Use of Liquid Nitrogen

Posted by Anonymous on Thu, 2016-04-14 14:53

Use of Liquid Nitrogen: Are there any restrictions to using liquid nitrogen in school laboratories? If appropriate storage is sourced and safety procedures are followed, can teachers perform liquid nitrogen demonstrations?

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Laboratory Technicians

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Submitted by sat on 27 April 2016

Thank you for your excellent question.

Summary response

Yes, demonstrations using liquid nitrogen may be conducted by suitably trained science teachers and technicians who are competent in the handling of cryogenic materials. Such use is subject to a detailed local risk assessment, and to following established procedures for the procurement, storage, use and disposal of the material. Note: It is important that schools adhere to any policies regarding the use of liquid nitrogen that may apply in their school systems.

Further details

Science ASSIST is in the process of developing a Standard Operation Procedure (SOP) for handling liquid nitrogen, which will be published on the Science ASSIST website soon. The following information summarises the greater detail that the SOP provides.

Main hazards associated with the use of liquid nitrogen

- **Potential for cryogenic (cold) burns:** Liquid nitrogen boils at minus 196 degrees C, so contact with the skin and eyes is to be avoided. Appropriate PPE would include:
  - enclosed goggles or face shield;
  - thermal or leather gloves (e.g., welding gloves that can be easily removed in the event of splashes entering a glove);
  - long-sleeved shirt with the cuffs worn outside of the gloves;
  - closed leather boots or shoes that are easily removable in the event of a splash entering a boot or shoe;
  - long pants with the cuffs outside to prevent splashes entering a boot or shoe.
- **Potential for asphyxiation:** Due to depletion of oxygen levels in the air as the nitrogen boils there is a danger of asphyxiation. Liquid nitrogen has a very high “volume expansion ratio”, that is, the boiling of a volume of liquid nitrogen creates a much greater volume of gas. Storage and demonstration activities must be conducted in well-ventilated rooms. Although nitrogen gas has the same density as air (of which it is the major component) at the same temperature, the nitrogen generated from the boiling liquid is much colder and denser than the air that it is being released into, and so it can pool in low-lying areas unless ventilated.

Procurement, transport, storage and disposal

- Procurement: Liquid nitrogen is inexpensive and readily available from gas supply sources.
- Liquid nitrogen must be transported in an open vehicle (an open truck or trailer) and not in a closed vehicle. It is recommended that schools arrange delivery and collection of the container by the gas supply company.
- Liquid nitrogen must be transported and stored in a “Dewar”, an open-necked vessel purpose-designed for such cryogenic materials. Gas supply companies hire these out at a nominal cost and it is recommended that schools make use of this service. Dewars are available in various sizes, and to minimise handling issues, sizes of 5 or 10 litres are recommended. This volume would be suitable for school demonstration purposes over several days. Liquid nitrogen must not be transported or stored in domestic vacuum

flasks.
    - Liquid nitrogen dewars should be stored in a secure, dry, cool, well-ventilated place away from heavy traffic and combustible materials. They should be stored upright on a firm level floor and secured to prevent tipping or falling.
    - Surplus liquid nitrogen can be disposed of by allowing it to boil off either in an operating fume cupboard, or in an open, well-ventilated place. It must not be poured down sinks or drains.

Demonstration activities with liquid nitrogen

All demonstrations should be subject to a well-documented risk assessment.

Unsuitable demonstration activities include:

- activities conducted close to the face or skin of the demonstrators and audience,
- activities that involve boiling-liquid-expanding vapour explosions (BLEVEs).

There is an unacceptable risk of showering spectators with liquid nitrogen splashes or other cryogenic matter.

Suitable demonstration activities include:

- cryogenic freezing, or embrittlement, of organic materials such as flowers, fruit or eggs;
- cryogenic freezing, or embrittlement, of other materials such as rubber bands, stoppers, tubing, marshmallows, soft drink cans;
- demonstrating the contraction and expansion of gas with extreme temperature change, such as using air-filled balloons;
- demonstrating the effects resulting from boiling liquid nitrogen;
- testing of various insulating materials;
- demonstrating magnetic field effects at cryogenic temperatures.

Further details of these will be given in the Standard Operating Procedure: Handling Liquid Nitrogen.

References

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