Ask the Historian

The Origin of Pyrex

William B. Jensen

Department of Chemistry, University of Cincinnati
Cincinnati, OH 45221-0172

Question

What is the origin of Pyrex?

Rob Lukens
Chemical Heritage Foundation
Philadelphia, PA 19106

Answer

Ideally the glass used to make common laboratory apparatus, such as flasks, beakers, and retorts, should be colorless and transparent; have both a high melting point and resistance to chemical attack by water, alkalis, and acids; and be able to sustain both thermal and mechanical stress. Prior to the 19th century, laboratory glassware did poorly in all of these categories. The glass was often colored brown or green due to iron contamination, had a low melting point, and was extensively corroded by boiling water and alkalis, as witnessed by Lavoisier's famous experiment refuting the supposed transmutation of water into earth during refluxing (1). Because the glass was quite thick, flasks and retorts seldom survived the heating process despite the practice of luting or coating the outside with a mixture of clay and binder prior to heating (2). This was because silica-based glass is a poor conductor of heat. Consequently, when glass objects are rapidly heated or cooled, the temperature of the exterior surface changes much more rapidly than that of the interior. If the specific volume of the glass is highly sensitive to temperature, this imbalance can induce mechanical strains in the glass and result in cracking.

One solution to the heating problem was to make the glass apparatus as thin as possible in order to reduce the temperature gradient between the outer surface and the interior and, starting in the 19th century, thin-walled laboratory glassware made of relatively hard Bohemian glass (also called potash or lime glass because of its high K_2O and CaO content) became common (3). A second solution is to find a glass composition that has a low coefficient of thermal expansion, thus reducing the mechanical stress induced by uneven heating and cooling rates. This was accomplished by the German chemist, Otto Schott (figure 1), through his discovery of borosilicate glass, which has a high B_2O_5 content and a coefficient of thermal expansion that is roughly half that of common lime glass. Originally developed by the Jena Glassworks in the 1880s for use in optical systems, borosilicate glass was soon employed for the glass shades of gas mantles and for thermometer stems and, by the end of the century, so-called "Jena" brand borosilicate laboratory glassware was also available.

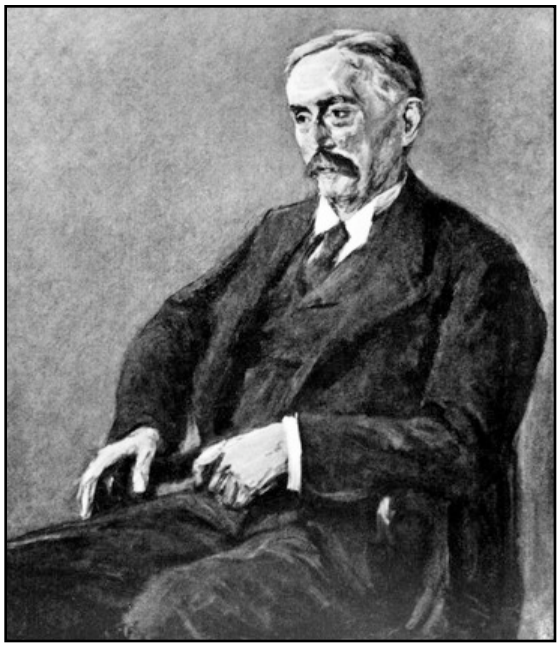

Figure 1. Otto Friedrich Schott (1851-1935).

By 1902 at least one American firm (Whitall Tatum & Co.) was also making borosilicate laboratory glassware under the trade name of "Nonsol." However, most American glass companies had trouble competing with German-made scientific glassware because it was classified as educational and was hence exempt from import duties. This situation was changed by the First World War, and in 1915 Corning Glass introduced its own brand of borosilicate glass under the trade name of "Pyrex." Initially marketed as glass cookware, the company began offering a modest selection of Pyrex

brand beakers, flasks, and glass tubing in 1916 (4). In 1918 the Bureau of Standards published a study of laboratory glassware comparing the most popular brand of lime glass (Kavalier) with six brands of borosilicate glass (Macbeth-Evans, Pyrex, Jena, Nonsol, Fry, and Libbey) (5). The borosilicate glasses were found to be uniformly superior to lime glass with respect to chemical attack by water and alkalis and with respect to thermal shock, and, of the various borosilicate glasses, Pyrex received the highest rating with respect to its ability to sustain mechanical shock.

As for the origin of the name Pyrex, at least three rationales have been suggested. Reflecting its initial use for cookware, including pie pans, it is either an English-Latin (*py* = pie + *rex* = king) hybrid for "Pie King" or a Greek-Latin hybrid (*pyr* = fire + *rex* = king) for "Fire King," or it is a contraction for its most important physical property: low thermal (*pyr*) expansion (*ex*) (6). As it turns out, none of these are correct, though the first version is closer to the truth than the others. Reflecting its use for glass pie pans, it was originally called "Pie Rite" or "Py-Right," but the name was eventually changed to Pyrex in order to rhyme with "Nonex" (for nonexpand) – a earlier brand of borosilicate glass that Corning had marketed for use in railroad signal lamps (7).

Literature Cited

1. A. Lavoisier, "Sur la nature de l'eau et sur Ie expériences par lesquelles on a prétendu prouver la possibilité de son changement en terre," *Mem. Acad. Sci.*, **1770**, *73*, 90. Reprinted in E. Grimaux, Ed., *Oeuvres de Lavoisier*, Vol. II, Imprimerie Impériale: Paris, 1862, pp. 1-28. Failure to heed this property of glass also led to the polywater scandal of the 1960s. See F. Frank, *Polywater*, MIT: Cambridge, MA, 1981.

2. This is the primary reason why most surviving chemical glassware dates from the 18th century or later. So-called examples of renaissance and medieval laboratory glassware found in many European museums are in fact mostly modern reproductions. However, many broken fragments of older glassware have been recovered by archaeologists. See R. G. W. Anderson, "The Archaeology of Chemistry," in F. L. Holmes, T. H. Levere, Eds., *Instruments and Experimentation in the History of Chemistry*, MIT: Cambridge, MA., 2000, Chap. 1.

3. E. Child, *The Tools of the Chemist: Their Ancestry and American Evolution*, Reinhold: New York, NY, 1940, pp. 93-111.

4. An early catalog for Pyrex brand laboratory glassware in the Oesper Collections is dated 1916 and is essentially an eight-page pamphlet.

5. P. H. Walker, F. A. Smither, *Comparative Tests of Chemical Glassware*, Technological Papers of the Bureau of Standards, No. 107, Government Printing Office: Washington, DC, 1918.

6. In the 1930s the name Pyrex was also employed for a brand of carbon tetrachloride used in fire extinguishers. In this context, it no doubt stood for a contraction of fire (*pyr*) and extinguish (*ex*). See J. Grant, Ed. *Hackh's Chemical Dictionary*, 3rd ed., Blakiston: Philadelphia, PA, 1944, p. 698.

7. R. L. Blaszczyk, *Imaging Consumers: Design and Innovation from Wedgwood to Corning*, Johns Hopkins: Baltimore, MD, 2000, p. 220.

Do you have a question about the historical origins of a symbol, name, concept or experimental procedure used in your teaching? Address them to Dr. William B. Jensen, Oesper Collections in the History of Chemistry, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172 or e-mail them to jensenwb@ucmail.uc.edu