A Demonstration of the Effect of Temperature on Reaction Rate

To the Editor:

There appeared recently in THIS JOURNAL (*1*) a demonstration experiment for showing the effect of temperature on reaction rate. The experiment involves the evolution of gas bubbles from the Alka-Seltzer® tablets in water. There are four difficulties with this experiment.

1) The Alka-Seltzer® tablet may not be conveniently available everywhere.
2) The rate of evolution of gas bubbles cannot be seen from a distance.
3) Sometimes it may not be possible to distinguish between the different rates of evolution of gas.
4) This process does not highlight a typical chemical reaction.

A reaction that is well known and that can be performed conveniently in any laboratory is that of permanganate with oxalic acid in acid medium. Mix 100 ml of ~0.01 *N* oxalic acid and 100 ml of ~1.0 *M* H_2SO_4 in a big conical flask. Add 25 ml of ~0.01 *N* $KMnO_4$ to this mixture and immediately divide this in three roughly equal portions in three separate 250-ml conical flasks. Put one of them in cold water (~5°C) and one in hot water (~50°C). The third one is left as such at room temperature (28°C). The times for disappearance of the permanganate color are 15–20 min for cold water, 1–1¼ min for hot water and 2–2½ min for the third one at 28°C. The experiment not only shows the effect of temperature on reaction rates but also gives a comparative idea of the rates in different ranges of temperature.

Any reaction with one colored reactant would show this. Decomposition (*2*) of the violet-colored Ce(IV) oxidation product of *n*-phenylanthranilic acid would do well.

Literature Cited

(1) Boring, W. C., and McMillan, E. T., J. CHEM. EDUC., **60**, 414, 1983.
(2) Mishra, S. K., Sharma, P. D., and Gupta, Y. K., J. CHEM. EDUC., **53**, 327, 1976.

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To the Editor:

Gupta and Mishra have pointed out what they feel are "difficulties" with our demonstration that utilizes Alka-Seltzer® tablets and water to show safely and simply, the effect of temperature on reaction rate. Gupta and Mishra suggest that a reaction based on permanganate oxidation of oxalate in acidic medium be used instead. In response to their remarks concerning our demonstration, the following comments seem appropriate.

The first difficulty with our demonstration that is pointed out by Gupta and Mishra concerns the availability of Alka-Seltzer®. Miles Laboratories manufactures and distributes Alka-Seltzer®. A representative of the company indicated Alka-Seltzer® is readily available in most countries of the free world. The company is planning to expand its distribution in countries outside the continental United States. Therefore, if the availability of Alka-Seltzer® is a problem now, it should be less of a problem in the future.

One other point should be made here. Chemical supply companies do not sell chemicals indiscriminately to anyone wishing to purchase them for demonstrations or other uses. In many cases, teachers have a lot of trouble getting chemicals they need. On the other hand, anyone can purchase Alka-Seltzer® at a store or through the mail in the free world. Therefore, Alka-Seltzer® may be more accessible than the chemicals needed (sulfuric acid, oxalic acid, and potassium permanganate) to perform the demonstration that Gupta and Mishra suggest be used instead of ours.

Gupta and Mishra indicate that other problems with our demonstration are associated with seeing and distinguishing between the different rates of the evolution of a gas from a distance. The demonstration using Alka-Seltzer® and water has been performed in a large auditorium with adequate lighting in front of two hundred students without difficulties or complaints. In demonstrations like this, the rates of reaction of the Alka-Seltzer® tablets were markedly different in two volumes of water which had a temperature difference of 20°C. Our demonstration uses 400 mL and theirs uses 125 mL. Therefore, ours is probably more visible from a distance than theirs.

Another remark was made by Gupta and Mishra that the process (Alka-Seltzer® reaction) does not highlight a typical reaction. This statement is ambiguous due to the uncertainties in the meanings of "highlight" and "a typical reaction." Since these uncertainties exist, a comment by us concerning their remark would seem pointless.

Finally, these points should be made. The reaction between Alka-Seltzer® and water that is used in our demonstration is safe and rapid. These two features are very important to a teacher and students. A teacher does not have to handle toxic chemicals or go to any trouble setting up our demonstration. Students are not bored in the time required for a reaction to take place. Also, students are familiar with the reaction between Alka-Seltzer® and water due to its widespread advertisement. Such is not the case with the reaction between oxalate and permanganate.

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