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Flow determination by chemical method

Scope

In many instances, it is inconvenient to install a weir or other flow measuring device to determine the mass flow rate of white water or thin stock. In such a case, the mass flow rate may be found by introducing a known solution of a salt, such as sodium thiosulfate, into the stream. By determining the dilution of the salt in the unknown stream, the mass flow rate may be calculated with reasonable accuracy.

Safety precautions

This Technical Information Paper may require the use, disposal, or both of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this technical information paper, the user should determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as, local, state, and federal authorities for safe use and disposal of these chemicals.

Content

Equipment

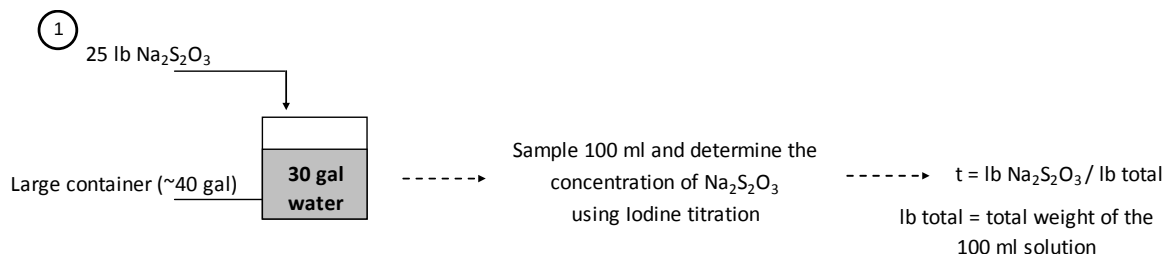
A large container [e.g., a 40-gal (150-L) drum] with an outlet at or near the bottom, fitted to introduce a constant flow into the unknown stream.

Flasks to collect samples of salt solution and white water.

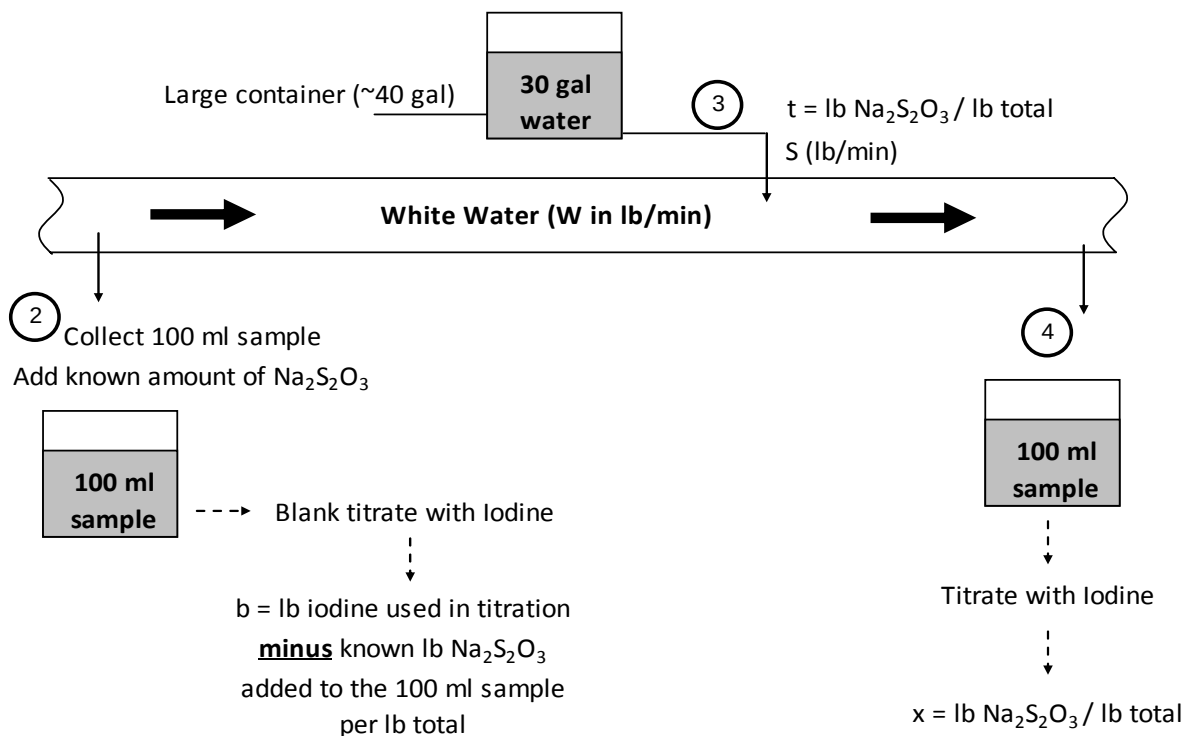
Equipment and reagents to determine the concentration of salt in the samples.

Example of method as used in white water

1. Dissolve about 25 lb (11.4 kg) sodium thiosulfate in about 30 gal (113.6 L) water in the container. Determine the concentration of thiosulfate in the solution using iodine for titration.



- To 100 mL of white water, collected before the introduction of the thiosulfate solution, add a known amount of sodium thiosulfate and blank titrate with iodine. If there is no existing sodium thiosulfate or any analyte that can react with iodine in the white water, the iodine titration should indicate that the amount of sodium thiosulfate in the 100 mL white water sample is exactly the same as the known amount of sodium thiosulfate added to the white water sample.
- Introduce sodium thiosulfate solution into the white water at a constant rate during five minutes
- Collect samples every 30 seconds (record the time response of measured sodium thiosulfate concentration). Filter the white water samples to remove the stock and titrate 100 mL of the filtrate with iodine.



NOTE: lb total = total weight of the 100 ml solution

Calculation of results

S	=	Flow of sodium thiosulfate solution in pounds per minute (or kilograms per minute)
W	=	Flow of white water in pounds per minute (or kilograms per minute)
t	=	lb (or grams) of sodium thiosulfate in 100 mL of solution (lb $\text{Na}_2\text{S}_2\text{O}_3$ / lb total)
x	=	lb (or grams) of sodium thiosulfate in white water equivalent to iodine used for titration (lb $\text{Na}_2\text{S}_2\text{O}_3$ / lb total)
b	=	blank (lb or grams of iodine – lb or grams of sodium thiosulfate used in blank test)

Then sodium thiosulfate balance $St + Wb = (S + W)x$. The white water flow can then be calculated as follows

$$W = S \frac{t - x}{x - b} \quad (1)$$