

General Guidelines for Working With and Handling Particles

Keywords

Particles, polymer, silica, glass, sonication, suspension, resuspension, dilution, ion exchange, dialysis, sample volume

Goal

Particle handling tips are provided to assist users with resuspension, dilution, suspending dry particles, drying a suspension, dissolving polystyrene particles, ion exchange and dialysis.

Introduction

The following guidelines provide helpful tips on how to use our particles and should be followed accordingly. Please read the literature that accompanies your particle product for any special handling notes.

If you have a critical application or need a product that can be used without additional processing, contact our technical service department at 1-800-232-3342 or 510-979-5000, or info.microparticles@thermofisher.com.

Note: For most applications, it is imperative to ensure the cleanliness of diluents, sampling implements, and any other component that will make contact with the particles.

Resuspension

Polymer particles $\geq 0.5 \mu\text{m}$ in suspension will sediment out over time. To resuspend the particles, simply invert the bottle several times.

Avoid rigorous agitation as any bubbles formed may result in statistical artifacts. Sonication after resuspension is recommended to de-gas and break up temporary agglomerates.

For applications that require the particles to be suspended for an extended period of time, a clean magnetic stir bar may be used.

Dilution

Polymer, silica or glass particle suspensions are suitable for dilution in deionized (DI) water or any other medium that does not contain solvents known to dissolve or warp the polystyrene. Such solvents include benzene, toluene, xylene, ethylbenzene, and methylene chloride.

Generally, the addition of surfactant or dispersant is not needed unless the dilution factor is 1000X or more.

We recommend diluting only the amount needed for a given experiment or application and using the particles immediately after dilution

1. Calculate the quantity of particles needed based on desired final concentration and quantity.
2. Resuspend the original particle suspension.
3. Sample immediately into a clean container.
4. Add desired amount of filtered, particle free deionized water.

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The dilution parameters and equations shown below can be used to calculate the amount of diluent or final concentrations (refer to Dilution Parameters table below):

$$VF + DF = VC + DP$$

General relationship with parameters

$$F = (VC + DP) \div (V + D)$$

Desired or final concentration

$$D = V(C - F) \div (F - P)$$

Amount of diluent

Dilution Parameters	
Sample volume	V (mL)
Initial concentration	C (particles per mL)
Amount of diluent	D (mL)
Particle concentration in diluent	P (particles per mL) Ideally this value is "0"
Desired count	F (particles per mL)

Following is an example that uses the "Amount of diluent" equation shown above:

Example parameters:

- Sample volume (**V**) = 15 mL
- Initial concentration (**C**) = 100,000 particles/mL
- Particle concentration in diluent (**P**) = 0
- Desired count (**D**) = 2,500 particles/mL

If one wants to dilute 15 mL of a 10 µm concentrated sample at 100,000 #/mL down to 2,500 #/mL, then the amount of diluent needed is calculated as follows:

$$15 \times (100,000 - 2,500) \div (2,500 - 0) =$$

$$15 \times (97,500) \div (2,500) =$$

$$585 \text{ ml (amount of diluent)}$$

Note: Please contact Thermo Scientific technical support at 1-800-232-3342 or 1-510-979-5000 if you would like the number per mL and only have the % solids. If desired, the formula for this can be found by referencing Thermo Scientific technical note TN-01704 "Derivation of Count per Milliliter from Percentage of Solids."

Suspending Dry Particles

This procedure outlines the steps necessary to put a dry powder into suspension.

1. Wet the dry particles with a 1% surfactant solution (anionic or non-ionic, i.e., Tween 20 or Triton X100) or an alcohol such as methanol or ethanol.
2. Add filtered water to the desired amount. Alternatively, let the resin settle and pour off the suspension into another clean bottle.

Drying A Suspension

Drying a suspension to achieve a dry powder is not recommended. The particles may form permanent aggregates and be aerosolized, creating an inhalation hazard.

Dissolving Polystyrene Particles

In general, aromatic hydrocarbons will dissolve polystyrene. Some commonly used solvents for this application are:

- Benzene
- Methyl Ethyl Ketone (MEK)
- Toluene

Note: MEK and toluene will dissolve polystyrene divinylbenzene (PSDVB) over time.

Removing/Reducing Additives By Ion Exchange Or Dialysis

These procedures are used to achieve low or surfactant-free suspensions in such applications as aerosol and biotechnology. However, removing the surfactant from a suspension may compromise the stability of the product and should be performed immediately prior to use. Please contact us if you are looking for a low or surfactant-free product.

Ion Exchange

This procedure is recommended for removing ionic surfactants from the suspension and surface of the particles:

1. Obtain mixed bed ion-exchange resin (i.e., Bio-Rad AG501-X8).

2. For a 15 mL bottle of particles at 1% solids, use three to four grams of resin.
3. Wash the resin thoroughly to remove potential contaminants.
 - a. Wash resin with approximately 200 mL deionized water five times.
 - b. Allow the resin to settle, and then pour off the water.
4. Add the particle suspension to the resin in a small bottle. Add extra water if needed.
5. Roll the mixture for four to six hours and filter through washed glass wool to remove the resin.

Dialysis

This procedure is recommended for removing surfactants from the suspension (but not from the particle surface).

1. Wash the dialysis tubing (i.e., Spectrapor 12,000-14,000 molecular weight cut-off) thoroughly with deionized water and place it in a container of deionized water (submerged).
2. Keep refrigerated for storage.
3. When ready to use, cut off the desired length of tubing.
4. Place a clamp on one end or tie it off.
5. Fill about half full with the particle suspension.
6. Clamp or tie the top end and place in the container of deionized water with at least 10 to 20 times the volume of the latex.
7. Roll or stir the contents of the container.
8. Allow to dialyze for at least four hours.
9. Repeat dialysis three times with fresh water.