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Accurate Measurement of Gas Volumes by Liquid Displacement

A Mariotte bottle is frequently used to obtain low, constant rates of gas or liquid flow, but it is also used as a liquid displacement device to measure volumes of gas at flow rates that are far below the threshold of wet-test gas meters. Flow rates may be determined by measuring the time elapsed during collection of a quantity of gas. With Mariotte bottles of ordinary design, the liquid displacement method provides accuracies in the vicinity of 1 to 2 percent; however, with proper techniques it is possible to achieve accuracies of about 0.1 percent, but careful attention must be given to apparatus design, the relative volumes of the metered gas and the confining liquid, and other factors such as gas solubilities, the non-ideal behavior of real gases, constancy of ambient temperature, etc.

Gas nonidealities become significant when accuracies better than 1 percent are required; however, with most "insoluble" gases such as helium and nitrogen or oxygen, departure from ideal behavior will influence results less than 0.1 percent. For soluble gases such as acetylene or carbon dioxide, corrections can be appreciable and generally are of the order of 2.5 percent; for inert gases, with water as the confining liquid, the error will be about 0.02 percent.

A detailed study of the factors affecting the amount of liquid (usually water) displaced from a Mariotte bottle by a flow of gas has been completed, and equations have been derived which relate the different variables involved. The report which summarizes results of the study also includes a discussion of design criteria and operating procedures for achieving accuracies of the order of 0.01 percent. Of particular interest are discussions of the design of Mariotte bottles which will provide required levels of accuracy.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
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Patent status:

NASA has decided not to apply for a patent.

Source: Jerry D. Christian
Ames Research Center
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