

The Induction Heated Mixer offers a proven, efficient way to process heat-sensitive or viscous fluids

Need

When viscous liquids are stirred in a steam-jacketed vessel, the velocity of the fluid decreases rapidly towards the wall, the heated surface. This low rate of movement can lead to thermal degradation of the fluid at the heated surface.

To overcome this shortcoming, C-Tech Innovation has developed the Induction Heated Mixer able to supply heat at the region of highest relative motion between fluid and heated surface. This leads to high heat transfer rates and a rapid interchange of the fluid in contact with the hot surface.

Applications

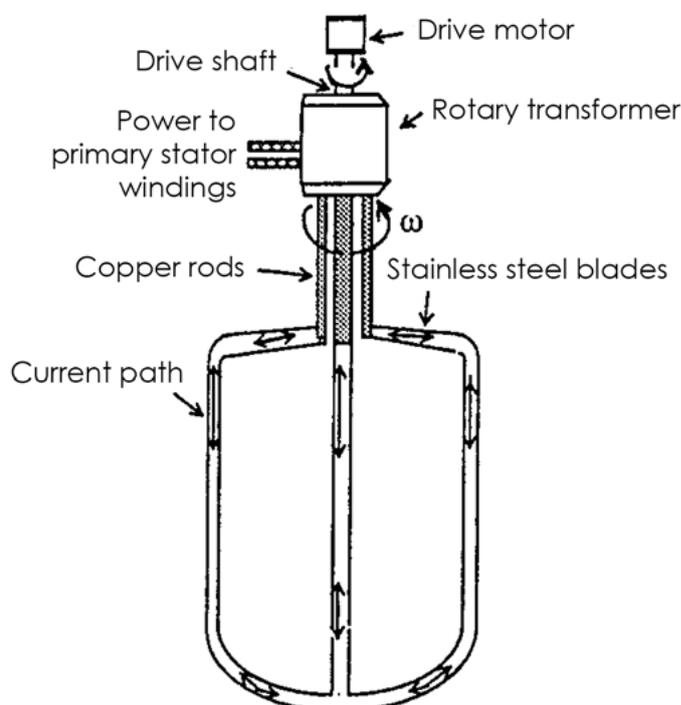
The benefits of the heated mixer are envisaged to be greatest in the processing of temperature sensitive viscous liquids, such as are encountered in the food, pharmaceutical, cosmetic and bulk chemical industries. However, the advantages of this technology should apply in all areas of the processing industries.

Technology

A rotating heated surface is provided by inducing an electric current to flow through the blades of a mixer. By modifying a standard induction motor to create a rotary transformer, current is made to circulate in a single turn secondary winding which forms the mixer blades. The current is carried in copper rods to the mixer head which is made of stainless steel.

As the conductivity of stainless steel is over 50 times less than that of copper, it is in the mixer head that the electrical power is converted to heat, according to Joule's law.

The rate of heat transfer is proportional to the velocity of fluid over the heated surface. Therefore, an increased relative rate of movement leads to a reduced temperature gradient between the fluid and the surface.



Schematic of an induction heated mixer

For processes involving temperature sensitive viscous liquids, where thermal gradient problems are most severe, the use of lower heated surface temperatures together with more rapid renewal of the liquid in contact with the heated surface will reduce any thermal degradation. By careful design of the heated mixer blades, the heated surface can be made to sweep through the whole volume of the vessel, thus providing heat more evenly throughout the liquid.

This inductively heated blade technology can be adapted to most types of mixer, with only minor adjustments to the basic blade design.

Characteristics

Temperature control is very rapid. Rates of blade temperature increase of about 100°C per minute are possible (similarly temperature decrease rates) because the only thermal inertia involved in the system is that of the heated blade, compared with the whole steam-jacket/boiler system for conventional vessel heating.

Heat input rates up to 100 kW giving a maximum blade temperature of around 400°C, depending upon the material of construction of the blades. These will be stainless-steel or titanium, in order to provide the correct resistivity for Ohmic losses to occur.

The rotary transformer will provide torque as well as current, so the drive motor required for speed control or to supplement the torque from the rotary transformer, can be smaller than would be required without the rotary transformer.

The rotary transformer, like all transformers, has low losses. Efficiencies of greater than 80% are easily attainable, resulting in very competitive running costs.

Trials indicate large increases in heat transfer coefficients, and corresponding high power input densities from the blade surface.

Advantages

- Faster heating due to higher relative motion between fluid and heated surface.
- Less likelihood of thermal degradation due to more rapid replacement of fluid in contact with heated surface leading to lower temperature gradients and shorter contact times.
- Heat input tailored to process requirements.
- Extra heat supply to supplement jacket heating for large vessel sizes.
- Rapid thermal response characteristics, with excellent controllability.
- Removes requirement for steam boiler plant.
- Allows cooling jacket to be designed specifically for cooling duty.
- Technology adaptable to most mixer types.
- Can be easily retro-fitted to existing tanks, giving heating capability to non-jacketed mixing vessels.

Further information

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