

Nanotechnology and Sonication

Ultrasonic processors have become standard equipment for dispersing and deagglomerating nanoparticles. Probe sonication is a highly effective means of creating dispersions capable of remaining in suspension for many months. Qsonica has several years of experience working with customers in the Nanotech industry. If you are interested in dispersing and/or deagglomerating nanoparticles, please note the following:



Probe diameter must match sample volume. For example, a ½” diameter probe is included with the purchase of a new sonicator system. This probe is recommended for samples up to 250ml. Larger samples require a larger probe. The ½” probe may take an excessively long time to process larger volumes and may not adequately disperse the samples at all. For example, a recent customer was processing a 1,000 ml sample with a ½” probe for over 1 hour to achieve their desired results. By running the system so long they also experienced overheating of their samples. By switching to a 1” probe with a booster (to increase amplitude) their processing time was cut in half! A high gain horn can provide the same increase in output as a booster/horn combination.

Large sample volumes can be processed in a continuous flow. If a probe sonicator will disperse your sample in a beaker, it can be scaled up to larger volumes with a Floccell inline processing device (shown at right).



Organic solvents or low surface tension liquids require a solid tip probe. Standard ½”, ¾” and 1” probes have small, replaceable tips on the end. No matter how tightly the tip is attached, solvents have the ability to seep inside this connection point. The sonicator will not perform effectively once this occurs and the system may overload. Solid tip probes must be used with solvents or low surface tension liquids.

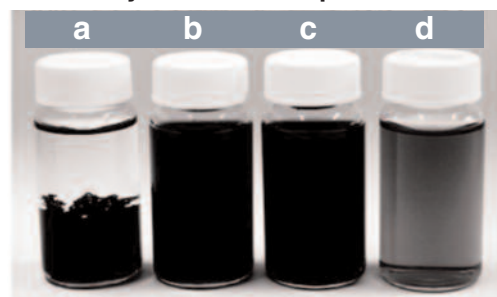
Probe sonicators are many times more powerful and effective than ultrasonic cleaner baths.

A cleaner bath takes hours to accomplish what a probe sonicator can do in minutes. Please see the following article excerpt:

Dispersions in vials (a) have coagulated CNTs in the body and at the bottom by means of bath sonication for 8 hrs, (b) appear free-homogenous with probe sonication for 3 minutes, and (c) keep free-homogenous even after 4 months of sitting at room temperature. The concentration of MWCNTs is 2500 mg/L and the MWCNTs/SDS ration is 1:10. (d) MWCNTs of (c) was diluted to 25 mg/L with deionized water.

It is clear that MWCNTs are not completely soluble in water by using bath sonicator for 8 hrs; there was much sedimentation of MWCNTs at the bottom of a small bottle (Fig. a). Upon operating 20 kHz applied by a probe sonicator, the MWCNTs are entirely dispersible in aqueous solution, forming a homogeneous-free solution (Fig. b). Remarkably, there is no sedimentation observed even after four months of sitting at room temperature (Fig. c).

Solubility of MWCNTs in aqueous solution



Temperature and viscosity are issues that should be discussed. 100°C sample temperature is generally the upper limit that a probe system can function within. The heat can travel up the probe to the converter causing overheating and overload conditions. If sample temperature is near this value the converter must be air cooled. Approximately 4000 cps. is the maximum viscosity that can be processed. Air cooled converters are available and can be attached to standard compressed air systems.

Summary: Questions to discuss with Qsonica in order to determine the correct Sonicator for your particular application:

1. What is the liquid sample volume (ml) you wish to process?
2. Do you plan on scaling up to larger volumes in the future? If so, please estimate how large?
3. Are you working with organic solvents?