

# Micro-Gap<sup>®</sup> Homogenizing Valve

It has been found through extensive experimentation that homogenization efficiency can be greatly increased, if a certain valve geometry is used and specific fluid flow conditions are met. The basic concept involves the transfer of homogenizing energy to the fluid in the shortest time and with the greatest energy density possible. The ideal way to do this is to generate a very thin film of fluid and to subject this film to high-intensity energy.

The Gaulin Micro-Gap valve (US Patents 5,749,650 and 5,899,564) achieves this result with a knife-edge design, which maintains an extremely small opening between the valve plate and valve seat, thereby, generating a thin film of processing fluid. The valve seat geometry has a very narrow travel distance from the high pressure fluid side to the low pressure fluid side, thereby, producing a large pressure differential in a very short time over a very short distance. This pressure change in the fluid film produces intense turbulence flow in the liquid. The flow condition through the narrow gap is also affected by the backpressure on the downstream side of the valve. By adjusting the amount of this backpressure, the turbulence intensity can be maximized in the fluid film. By combining these elements of a narrow land, a very small gap, and an optimum backpressure, a very high-energy density can be applied to the fluid being homogenized.

Conventional homogenizing valves usually consist of one valve and seat, which creates a small opening through which pressurized fluid flows. As the rate of flow increases, the size of the opening must also increase, in order to maintain pressure and accommodate flow. At high flow rates the cross-sectional area must be very large, and this can be accomplished by either increasing the gap between the valve and seat or by increasing the diameter of the valve and seat, so that the gap is small but the circumference is large. However, when the gap is large, homogenizing efficiency is decreased. When the valve diameter is large, size and actuation of the assembly are unfavorable.

The new Gaulin homogenizing valve assembly overcomes these limitations by stacking homogenizing valves in parallel and by allowing the flow to be split into equal parts, such that each part of the flow is simultaneously subjected to the ideal conditions of homogenization. Each valve member acts as both a valve plate and valve seat. The valve seat has the knife-edge configuration. Because the number of valve members can be varied, a large flow of liquid can be efficiently homogenized by dividing the total flow into the correct number of parts, so that each part goes through one valve member at the correct gap and flow conditions. With this stacked configuration, the flow can be increased without sacrificing homogenizing efficiency by increasing the number of valves so that each valve member always works at the optimum rate of flow.

Figure 1 shows a production design of a Micro-Gap valve assembly for use at high flow rates. In this design a hydraulic valve actuator (1) is used to clamp the valves together to generate pressure. The fluid enters through port (2) from the positive-displacement pump and travels into chamber (3) which is formed by the stacked valves (4). The knife-edge (5) is lower than the plane of the top flat of the valve periphery (6). This means that when the HVA (1) clamps the valves together, a gap is formed between the knife-edge (5) and the valve above it at a distance less than .002 inches. The fluid travels through this restricted passageway from (3) across the knife-edges and into the holes (7) and chamber (8).

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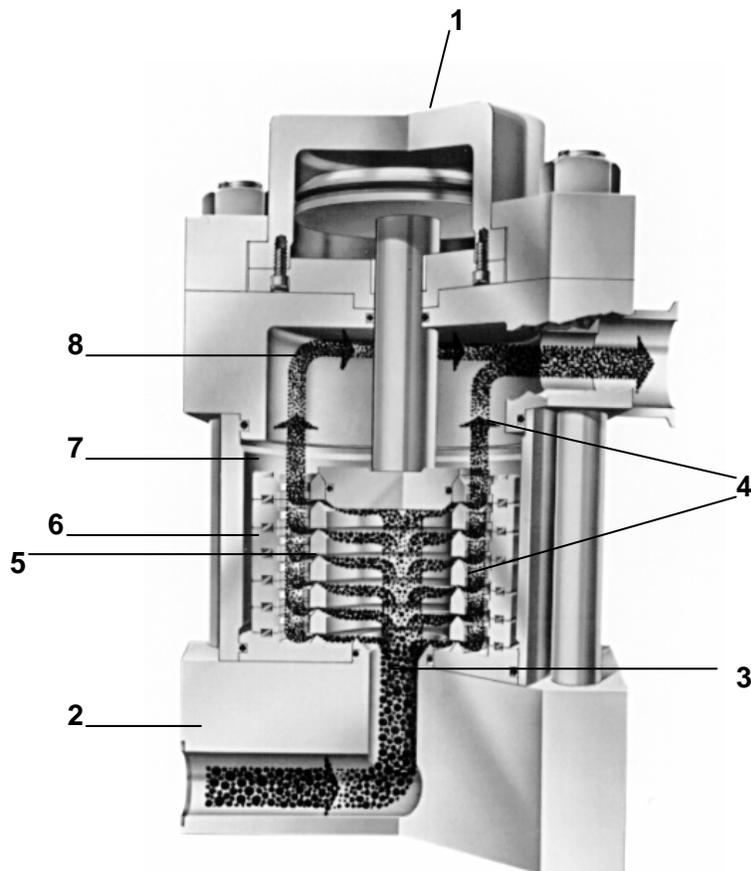
The required backpressure, at the discharge of homogenizing valves, which is 10 to 15 percent of the total homogenizing pressure, is generated by a flow restrictor downstream of the assembly.

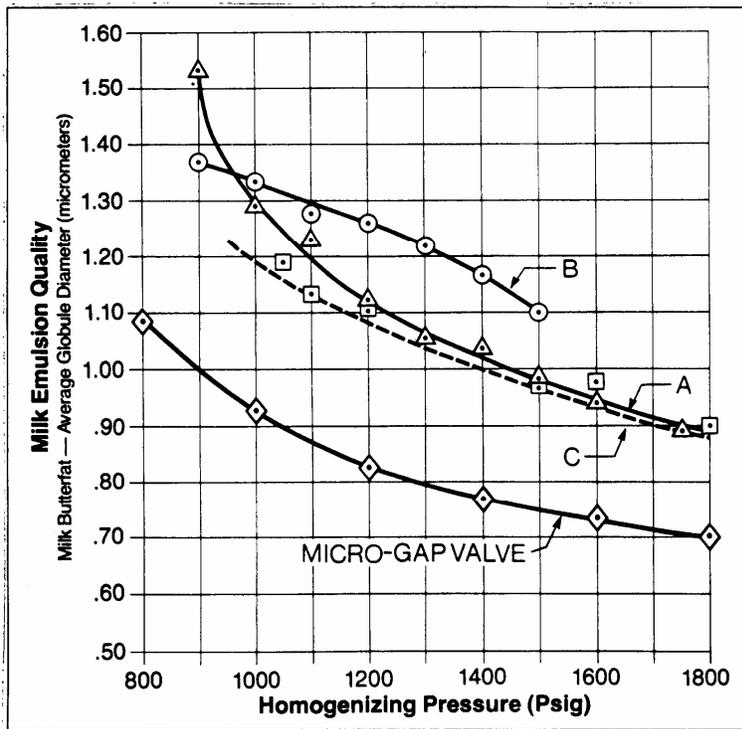
Wave springs are located between all valves (4). When pressure is released from the HVA (1), the bearing plate lifts up due to the spring tension, thereby, separating all valves from one another, releasing all fluid pressure from chamber (3) and assuring proper cleaning of the assembly.

The Gaulin Micro-Gap valve has been designed for use on dairy products. The increased homogenizing efficiency of the new valve over conventional valves and the ability to retain excellent homogenizing efficiency, even at very high flow rates, is very beneficial to the processor. The homogenizing pressure can be lowered using the new valve, and the quality of the emulsion will be equivalent to what was previously obtained with a conventional homogenizing valve.

Figure 2 shows how the Micro-Gap valve compares to other conventional valves with respect to homogenizing efficiency. The emulsion quality is expressed as the average droplet diameter of the dispersed oil or fat (determined by spectroturbidity); a decrease in average diameter signifies a better emulsion. The average diameter is plotted against the total homogenizing pressure.

It can be readily seen that the Micro-Gap valve assembly is far more efficient than the other valve designs. This is demonstrated by the fact that, in order to obtain a selected average diameter, more homogenizing pressure is required using valves A, B or C, than is required with the Micro-Gap valve. For example, the Micro-Gap valve will produce an emulsion having an average fat globule diameter of 0.82 micrometers at 1200 psig. In order to obtain this average particle size with valve A or C, more than 1800 psig is required. The emulsion is beyond the capability limits of valve B.





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