Gel Electrophoresis Safety

Electrophoresis equipment is used in many biological laboratories to separate molecules like DNA, RNA, and proteins by size and length. This process uses an electrical current (positive or negative) passed through a gel to separate the molecules by size or length dependent upon their charge. Dyes, fluorescents, and isotopes can also be used to help distinguish this migration.

Potential Hazards:

Chemical: Common chemicals used in Gel Electrophoresis experiments pose health hazards to researchers.

- Ethidium bromide is a known mutagen and acutely toxic irritant, and acrylamide is a presumed carcinogen and acutely toxic.
- Solvents such as phenol and chloroform are also acutely toxic and should be handled with caution.

Electrical: The use of electrical currents in solutions (electrophoresis buffers) can create potential risks to laboratory staff in the form of electrical shocks and burns, which may cause serious injury or even death.

- Currents of 10 milliamps are capable of "freezing" muscles, and currents as low as 30 milliamps are capable of causing respiratory paralysis.
- Voltage between 50-100 Volts is capable of producing serious injury, which has been documented by OSHA. (Household outlets operate at 120 V).
- High voltage (defined by the DOE as voltage greater than 600 V) is capable of creating currents as high as 4-5 amps in the human body, which is sufficient to cause damage to internal organs and/or death.

Best Practices:

Before running electrophoresis gels, be sure to do following:

- Inspect the electrophoresis chamber or well to ensure that it is not cracked or damaged, all seals are intact, and that no part of the chamber is leaking.
- Consider using an ethidium bromide substitute.
- Use pre-made gels or pre-mixed acrylamide and ethidium bromide solutions.
- Dispense and manipulate all hazardous chemicals (ethidium bromide, acrylamide, phenol, chloroform) within chemical fume hoods and with proper PPE.
- Exercise caution when using a microwave to melt agarose solutions. Do not use sealed containers, and beware of superheated liquids that may suddenly and unexpectedly boil. Let hot agarose solutions cool to 50°-60°C before handling, and wear insulated gloves.
- Ensure all switches and indicators are in proper working condition and that power cords and leads are undamaged and properly insulated.
- When connecting leads to the gel chamber, be sure that your gloves are dry, and only use one hand at a time. Using both hands at once can create a full circuit in the event of an equipment malfunction, potentially leading to an electrical shock.

- Ensure that no other materials (flammables, liquids, hand tools, other electronics, etc.) are near the power supply or equipment setup.
- Use outlets only with ground fault circuit interrupters (GFCIs).
- Use power supplies with safety features designed to detect electrical circuit issues (e.g., no-load, overload, sudden load changes, short circuits, etc.).
- Never touch the electrophoresis apparatus with your hands while the setup is running. Use a thermometer or infrared (IR) thermometer to assess the temperature.

All gels containing any hazardous chemical must be disposed of as Hazardous Chemical Waste through the Chematix system. Collect and dispose of all ethidium bromide gels and debris in designated ethidium bromide buckets. If you have any questions regarding waste, please contact the Environmental Compliance Unit at (585) 275-2056.

Power Supply Safety:

External power supplies are very common in laboratories for equipment and testing. Power supplies provide precise, constant voltage and amperage for a variety of laboratory setups and laboratory equipment. Most laboratory power supplies take the Alternating Current (AC) from the standard outlets in a lab (120 volts) and convert and condition that power to Direct Current (DC) for use. Transformers, rheostats, and other electrical equipment can increase or decrease the electrical voltage and current of the power supply to meet the needs of laboratory users. Capacitors can then be charged to store electrical energy for later use.

Potential Risks:

- Exposed wires create potential for electric shock.
- Capacitors can pose the risk of accidental electrical discharge when improperly used or *even when not plugged in*, due to stored electrical energy.
- Fires can be caused by a variety of electrical issues, such as overheating from using incompatible equipment (e.g. connecting new and old capacitors).

Best Practices:

Whenever using electrical equipment, do the following:

- Use the lowest voltage or amperage supply necessary.
- Check all wires, cords, and electrical connectors for damage **PRIOR** to every use.
- Connect equipment to outlets with ground fault circuit interrupters (GFCIs).
- Only use insulated cords and connectors.
- Ensure that no other materials (flammables, liquids, hand tools, other electronics, etc.) are near the power supply or equipment setup.
- Ensure proper cable management by securing all cables and cords with ties, wraps, and/or cable paths.
- Use power supplies with safety features designed to detect electrical circuit issues (e.g., no-load, overload, sudden load changes, short circuits, etc.).
- **Never try to repair energized equipment**, especially those with capacitors.

All electronic and mechanical repairs must comply with the University of Rochester's Lock Out Tag Out Program.

Additional Resources:

- DOE Handbook of Electrical Safety
- NIOSH Electrical Safety: Safety and Health for Electrical Trades Student Manual Revised Edition
- OSHA: Standard Interpretations Guarding requirements for 50 volts or more DC