Collection and Use of

Total Suspended Solids Data

by John R. Gray and G. Doug Glysson

An important measure of water quality is the amount of material suspended in the water. The U.S Geological Survey (USGS) traditionally has used measurements of suspended-sediment concentration (SSC) (USGS parameter code 80154) as the most accurate way to measure the total amount of suspended material in a water sample collected from the flow in open channels. Another commonly used measurement of suspended material is the Total Suspended Solids (TSS) analytical method. The TSS method originally was developed for use on wastewater samples, but has been widely used as a measure of suspended material in stream samples because it is mandated or acceptable for regulatory purposes and is a relatively inexpensive laboratory procedure. The TSS analytical method (USGS parameter code 00530) to determine concentrations of suspended material in open-channel flow is fundamentally unreliable and can result in unacceptably large errors.

Summary of Recent Studies

Studies on the accuracy of the SSC analytical method by ASTM (1999) and the USGS Branch of Quality Systems (Gordon and others 2000) have shown that the SSC analysis represents an accurate measure of the concentration of the suspended sediment in a sample. Data from measurements such as TSS, turbidity, and optical backstatterance are being used with increasing frequency as surrogates for suspended sediment. Collection methods for these data are typically less-expensive than those for traditional data-collection techniques. Additionally, some measurement techniques enable acquisition of suspended-sediment data on a more frequent basis, such as every 15 minutes. However, proper use of these surrogate measurements of suspended material requires that a relation between SSC and the surrogate be defined and documented for each site at which the data are collected.

Differences between the TSS and SSC analysis were investigated using 3,235 paired TSS and SSC samples provided by eight USGS Districts throughout the U.S. (Gray and others 2000), and with 14,446 data pairs from the USGS's National Water Information system (NWIS) data base (Glysson and others 2000). The findings of these studies can be summarized as follows.

1. The TSS analysis normally is performed on an aliquot of the original sample. The difficulty in withdrawing an aliquot from a sample that accurately represents suspended material concentration leads to inherent variability in the measurement. By contrast, the SSC analysis is performed on the entire sediment mass of the sample. If a sample contains a substantial percentage of sand-size material – more than about 25 percent – then stirring, shaking, or otherwise agitating the sample before obtaining a subsample

rarely will produce an aliquot representative of the suspended material and particle-size distribution of the original sample.

2. TSS methods and equipment differ among laboratories, whereas SSC methods and equipment used by USGS sediment laboratories are consistent, and are quality assured by the National Sediment Laboratory Quality Assurance Program (OSW Technical Memorandum 98.05; Gordon and others 2000).

3. Results of the TSS analytical method tend to produce data that are negatively biased from 25 to 34 percent with respect to SCC analyses collected at the same time and can vary widely at different flows at a given site (Figure 1). The biased TSS data can result in errors in load computations of several orders of magnitude.

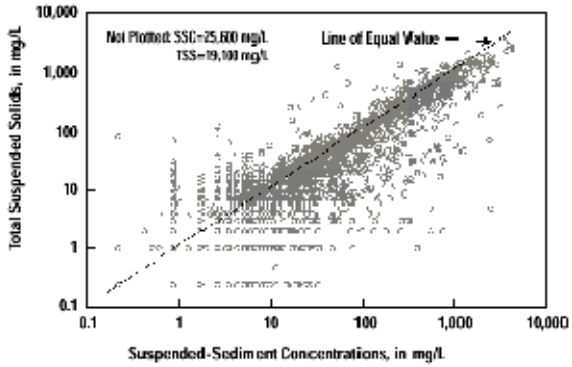

Figure 1. Relation between the base-10 logarithms of suspended-sediment concentration (SSC) and total suspended solids (TSS) for 3,235 data pairs in the scattergram. All SSC and TSS values less than 0.25 mg/L were set equal to 0.25 mg/L to enable plotting the data on logarithmic coordinates.

Analysis of paired data for TSS and SSC (Glysson and others 2000) indicates that in some cases, it might be possible to develop a relation between SSC and TSS at a given site. At least 30 paired sample points, evenly distributed over the range of concentrations and flows encountered at the site, would be needed to define such a relation. No reliable, straightforward way presently is available to adjust TSS data to estimate suspended sediment without corresponding SSC data.

Because the TSS analytical method is widely used outside of the USGS for the determination of suspended-material concentrations in water samples for open channel flow, and because the TSS analysis is specified in various States' water-quality criteria standards for sediment, the USGS wishes to share this information with its cooperators. The USGS is passing this information on to the U.S. Environmental Protection Agency's Office of Water, other Federal agencies, and State and local agencies that are involved in collection or use of sediment data.

Summary

It is not appropriate to use TSS data resulting from the analysis of water samples to determine the concentration of suspended material in water samples collected from open-channel flow and calculations of fluxes based on these data. Collection of samples to determine TSS requires concurrent collection of samples for suspended-sediment concentration analysis. Concurrent SSC analysis can only be discontinued after it is conclusively documented in a published report that the TSS data, on a site-by-site basis, can adequately represent SSC data over the entire range of expected flows.

Selected References

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***** The references (Gray et al. 2000 and Glysson et al. 2000) discussing comparability and adjustment of TSS and TSS data are available on-line for downloading at URL http://water.usgs.gov/osw/techniques/sediment.html.

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