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Burning a \$1.00 Bill

Abstract

A \$1.00 bill is dipped into a clear colorless liquid then quickly ignited in a candle flame. It looks like the \$1.00 bill is burning but its not.

Materials

Isopropyl alcohol 99+%
DI Water
\$1.00 Bill
Sodium Chloride
Wide Mouthed Jar
Candle/Matches
Tongs

Safety

Isopropyl alcohol can be toxic to liver, skin, CNS, and kidneys. Repeated exposure and breathing of vapor could result in damage to target organs. Work in the hood area and always wear gloves and goggles. Isopropyl alcohol is combustible in the presence of open flames. Because this demo involves open flames it is critical that all flammable materials are removed from the immediate area of the demonstration. When doing this demonstration there is always a slight possibility that the currency might burn if that happens be prepared to put out the fire.

Procedure

Preparation of Solution:

Measure out 50 mL of isopropyl alcohol and 50 mL of DI water into a large wide mouthed jar. Add 2 grams of NaCl. The resulting solution is a 50% mixture of isopropyl alcohol and water. (In the event 70% rubbing isopropyl alcohol is used

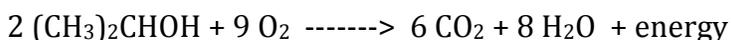
this is already diluted with water 70% alcohol and 30% water so, you will need to change the ratio for the solution and measure out 70 mL alcohol to 30 mL of DI water)

Presentation:

Obtain a \$1.00 bill or any other denomination and soak it in the 50% isopropyl alcohol mixture and remove it with a pair of tongs. Immediately after allowing the excess solution to run off move the \$1.00 bill into the flame of a candle or bunsen burner. Leave it in the flame for 1-2 seconds then quickly pull it out. The flame burns then suddenly is extinguished leaving the bill intact.

Discussion

The isopropyl alcohol has a higher vapor pressure than water causing the vapor to easily ignite when the \$1.00 bill was placed into the open flame. The combustion reaction that takes place can be described by the following reaction:



The composition of the currency is approximately 75% cotton and 25% linen. When dipped into the water-alcohol mixture the water gets readily absorbed into the cotton with the alcohol sitting more toward the surface due to its higher vapor pressure. When the bill is placed into the flame the alcohol burns off producing heat, some of the resulting heat energy is transferred to the water, which can easily absorb it due to its high specific heat capacity. This action prevents the paper from reaching its ignition temperature resulting in currency that does not burn. The presence of the water soaking the bill protects the bill while the alcohol burns itself off. The yellow flame generated during the reaction comes from the small amount of sodium chloride that was added. The sodium atoms are heated in the flame and emit a yellow light, which makes the flames more visible. Ordinarily mixtures of alcohol and water burn with a blue flame that is difficult to see.

Disposal

The alcohol water mixture can be stored in its container and re-used in subsequent demonstrations. Isopropyl alcohol can produce hazardous vapors in a closed storage flask so precautions should be taken. Dispose of in accordance with Local, State and Federal regulations.

References

Jardin, J.; Murray, P.; Tyszka, J.; Czarnecki, J. *J. Chem. Educ.* **1978**, 55, 655.

Shakhashiri, Basaam Z. *Chemical Demonstrations, Volume 1*, University of Madison Press, 1983, p. 13.

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