Use of Triton X100 Surfactant in Microtrac Particle Size Instruments

Philip E. Plantz, PhD and Toni Weigel

Application Note

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Provided By:
Microtrac, Inc.
Particle Size Measuring Instrumentation

Triton X100 is the name of a chemical that has been in use for many years in particle size measurements as well as in household goods. It is considered a high-foaming surfactant that has excellent grease dissolving characteristics as used in liquid dish detergents since the 1960s. This note will provide an explanation of its use in Microtrac instruments as a wetting agent and as a cleaning agent.

General

Triton X100 is known chemically as Octylphenoxy polyethoxyethanol (CAS 9036-19-5). It has sufficient polar groups to have solubility in water, but the solubility is limited to approximately 10%. Triton X100 also demonstrates some solubility in other liquids such as isopropyl alcohol and toluene. These solvents are more non-polar than water. The dual solubility is due to the chemical structure where polar and non-polar portions of the molecule are present.

The dual nature allows Triton X100 to be used in liquid dish detergents since the non-polar portion will interact with grease and oil, while the polar portion interacts with water. The interaction with water is to reduce the high surface tension exhibited by water due to inter-molecular bonding. Triton X100 interrupts that bonding thus allowing the oil to be “wetted” and then mix with water. Wetting is the first step in particle dispersion when desirable for particle size measurements using Microtrac instruments.

Many particles do not wet or mix well with water due to the intermolecular bonding among water molecules. Just as with oil and grease, Triton X100 reduces the surface tension of water to allow particles to be wetted and then be able to mix with water or other solvents. Particles adhering to glass can be difficult to remove when water alone is used since the surface cannot be wetted sufficiently. The use of Triton X100 wets the surface of glass and particles allowing easier removal of the particles. Thus, Triton X100 is also useful as a cleaning agent for the Microtrac cell and other circulation system components.

Cell Cleaning

Particles not wetted or dispersed but transferred to Microtrac instruments represent a source of material that can coat the inside of sample cell windows on Microtrac models X100, S3000, S3500 and Bluewave. The same can occur to the UPA or Nanotrac probe tips where the laser starts to interact with the sample particles. Particles that coat the windows prevent laser light from properly passing through to either interact with the particles to produce light scattering or to allow the light to reach the light collection areas unrestricted. The coating will cause issues with alignment (diffraction instruments DS3500, Bluewave, etc) or cause high background and other alarms. The high background means that light is being scattered excessively before sample particles are present. Continuing when high background or alignment issues occur often will negatively impact data results.

The diffraction instrument cells may be cleaned on the inside by using Triton X100 dissolved in water, or a solution prepared of water, Triton X100 and mild acid as described below. A swab (pipe cleaner or foam-tipped stick) may be used. These should fit snugly inside the cell so that there is a slight pressure on the windows as the dampened tip or pipe cleaner is pushed into the cell and along the windows. The following provides detailed information on using Triton X100 as a cleaning agent for the interior of cell windows (SRA, X100, S3000, S3500 and Bluewave). Either solution mentioned above may also be used for cleaning the Nanotrac/UPA probe tip.

Instructions

Caution: NEVER use the cleaning solution on the lenses or on the outside of cell window surfaces.

A. Required Materials

36 inches cell swab (also known as pipe cleaner) or soft-tipped wand.
1 bottle Cell Cleaning Fluid which is 3ml phosphoric acid and 2ml surfactant dissolved in 95ml deionized water.
1 - 15 ml water rinse bottle

B. User supplied item:

Distilled or deionized water for filling the water rinse bottle. This may be prepared using the composition above

C. Directions:

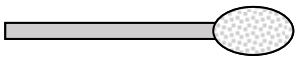
1. Preparation of solution: The cleaning solution is ready for use. The solution may be re-used until discoloration appears or particulate accumulates in the storage bottle.

2. Water Rinse Bottle: Used to rinse the interior of the cell with distilled water. Fill the bottle with distilled, demineralized or deionized water and return the top and tighten securely. The bottle has a tip that can be inserted into the cell opening.

3. *IMPORTANT!* *DRAIN Microtrac SYSTEM OF FLUID BEFORE REMOVING CELL!*

4. Initial Rinse: Insert the tip into one open end of the cell and squirt the water into the cell so that any grit is removed from the windows.

5. Using the solution and cell swabs: Cut 6 inch (15cm) length of cell swab. Make a large, round (horseshoe shape) bend in the swab so that when it is inserted, each arm contacts and applies pressure to the interior edges of the cell Twist at the ends to maintain shape. Note shape indicated by the drawing.



Soft-tipped Swab

Dampened portion

It is advisable to use acid resistant gloves when using the solution on the swab since it may “”wick” to the area of finger contact. As with all chemicals, proper care should be taken to protect eyes, hands, body and clothes. The solutions are to be used by personnel responsible for the maintenance of Microtrac cells. Dip the cell swab into the cleaning solution to within one-half to 1 inch of the twist. Hold the cell horizontally by the handle to avoid drips that may coat the outside of the cell windows. Generally, you will need to squeeze the cell swab into the cell opening since the horseshoe bend will be as large as or larger than the opening. Force the dampened swab through the cell interior until the U-shaped tip begins to exit the cell. Be sure that the edges of swab contact the edges of the cell flow path. Then remove it by pulling it back out of the cell from where it was entered. Rinse the swab with water, dampen it with cleaning solution and repeat the process. Discard the swab after cleaning. Rinse the interior with distilled or de-ionized water from the small water bottle to remove any cleaning solution residue.

6. Final steps: IMPORTANT: Please reed the following completely before re-installing the cell.

a. Replace the cell into the holder in the Microtrac sample cell compartment by reversing the procedure for removal as described in the operating manual. **NOTE: Be sure that the two “O” rings (top and bottom of the cell holder) are placed properly before inserting the cell into the holder.**

b. Leave the door open so that the cell can be observed during filling operation. Observe the cell that resides in the cell holder. While observing the cell, initiate the fill operation. **Be prepared to stop the fill operation**. Observe for leaks. If any leaks are noted from the top or bottom of the cell – STOP FILLING OPERATION. Check for properly seated o-rings and that the knurled nut on the top is properly tightened.

c. Rinse the system 4 times to remove all traces of the cleaning solution.

Please contact Microtrac for assistance: 727-507-9770 or www.microtrac.com

Wetting and Dispersion Use

Triton X100 is often used as a means of starting a dispersion process. Used in dilute solution it provides a means of reducing surface tension as mentioned above. It can be used in many situations and its application is best determined by direct testing.

The testing is performed by placing a 5% percent solution in a small container such as a 20ml beaker or weighing dish. Transfer a small portion to the solution and note whether the powder particles or slurry freely mix with the solution. If so, then the particles are being wetted. The solution is not wetting the particles when the sample resides on the top or floats - even after mild agitation. The material may also form a mass on the bottom and will not mix even when mild agitation or stirring is applied. In these cases another chemical must be sought. Contact the Microtrac Applications Laboratory for suggestions.

If the sample “wets”, then energy may be used to complete the dispersion if necessary. The need for added energy may be determined by using a light (optical) microscope to observe a portion of the wetted sample. Particles sticking together are signs of agglomeration. This is often resolved by using ultrasonic energy. This treatment should be used judiciously and a proper approach to determine optimal conditions may be obtained by contacting Microtrac applications personnel.

The Microtrac Laboratory maintains a solution of 10% Triton X100 in deionized water. To prepare this solution, 10 grams of Triton X100 is mixed with 90 grams deionized water. The mixture is stirred with heating until complete dissolution occurs. This solution may “age” as determined by observing a non-colored mass in the bottom of the storage container. When this occurs, a new solution must be prepared. We recommend that the 10% solution be freshly prepared once per month. An alternative is to prepare a solution of 5% Triton X100 which may be more stable and can be prepared without heating.

Triton X100 Can Form Bubbles

Triton X100 is a high-foaming surfactant and therefore can produce many bubbles which are measurable by Microtrac instruments. Care needs to be exercised during its use to avoid generating bubbles. Bubbles are often caused by “surging” the sample back and forth in a delivery pipette as a means of stirring the sample. To prevent this, agitation should be by an over-head stirrer and sample withdrawn from about midway between the liquid surface and the bottom of the preparative container.

Once sample has been wetted and dispersed, a portion is drawn into a transfer pipette and transferred to the Microtrac circulation system. To avoid generating bubbles in the system during transfer, place the tip of the pipette against the inside wall of the circulation bowl and expel the sample from the pipette. It is very important that the sample NOT be discharged forcefully into the waiting circulating fluid as this will cause entrainment of bubbles. Allowing the sample run down the wall into the waiting fluid will avoid bubbles.

Sometimes complete wetting can be accomplished by adding a few drops of the 5% solution directly to the circulation system and then transferring sample. When using this procedure, it is best to perform a setzero after the addition but prior to transferring sample. This will eliminate the effect of any bubble formation when sample is not present. Alignment is not needed prior to this setzero if it has been performed recently.

Triton X100 Substitute

Triton X100 is a nonionic surfactant and performs very well in many situations. However, it does not work in all situations. An alternative is to use liquid dish detergent that has a combination of nonionic and anionic surfactants. This will be shown on the label of ingredients. The combination of surfactants often enhances wetting activity. A 10 -15% solution can be used as substitute. The drawback of using such commercially available material is that the composition may change at the discretion of the manufacturer and thus its properties may change.