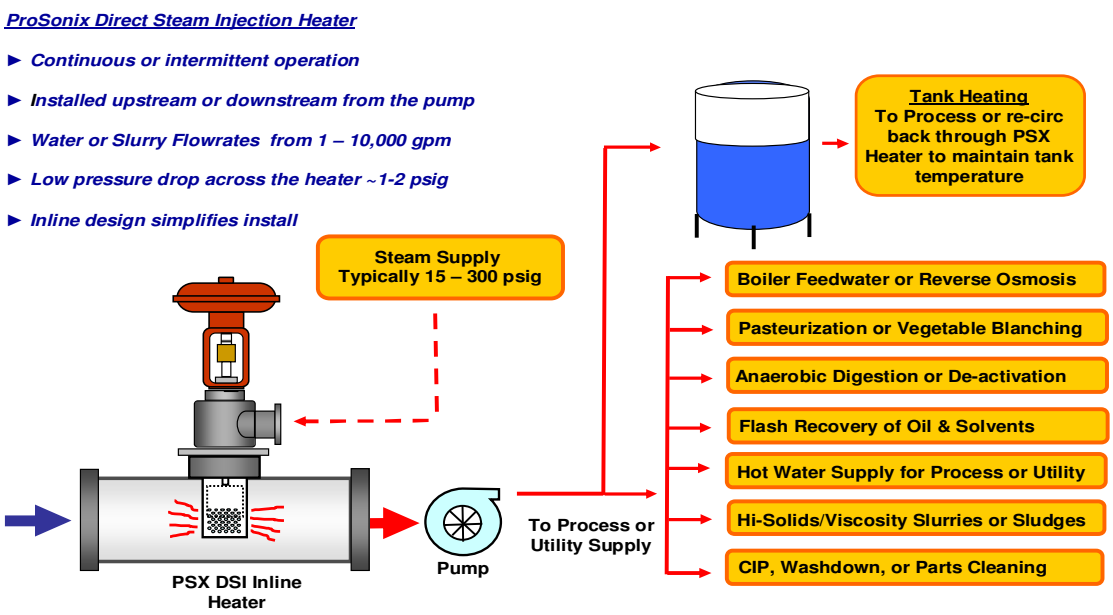


Fig. 3 - ProSonix Inline Direct Steam Injection Heating for Water or Slurry

The PSX inline heater (Fig. 3) can be controlled either locally or remotely via the plant DCS or PLC control system. Remote control inputs typically used are 3-15 psig, 4-20 mA, or other Fieldbus devices. The PSX heater can be installed on the incoming water or slurry line or in a re-circ heating loop to the tank, re-circulating through the heater until the tank reaches a steady state temperature. The PSX heater has a high heating capacity and can achieve a temperature rise from 1 to 250℉ in a single pass through the heater.

For additional information, please visit … www.pro-sonix.com

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