

Processing innovation

SPX harnesses cavitation



SPX's new APV Cavitator is a modular processing technology that offers breakthrough benefits for scale-free heating, microscopic mixing and dispersion (photo: SPX)

The dairy processing industry is one of the main beneficiaries of the latest product to be commercialised under SPX's Innovation Initiative.

SPX's new APV Cavitator is a modular processing technology that offers breakthrough benefits for scale-free heating, microscopic mixing and dispersion. In particular it solves the problem of heating liquids with high protein content without scale build-up, while also vastly improving the

mixing and dispersing of additives and flavours in dairy-based drinks and foods.

In terms of emulsification, the APV Cavitator achieves very fine and uniform particle sizes. The particles are exceptionally regular when viewed under the microscope. To put this in context, it is better than what many traditional high shear mixers can achieve and is a big benefit to manufacturers of products such as ice creams and other dairy based emulsions.



At the heart of the new Cavitator device is a specialised rotor, which is manufactured with equidistant cavities. When the rotor spins, it generates hydrodynamic cavitation within these cavities. Because the cavitation is controlled, there is none of the traditional damage from this process to either the rotor surface or its metal housing (photo: SPX)

For example, it can be used before the homogeniser to create a really good pre-emulsion: the better the pre-emulsion, the better the end product.

Another important use is in scale-free heating: the APV Cavitator can carry out the critical heating step without the excessive protein fouling that is often observed during traditional heat treatment. This can be combined with the microscopic mixing as it has been with pasteurized egg processing.

Users not only make significant space savings because the APV Cavitator is substantially smaller than rival technologies, but they can also potentially combine these two process steps into one if required. In addition, its modular design keeps operating and maintenance costs to a minimum. SPX use standard parts from the rest of their range, so they are easy and quick to replace.

How it works

Uncontrolled, cavitation can be very destructive, particularly to process equipment such as pumps and impellers, and engineers all over the world are familiar with the associated banging as low-pressure bubbles collapse and release shockwaves into the surrounding liquid. The SPX APV Cavitator harnesses and controls this force into controlled cavitation that can be successfully used for food processing.

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traditional damage from this process to either the rotor surface or its metal housing.

So as a process material passes through the device it is subjected to controlled cavitation. Here microscopic cavitation bubbles are produced that on collapsing give off shockwaves and cut the material into microscopic sizes. This increases the surface contact area between the liquids, gases and/or solids being mixed and maximises the efficiency of the process for processes such as hydration, emulsification and gas dispersion.

For example, conventional batch mixing normally occurs in large tanks containing an impeller that constantly stirs the contents in hopes of achieving uniformity. Because the tanks are often quite large, it requires long process times in order to achieve uniformity. In many cases, a completely homogeneous mixture cannot be achieved. However, the SPX APV Cavitator can normally mix the same amount of liquid as the conventional tank in less time while achieving uniformity. This occurs because powerful forces of cavitation are applied to a limited volume of liquid inside the SPX APV Cavitator as it passes across the cavitation zone.

The technology can be configured in a number of ways, depending on the product in question. For example, the low-shear set-up is ideal for handling shear-sensitive compounds such as proteins. Similarly, addition of particulates is much more straightforward because of the flexible clearances between the rotor and its housing. In another configuration, gases and liquids can be subjected to microscopic mixing.

Because the SPX APV Cavitator heats liquids in seconds and that heat is created inside the liquid rather than transferred through high temperature metal surfaces, product scorching is minimised. So a traditional problem with fouling, high-protein-containing food products is overcome, reducing costly and time consuming shutdowns and many maintenance problems. Overall, this improves product yield and quality, while reducing production costs. In trials, many manufacturers are also noting an improvement in product taste.

Moving ahead with trials

The SPX APV Cavitator has been extensively tested at SPX's Innovation Centre in Silkeborg, Denmark. The centre is an active participant in development, testing and application validation of SPX equipment, systems and processing lines.

Some of these trials have just been completed and SPX is now moving on to the next phase, which is where the application is validated together with customers. SPX APV offer three models in the range, the 12", 14" and 16" units, with throughput varying from a few hundred litres per hour up to 8000 l/h. These validations are focusing on the emulsification and the critical heating steps of high protein products. They are also looking at the dispersion of high value ingredients and gases such as nitrogen and carbon dioxide into products.

The remarkable uniformity seen under the microscope needs to be evaluated in the customers' own products. So there is a lot of interest particularly in ice creams and other dairy based emulsions.

The validations are currently ongoing both at Silkeborg and at customers' own sites. SPX is adopting its usual innovation approach of extending the platform of proven applications as this process continues.