APPLICATION NOTE

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Turbidity Calibration of OBS® Sensors

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WHEN MEASUREMENTS MATTER

Turbidity Calibration of OBS® Sensors

This application note provides a discussion of formazin and SVDB-microsphere turbidity standards.

Formazin

In the USA, formazin is a common standard for the calibration of turbidimeters. As Figure 1 shows, formazin particles have many different shapes. The median particle size of formazin is 1.5 µm; the standard deviation of size is 0.6 µm (see Figure 2).

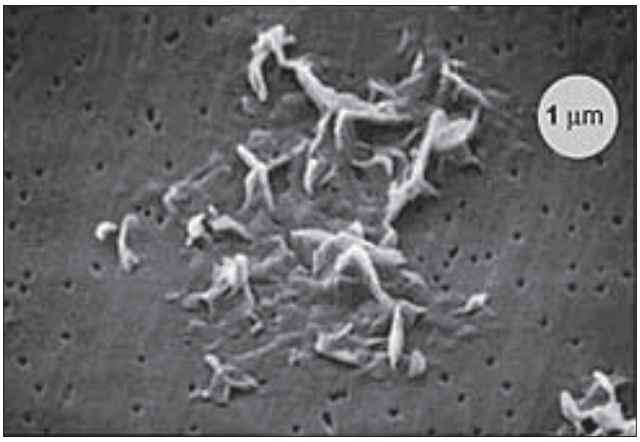

Photo courtesy of GFS Chemicals.

Figure 1. This Scanning Electron Microscopy (SEM) image shows that formazin particles have many different shapes.

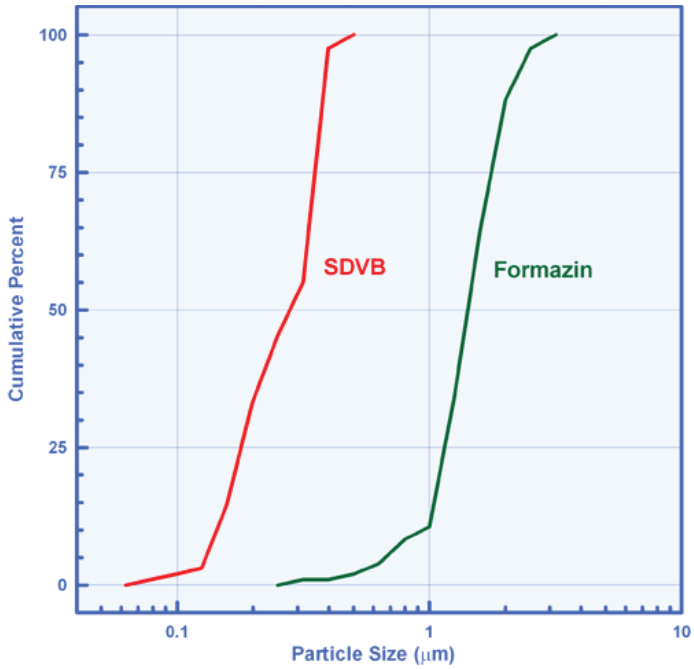

Figure 2. Graph compares the particle sizes of formazin and SDV8. The SDV8 particles are ~1/5 that of formazin particles.

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The preparation, storage, and handling of formazin will affect its accuracy and stability. Recommended formazin storage times are listed in Table 1. Working standards are prepared by volumetric dilution of 4000-NTU stock formazin with distilled water. So for example, a 2000 NTU calibration standard is made by mixing equal volumes of stock formazin and distilled water.

Turbidity (NTU)	Maximum Storage Time
1 to 10	1 day
2 to 20	1 day
10 to 40	1 day
20 to 400	1 month
> 400	1 year

Table 1. The recommended storage times for formazin.

Formazin has two other advantages. It is available from several chemical and scientific suppliers including (www.vwrsp.com, www.ColePalmer.com, www.riccachemical.com, and www.labchem.net) and it is the least-expensive, commercially available standard.

Formazin also has some disadvantages, which include:

1. It has a MSDS health-hazard rating of 2.
2. Turbidity can vary by ±2% from the lot to lot.
3. The size, shape, and aggregation of formazin particles change with temperature, time, and concentration
4. It settles in storage and must be mixed immediately prior to use.
5. Dilute formazin standards have a storage life as short as one hour.

SDVB

Another approved calibration standard is AMCO Clear supplied by GFS Chemicals (www.gfschemicals.com). It is made from styrene divinylbenzene (SDVB) microspheres. SDVB microspheres have a median size of 0.28 µm (~1/5 that of formazin particles) and a standard deviation of 0.10 µm (see Figure 2). SDVB's refractive index is 1.56. As shown on Figure 3, SDVB's microspheres are dimensionally uniform.

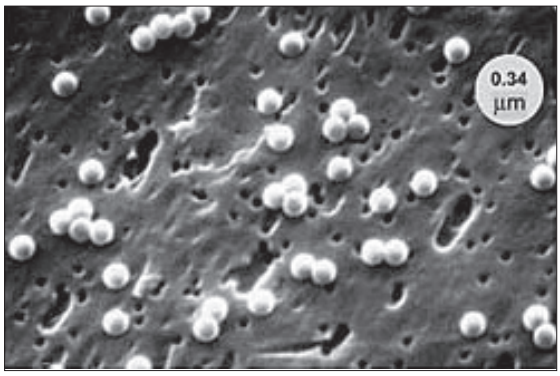

Figure 3. This SEM image shows that SDV8 particles are dimensionally uniform.

Photo courtesy of GFS Chemicals.

SDVB standards are formulated especially for OBS® sensors and cannot be used with different meters. Superior physical consistency of AMCO Clear results in a more precise calibration standard. Standard errors are less than 1% compared to 2.1% for formazin, and the linearity of SDVB is 0.15 NTU compared to 0.32 for formazin.

The key benefits of SDVB standards are:

1. <1% lot-to-lot variation in turbidity
2. Consistent optical properties from 10° to 30°C
3. Guaranteed one-year stability
4. Mixing and dilution not required
5. SDV8 is not toxic

Two drawbacks are that SDVB standards can only be used with the instruments for which they are made and they are more expensive than formazin. For example, one liter of 4000-NTU standard costs about twice as much as an equivalent amount of 4000-NTU formazin. Our instruction manuals explain how to use turbidity standards and the instructions provided by the suppliers tell how they should be handled.

Please note that unlike suspended solids concentration (SSC), turbidity values (e.g., NTUs, FTUs) do not have physical units. Therefore, if you measure water turbidity to be 100 NTUs, you cannot directly infer any physical quantities from it. Turbidity values do not represent particular SSC values, indicate light levels at the bottom of a stream, or quantify biological processes. Moreover, turbidity standards typically assume that they behave optically like sediment, which is possible when the turbidity standard and the sediment's size, near infrared (NIR) reflectivity, refractive index, and shape are similar. This is an extremely rare occurrence. For example, even the median diameters of the two approved calibration standards differ by a factor of more than five and the shape of SDVB and formazin particles also differ (see the *Comparison of Suspended Solids Concentration (SSC) and Turbidity* Application Note).

References

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