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Posted by Anonymous on Mon, 2019-07-29 13:19

Whoosh bottle: Is using isopropanol as a fuel safer than using ethanol or methanol?

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Laboratory Technicians:

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Answer by labsupport on question Whoosh bottle

Submitted by sat on 29 July 2019

Answer reviewed 24 November 2022

What is the whoosh bottle experiment?

The 'Whoosh bottle' activity demonstrates the combustion of an alcohol/air mixture. It is conducted using a 20L polycarbonate bottle with a narrow neck. When the fuel mixture is ignited it releases a large amount of energy accompanied by flames and a 'whoosh' sound.

This is a **high-risk activity** as the bottle has been known to explode, fires have been caused, and injuries have resulted under certain conditions.^{1,2,3} Consideration is required as to whether the educational outcomes outweigh the risks and whether it is permitted to conduct this experiment in your school jurisdiction.

There are reports of explosions occurring where:

- a glass bottle has been used ⁴
- the flammable liquid has sat in the bottle and possibly settled ⁵ or
- the flammable liquid has been placed into a warm bottle ⁵
- methanol has been used ²

Recommendations and safety notes

If this demonstration is to be conducted, it should only be performed by staff who are trained in the handling of flammable liquids. Science ASSIST recommends strict adherence to the following safety measures and procedure:

- **Never use glass bottles.**
- **Never enrich the bottle with oxygen.**
- **A written risk assessment must be approved by a HoD or HOLA.**
- **It is only performed as a demonstration** (See references for a link to ‘Safety Guidelines for Chemical Demonstrations’).⁶
- **Use only 70% isopropanol** ⁷ (also known as isopropyl alcohol, sec-propyl alcohol, propan-2-ol or 2-propanol), due to its lower vapour pressure. It is less volatile than other alcohols and will therefore react less vigorously (it will be a slower and more enjoyable reaction to watch). Consult the relevant Safety Data Sheet to determine its suitability. Some formulations may be ethanol based and/or include additional hazardous components.⁸

Note: Science ASSIST **does not recommend** the use of other alcohols or fuels (including methylated spirits, because the combustion products of the additives may be uncertain and/or hazardous) and **strongly advises against** the use of methanol due to its toxic properties.

It is important before and after the viewing of a high-risk activity, to carefully discuss the risks associated with such an activity and to discourage students from experimentation outside the school setting, to reduce the likelihood of injury.

- **Trial the activity first without an audience** if the demonstrator is unfamiliar with this activity.
- **Always ensure that the polycarbonate bottle is in good condition**, no glazing, frosting or cracking. Only use cylindrical bottles (not rectangular bottles).
- **Always use a cool dry bottle** if more than one demonstration is to occur, have several bottles ready. If a flammable liquid is placed into a hot bottle, a flash-back can occur, causing a fire.⁹
- **Always use a safety screen**, perform in a location with good ventilation, a high ceiling of at least 2.5-3m above the top of the bottle and not under smoke/heat detectors or any combustible materials.
- **Ensure** the demonstrator is wearing PPE (laboratory coat, safety glasses and closed in shoes).
- **Ensure** spectators are more than 4 metres away and are wearing safety glasses.
- **Ensure** that a fire extinguisher and fire blanket are close by and that you know how to use them.
- **Measure the amount of alcohol** used and pour out the excess alcohol and remove from the area. Always keep the stock bottle of alcohol in a different area well away from this demonstration.
- **Use a taper attached to a metre ruler** and light away from the bottles to enable a safe distance between the demonstrator and the bottle.
- **Mark the bottle** as “not suitable for storing water for human consumption” (So that it is not inadvertently recycled).

Procedure

(We suggest conducting the demonstration in a darkened area to enhance the visual effect.)

1. Make sure the bottle is completely dry.

2. Add 25mL of isopropanol to the bottle and roll the bottle to coat the inside, pour out any excess and remove from the area. Wipe up any spill from the outside of the bottle.
3. Place the bottle behind a safety shield.
4. Light a taper and hold it over the neck of the bottle via a metre ruler to provide a safe distance.
5. The isopropanol combusts with a whoosh sound and a yellow flame.
6. Allow the bottle to cool, rinse out with water and completely dry before reuse.

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