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A Eutectic Mixture with Medicinal Applications

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Few articles on eutectics have appeared in *this Journal*[2] in the past 65 years, despite the fact that eutectics are treated in virtually every undergraduate physical chemistry textbook and many physical and organic laboratory books. A survey of current introductory physical chemistry texts shows that while eutectic mixtures are treated at various levels of detail, most examples presented are aimed toward engineering applications and high-temperature chemistry. In fact, the only commonly used example of a eutectic close to room temperature seems to be the NaCl–ice system, one with which most students are already at least casually familiar.

We have found that the menthol–phenol eutectic has some important advantages for classroom use. First, it fills a gap in the textbooks by providing an example of a room-temperature eutectic that is new to students. Second, this eutectic can be used as a simple demonstration.[3] Finally, the menthol–phenol mixture provides an example of the application of eutectic science to medicine since this particular eutectic is used for the relief of itching and is dispensed in ointments for such purpose by pharmacists.[4] This medicinal application is an important motivator in classes with substantial numbers of life sciences majors.

The menthol–phenol eutectic can be presented in several ways. It can simply be mentioned during a lecture or it could be developed as a laboratory project, although we have not pursued the latter. At Eckerd College we have found this eutectic system to be an excellent overhead demonstration. Crystals of menthol (mp 44 °C) and phenol (mp 41 °C) can be placed on two sides of a Petri dish on an overhead projector. When a few crystals of each compound are placed in contact in the center of the dish, liquefaction is obvious in a minute or so, often sooner. Furthermore, the change from solid to liquid is easily seen on a projection screen, even from the rear of a large lecture hall. We have used this demonstration successfully in both general and physical chemistry classes.

Since our literature searches failed to uncover details concerning the menthol–phenol system,[5] we have made a few thermal and spectroscopic measurements on menthol–phenol mixtures. Our cooling curves for various mixtures lead to a eutectic composition of approximately 50 mol % menthol and a eutectic temperature around −30 °C. NMR and IR evidence of shifts in O–H absorptions suggest hydrogen bonding between molecules in the eutectic, as expected.

The authors will be pleased to hear from readers with information on this and other medically related eutectic mixtures.

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[2] (a) Copley, G. N. *J. Chem. Educ.* **1959**, *36*, 596; (b) Petrucci, R. H. *J. Chem. Educ.* **1959**, *36*, 603; (c) Viswanathan, A. *J. Chem. Educ.* 1960, *37*, A361; (d) Wise, J. H.; Shillington, J. K.; Watt, W. J.; Whitaker, R. D. *J. Chem. Educ.* **1964**, *41*, 96; (e) Petrucci, R. H.; Melnyk, A.; Muller, O. *J. Chem. Educ.* **1965**, *42*, 362; (f) Karunakaran, K. *J. Chem. Educ.* **1976**, *53*, 676; (g) Blanchette, P. B. *J. Chem. Educ.* **1987**, *64*, 267.

[3] For a recent call to reinstitute demonstrations in physical chemistry classes, see Crosby, G. A. In *Essays in Physical Chemistry;* American Chemical Society: Washington, DC, 1988; p. 7.

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The Human Salt Bridge

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A common electrochemistry demonstration involves pushing a strip of zinc and one of copper into a fruit like an orange, apple, or lemon or into a vegetable like an onion, carrot, or tomato.[3] The Edmund Scientific Co. sells a potato clock (#D34,357 $19.95) that runs with the help of potatoes, fruits or vegetables, and even soda pop or beer! We found that the human body works, too. An interesting historical note is that Volta[4] is said to have experienced an "unpleasant taste" when he joined a bit of tin on the tip of his tongue to a silver spoon resting further back. In this paper we describe a simple device designed for use on an overhead projector to illustrate the "human salt bridge".

The device that is shown in the figure is made of a ¼-in.-thick Plexiglas base plate that is 7.5 × 10 in. Ten pairs of electrodes are mounted side by side on the base. The 10 electrodes on each side are all attached to a copper bus bar that is in turn connected to a dual banana jack. The electrodes are approximately 1/16 × ¼ × 2 in. Transfer letters placed on the base indicate the electrode material used. Our initial set of 10 electrodes was: Cu, Ag, Pb, Fe, Cd, Mg, Zn, Al, C, and Ni. Other interesting electrode materials would be: brass, Sn, Cr, W, Pt, Pd, Mn, Co, and Au. For the more

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