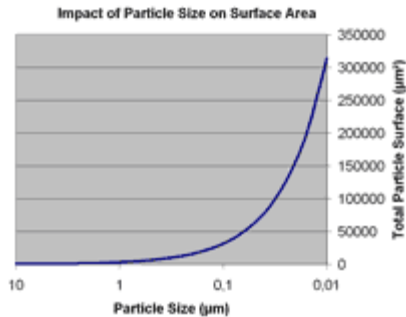


Ultrasonic homogenizing is a mechanical process to reduce small particles in a liquid so that they become uniformly small and evenly distributed. Hielscher offers ultrasonic homogenizers for application in lab and production scale.

Impact of Homogenization



When ultrasonic processors are used as homogenizers, the objective is to reduce small particles in a liquid to improve uniformity and stability. These particles (disperse phase) can be either solids or liquids. A reduction in the mean diameter of the particles increases the number of individual particles. This leads to a reduction of the average particle distance and increases the particle surface area. The graphic shows the correlation between individual particle diameter and total surface area. Surface area and average particle distance can influence the rheology of a liquid.

If there is a difference in specific gravity between the particles and the liquid, the homogeneity of the mixture can influence the stability of the dispersion. If the particle size is similar for the majority of the particles, the tendency to agglomerate during settling or rising reduces, because the similar particles have a similar speed of rising or settling.

High Pressure Homogenizer

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The most common mechanism for homogenization is high pressure homogenization. There, liquid is pressed at high pressure (approx. 2000 barg) through a homogenizing valve. When passing the valve, the liquid undergoes a short (approx. 50microsec.) high-pressure low-pressure cycle. While this mechanism works well for small, soft particles, such as fat globules in milk, it has its limitations when used for dispersions of hard and abrasive materials, such as pigments, polishing media or metal oxides, or fibrous and stringy materials, such as fruit purees, algae or sludge. This is due to the high liquid speeds (up to 120mtr/sec) and because of the small orifices of the valves used. As the abrasive material passes the pumps and the valve orifice, it causes wear. This reduces the efficiency and life time of the pump and of the valve.

Advantages of Ultrasonic Homogenizing

Ultrasonic homogenizing is very efficient for the reduction of soft and hard particles. The homogenization is based on cavitation. When liquids are exposed to intense ultrasonication sound waves propagate through the liquid causing alternating high-pressure and low-pressure cycles (approx. 20000 cycles/sec.). During the low-pressure cycle, high-intensity small vacuum bubbles are created in the liquid, as the liquid vapor pressure is attained. When the bubbles reach a certain size, they collapse violently during a high-pressure cycle. During this implosion very high pressures and high speed liquid jets are generated locally. The resulting currents and turbulences disrupt particle agglomerates and lead to violent collisions between individual particles.



One major advantage of ultrasonic homogenizers is the low number of wetted and moving parts. This reduces frictional wear and cleaning time. There are only two wetted parts: The sonotrode and the flow cell. Both have simple geometries and no small or hidden orifices.

Another advantage is the exact control over the operational parameters influencing the cavitation. Hielscher ultrasonic processors can be used at oscillation amplitudes from approx. 1 to 200 micron. The liquid pressure can range from 0 to approx. 500psig. As amplitude and pressure are the most influential parameters, the wide operational range of each parameter allows for very gentle to very destructive processing.

Hielscher ultrasonic devices are amplitude controlled. By this, the adjusted amplitude will be maintained under all operational conditions. This makes ultrasonication controllable and repeatable. Sonication under identical operational parameters will yield consistent and reproducible results. This is important for the quality of the produced material and for the scale-up of process results from the lab to the production level.

Homogenization at Any Scale



Hielscher produces ultrasonic devices for the homogenization of **any sample volume** from for **batch or inline** processing. **Laboratory ultrasonic devices** can be used for volumes from 1.5mL to approx. 2L. **Ultrasonic industrial devices** are used for the process development and production of batches from 0.5 to approx 2000L or flow rates from 0.1L to 20m³ per hour.

The table below, indicates general device recommendations depending on the batch volume or flow rate to be processed. Click at the device type to get more information on each device.

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Batch Volume	Flow Rate	Recommended Devices
0.5 to 1.5mL	n.a.	Vial Tweeter
1 to 500mL	10 to 200mL/min	UP100H
10 to 2000mL	20 to 400mL/min	UP200S , UP400S
0.1 to 20L	0.2 to 4L/min	UIP1000hd , UIP2000
10 to 100L	2 to 10L/min	UIP4000
n.a.	10 to 100L/min	UIP16000
n.a.	larger	cluster of UIP16000