

FLAMMABLES AND EXPLOSIVES **IN THE LABORATORY**

COURSE OUTLINE

- **A "flammable" is a substance that will readily catch fire and burn.**
- **Xylene, a commonly used chemical, might or might not burn depending on its condition.**
 - If it is cooled below its "flashpoint" it will not ignite.
- **A substance's flashpoint is the lowest temperature at which it gives off vapors that will burn.**
 - The vapors burn, not the substance.
- **Both flammables and explosives can be very dangerous.**
- **Explosives can be subject to very rapid chemical reactions or decomposition.**
This:
 - Releases gas and heat.
 - Has potentially violent results.
- **Gasoline is highly flammable.**
 - It ignites at as low a temperature as -45 degrees Fahrenheit.
 - Yet gasoline may still not ignite in certain situations.
- **Gasoline's "limits of flammability" also affects ignition.**
 - The lower flammable limit is the minimum percentage of vapor to air required for ignition.
 - The upper flammable limit is the percentage of vapor to air above which ignition is no longer possible.
 - For instance, diethyl ether has a range of 1.9% to 36.5% (by volume of air) for ignition.
- **Most "lower flammable limits" are reached quickly.**
 - This makes it easy for fire or explosion to erupt.
 - The surrounding air will also be above toxic limits.

- **"Ignition temperature" is also important.**
 - This is the minimum temperature required to cause self-contained combustion regardless of the type of heat source.
 - For example, carbon disulfide has an ignition temperature of 80 degrees Celsius (easily ignitable by a lightbulb or steam line).
- **It is important to remove equipment that causes heat or sparks from the areas where flammables and explosives are used. This includes:**
 - Stirrers.
 - Pumps.
 - Bunsen burners.
 - Hotplates.
- **Use a heating mantel or water bath to heat flammables.**
- **You should consult Safety Data Sheets (SDSs) for information on flammables/explosives, including their:**
 - Flashpoints.
 - Ignition temperatures.
 - Flammability limits.
- **Adequate ventilation is needed to keep chemical vapors from reaching lower flammable limits.**
 - You want to minimize the release of vapors.
 - Look for chemicals requiring auxiliary ventilation.
 - Use lab hoods to confine and remove vapors.
 - Hoods can also help to prevent flashback.
- **Always transport flammable materials in secondary containers such as:**
 - Rubber acid-carriers.
 - Plastic-jacket overpacks.
- **Transport carts should have large wheels.**
 - This helps when crossing uneven surfaces.
 - Don't use instrument, equipment or mail carts (they are too easy to tip).
- **All flammable chemicals should have a specific storage space.**
 - Return the material to this location after use.
 - Storage areas should eliminate exposure to heat or sunlight.

- **Flammable liquids should be stored in approved safety containers.**
 - Red/yellow labels identify materials with low flashpoints.
 - "Arrester spouts" help prevent flashback.
- **Be careful not to store materials in undesirable places, where they can be easily knocked over or interrupt air flow.**
 - Such as on bench tops.
 - Or in hoods.
- **Store flammables in amounts greater than one liter in approved cabinets.**
 - These cabinets don't require venting.
 - If they are vented, vent pipes should have flame arresters.
 - Keep cabinet doors closed and locked.
- **Do not store flammables in lab refrigerators unless they are explosion-proof.**
- **Several sources should be consulted regarding correct storage procedures:**
 - NFPA standards.
 - Company policies.
 - Your supervisor.
- **Strap flammable gas cylinders to benches or wall racks.**
 - This keeps them steady.
- **Specialized training is required to work with compressed gases and their cylinders.**
 - Rely only on the cylinders' labels for information, not on their color.
 - Don't "mix" flammable gases which may react.
 - Check all connections before use.
- **You should create contingency plans for flammable/explosive spills, since they often spread quickly.**
 - Remove or turn off ignition sources.
 - Keep cleanup equipment/materials nearby.
- **Use appropriate absorbents for cleanup.**
 - Vermiculite does not keep vapors from rising.
 - Carbon absorbents may be more appropriate.

- **Many chemicals are dramatically affected by increases in temperature.**
 - They can decompose quickly.
 - They may become dangerously reactive.
 - Light mechanical shock can begin reactions.
 - Catalysts can also have an effect.
 - These chemicals are called "explosives".
- **Other conditions can also create explosive situations.**
 - Certain chemicals will explode when they are mixed (such as calcium carbide with water).
 - Chemical impurities (such as organic peroxides from diethyl ether) also have the potential to explode.
- **Always check Safety Data Sheets (SDSs) before handling or storing explosives.**
 - Look for indications of potential problems.
- **You should protect yourself as much as possible when using explosives in experiments.**
 - Use the smallest possible amounts.
 - Place your equipment behind shields.
 - Wear appropriate PPE (face shield, gloves and lab coats of slow burning material).
- **Frequently check stored containers of explosives.**
 - Look for corrosion or contamination.
 - Keep them well away from shelf edges.
- **Disposing of flammable and explosive waste can often pose serious problems.**
 - Ask your supervisor/safety officer about applicable regulations.
 - Know your facility's disposal plan.
 - Most materials should not be flushed down drains (they can contaminate the environment).
 - Waste containers should be properly labeled and segregated.
 - Recycling is a possibility.
- **Plan ahead in case of fire or other emergencies.**
 - Know evacuation routes and fire exits.
 - Know locations of emergency equipment, including fire extinguishers.
 - Only use emergency equipment you have been trained on.

*** * * SUMMARY * * ***

- **Working safely with flammables and explosives takes a concentrated effort.**
- **They are dangerous.**
- **You should always take your time when using them.**
- **Learn the rules.**
- **Design your experiments carefully.**