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Fuels

Posted by Anonymous on Tue, 2015-09-08 13:08

Fuels: I have been asked to provide diesel, kerosene, methanol and ethanol to be used in spirit burners for an evaluation on different fuels. Is it safe to do so? I am particularly concerned about the diesel.

Voting:



No votes yet

Year Level:

Senior Secondary

Laboratory Technicians:

Laboratory Technicians

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Fuels

Submitted by sat on 17 September 2015

The short answer is yes, under controlled circumstances this practical activity is safe to conduct, however we do not recommend the use of diesel. In addition we recommend limiting the number of methanol and kerosene burners to one per class. It is important to perform a risk assessment, considering the equipment used i.e. the spirit burner as well as the fuels used.

Spirit Burners:

There are some important safety aspects to be considered when using spirit burners. There is a potential, if good practices are not observed, that the flame may travel back into the burner and/or an explosive air-fuel mixture may be generated.

Here are some safety instructions for the use of spirit burners:

- Observe standard laboratory safety practice such as long hair tied back and wearing safety glasses
- Check that the burner is a well-constructed clear glass vessel so that the level of the fuel can be seen
- **Ensure that the wick fits tightly in the neck of the wick holder and that the wick holder fits firmly in the burner.** If the wick is loose or the holder is not fitting firmly, there is the possibility that the flame may burn back into the bottle.
- Label the spirit burner with the fuel that will be used
- Fill the burner using a funnel, to avoid spills and do this in an operating fume cupboard with no sources of ignition. Students should **not** refill the burners.
- Wipe any excess fuel from the outside of the burner.
- **Burners should be filled to more than half full.** Keeping the volume of fuel in the bottle above 50% will help to avoid an explosive air fuel mixture in the bottle. To avoid having to use a larger volume of the fuel to maintain the less than 50% air ratio, an inert object like some glass beads or marbles could be added to the flask.
- Spirit burners should be upright when lighting and not be moved when alight
- **They should be used in a well ventilated room**
- At the conclusion of the activity, empty the unused fuel into a labelled screw capped storage bottle and allow any residue in the spirit burner to evaporate in an operating fume cupboard.
- Do not store the spirit burners with fuel in them because they do not provide a vapour tight seal
- Do not have the stock bottles of fuels in the classroom during the activity

Fuels:

The next consideration is the flammability of the fuels. Methanol, ethanol and kerosene are all classed as flammable liquids, while diesel is classified as combustible. Vapours from flammable liquids can form explosive mixtures with air. These vapours can also travel to a source of ignition and flash back to its point of generation. The lower the flashpoint the more easily these liquids can be ignited.

The flashpoint of the fuel is the temperature at which sufficient vapour is produced to maintain a flame.¹ The flash point for methanol is 12°C; methylated spirits 13°C; ethanol is 13°C, kerosene about 38°C, while for diesel it is about 56 °C. Kerosene and diesel are both products of crude oil generally separated by fractional distillation, hence not being pure substances an exact flash point cannot be given. Kerosene generally consists of carbon chains of 12 to 15 carbon atoms while diesel is in the next range being 16 to 19 carbon atoms.

Methanol: Highly flammable and toxic alcohol. It is toxic by inhalation, as well as ingestion

and via the skin, so **MUST** be dispensed using an operating fume cupboard and wearing relevant PPE such as safety glasses, laboratory coat, gloves and closed in shoes. This is the most volatile out of all these fuels. Explosions have been reported using this fuel in spirit burners, but this appears to be when the above safety measures have not been observed.²

Ethanol: Highly flammable alcohol.

Methylated spirits: Highly flammable, this is generally about 95% ethanol and commonly used in camping spirit burners. This is a good suggestion for evaluating a fuel source. Note: some manufacturers include methanol in the composition of this fuel.

Kerosene: A well-established heating and lighting fuel, kerosene is usually coloured blue and has a distinctive smell. Combustion produces a complex mixture of gases, such as carbon dioxide and carbon monoxide, water, airborne solids and organic compounds.

The above fuels would be suitable for this activity, however it **must be conducted in a well ventilated room, following all the above mentioned safety instructions for using spirit burners. In addition we recommend limiting the number of methanol and kerosene burners to one per class.**

Diesel: Due to the flash point of diesel being so high, it may not ignite under normal room conditions where the temperature is around 20°C, so it may not work well anyway. Combustion of diesel also produces a complex mixture of products such as ?toxic ?and/or ?irritating ?fumes,? ?smoke ?and ?gases ? including ?carbon ?monoxide,? ?carbon ?dioxide ?and ?oxides ?of ? nitrogen as well as organic compounds, including benzene-derivatives and polycyclic aromatic hydrocarbons.? It is worth noting that in 2012 the International Agency for Research on Cancer reclassified diesel engine exhaust as carcinogenic to humans (Group 1).

Whilst burning diesel may not be identical to the emission from diesel motors, there is sufficient concern to recommend that diesel is not used in this science activity. In addition the safety data sheet states that it is intended for use only in a closed system. Therefore Science ASSIST does not recommend the use of diesel in this activity.

References:

¹ 'Flammable & Combustible Liquids – Hazards'. Canadian Centre for Occupational Health and Safety website. <http://www.ccohs.ca/oshanswers/chemicals/flammable/flam.html> (Accessed 16/09/2015)

² CLEAPSS. 2006. *L195 Safer chemicals, safer reactions*. CLEAPSS. Uxbridge UK.

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