

Making a Low-Cost Soda Can Ethanol Burner for Out-of-Laboratory Flame Test Demonstrations and Experiments

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S Supporting Information

ABSTRACT: This article demonstrates how to make a low-cost ethanol burner utilizing soda cans. It burns with a light blue flame suitable for out-of-laboratory flame test demonstrations where interference from a yellow flame needs to be avoided.

KEYWORDS: High School/Introductory Chemistry, Demonstrations, Hands-On Learning/Manipulatives, Atomic Properties/Structure

INTRODUCTION

The flame test is a basic high school to introductory undergraduate chemistry experiment to illustrate the emission spectra of common metals. This can be easily done when a Bunsen burner is available. However, it is difficult to do for outdoor and other applications where a gas source is inaccessible because a suitable flame source is not readily available. Thus, some variations to the flame test have been proposed over the past years. These include using cotton swabs¹ or filter paper² instead of a nichrome wire or an atomizer, using common household items as sample,³ and improvising burners,^{4,5} among others.^{6–8} One common problem in demonstrations outside a laboratory setting, especially when a candle or an alcohol burner is used, is the interference due to the yellow flame. In this article, the authors describe how to make a low-cost burner made from soda cans and ethanol as a fuel. It produces a light blue flame making the color emitted by the metal more prominent. In addition, 70% ethanol solutions are readily available from the pharmacy or personal care stores and works fine in this experiment. This was found to be a cheap, effective, safe, and a handy flame test set suitable for demonstrations in classrooms and for audiences outside the laboratory setting.

MATERIALS AND METHODS

To make the improvised soda can burner, you would need three empty soda cans. Use a utility knife or a good pair of scissors to cut two of the cans two inches from the base; these two pieces form the base and the cover of the burner. To make the support, cut the third can on both ends leaving around three inches of the aluminum body, and then cut it along its height. Finally, to make the cover, take one of the first two cans cut two inches from base and trace along the inner edges of its base using a utility knife. Use a nail or a sharp tool to puncture a hole and use a pair of long-nose pliers to cut through the base and to pull it out. The base, support and cover are shown in Figure 1.

To assemble the burner, staple the two ends of the support together so it will form a cylinder with a diameter equal to that of the rim of the base. It should fit inside leaving a hollow space

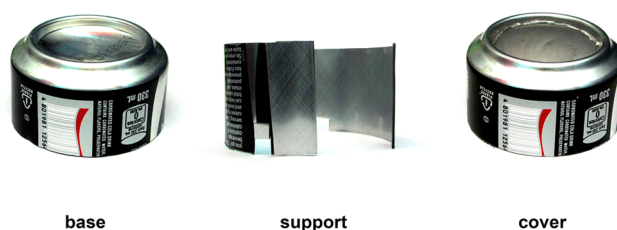


Figure 1. Three initial pieces required to make the improvised burner.

in the between the cylinder and the outside container as shown in Figure 2A. Then, place the cover upside down over the base



Figure 2. The support is placed in the middle of the base (A); the cover over the base and support forms the burner (B); and top view of burner with the pinholes along its top frame (C).

to form the burner as shown in Figure 2B. Placing the cover over the base will require some twisting to allow one to get in another. The support inside will prevent the cover from going all the way down the base since the former is taller than the latter. Afterward, puncture pinholes along the top frame of the burner by lightly hammering a small nail on the top of the burner to puncture pinholes on it as shown in Figure 2C.

Now that the burner is done, half-fill the burner with the ethanol solution, and light it with a match stick. As a safety precaution, a pair of tongs can be used to hold the match stick when lighting the ethanol solution. Once the burner is lit, add two to three drops of a metal salt solution (e.g., NaCl, BaCl₂,

LiCl, CuCl₂, KCl, etc.) onto the tip of a cotton swab. For the metal solutions, a one molar (1 M) solution is usually enough to give off its characteristic color.⁶ Place the tip just at the side of the flame to prevent the shaft of the cotton swab from melting. Keep it by the side of the flame until the flame changes its color as shown in Figure 3. To put out the flame, cover the burner with a beaker.

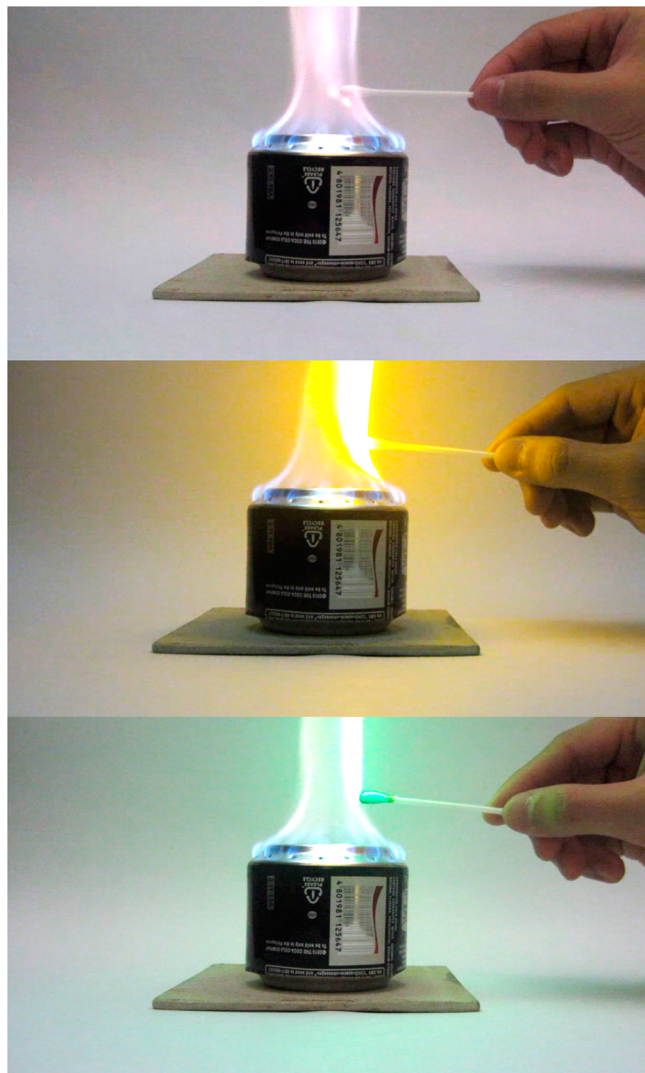


Figure 3. Flame test using the improvised burner with potassium chloride (top), sodium chloride (middle) and copper(II) chloride (bottom) solution.

Video clips for the three flame tests shown in Figure 3, and for turning the burner on and off, are available online as Supporting Information.

HAZARDS

Demonstrator and students SHOULD WEAR GOGGLES. Keep flammables away from the setup. Conduct the experiment only with small amounts of ethanol near the demonstration. The stock container of ethanol should not be near the setup. (For additional information, see the video “After the Rainbow” available online.⁹) The burner gets hot upon use; put it on a hard mat to prevent damaging the surface underneath and to easily move the burner.

ASSOCIATED CONTENT

Supporting Information

Video clips for the three flame tests shown in Figure 3, and for turning the burner on and off. This material is available via the Internet at <http://pubs.acs.org>.

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Notes

The authors declare no competing financial interest.

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