

## Discussion and Notes

*Keep a copy of these safety training notes and a signed attendance sheet to verify regular safety training. Regulatory inspectors will usually request proof of safety training.*

*A short lecture on chemical storage can emphasize the link between laboratory safety and more traditional chemistry content knowledge, e.g. chemical reactions.*

## Compatible Chemical Families

As science instructors, we want to be sure that the chemical reactions we're teaching take place in the lab, not in the chemical storeroom! Acids and bases, oxidizing agents and reducing agents, metals and nonmetals, organic acids and alcohols . . . different classes of chemicals react in a predictable manner. To prevent dangerous, unpredictable reactions among your stored chemicals, always store chemicals in compatible chemical families in locked storage areas specifically designed for chemicals. Storing chemicals in alphabetical order can lead to dangerous conditions due to accidental mixing of incompatible neighbors.

**The Flinn Compatible Chemical Family Storage System, which was developed and first published by Flinn Scientific in 1979, is a recognized system for classifying and safely storing chemicals.** OSHA addresses the storage of laboratory chemicals in Appendix A of the Laboratory Standard: "Toxic substances should be segregated in a well-identified area with local exhaust ventilation. Chemicals which are highly toxic or other chemicals whose containers have been opened should be in unbreakable secondary containers. Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity." The Flinn Suggested Shelf Storage Pattern is endorsed by the National Institute for Occupational Safety and Health (NIOSH) in the "School Chemistry Laboratory Safety Guide" as a suggested arrangement for segregating chemicals into compatible families.

Compatible chemical families are groups or classes of compounds that can be safely stored in one major grouping, such as on storage shelves, without risk of dangerous interactions among the substances. The first major classification of compatible chemicals is into inorganic and organic families, designated as I and O, respectively. Dividing chemicals into these groups eliminates potential reactions such as the oxidation of organic compounds with strong oxidizing agents. This division is also useful because many organic compounds are flammable or combustible and require special storage conditions.

The chemicals within each broad category of inorganic and organic compounds are further subdivided into numbered family groups. Among inorganic chemicals, the I1 family, for example, consists of metals and metal hydrides, such as sodium hydride. These substances are strong reducing agents, and must be segregated from oxidizing agents, which include chemicals in I6 (chlorates, bromates, iodates, hypochlorites, peroxides, etc.) and I8 (chromates, permanganates, molybdates, and vanadates). Similarly, metals in I1 should not be stored near nonmetals in I9. Chemicals within one compatible chemical family may be stored alphabetically. Thus, the inorganic salts making up I2, acetates, halides, sulfates, phosphates, etc., typically the largest group in a chemistry storeroom, may be stored alphabetically for ease in locating salts of particular metals, such as ammonium, copper, iron, and sodium salts.

Examples of compatible families of organic compounds include O1, such as acids and anhydrides, to avoid side-reactions with alcohols and amines, which make up O2. Many chemicals within O2, O3 (hydrocarbons, esters, and aldehydes), and O4 (ethers, ketones, etc.) will be segregated from each other within flammable storage cabinets. See the following page for a complete description of all Flinn Compatible Chemical Families.

## **Protect Yourself and Your Storeroom with Flinn Storage Code Labels!**

The Flinn Compatible Chemical Family Storage Code appears on the label and SDS for every Flinn chemical. Convenient shelf labels are also available to improve safety in your chemical storeroom.

### **Flinn Inorganic Compatible Family Codes**

- I1 – Metals, Hydrides
- I2 – Acetates, Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Oxalates, Phthalates, Oleates
- I3 – Amides, Nitrates (except Ammonium Nitrate), Nitrites, Azides
- I4 – Hydroxides, Oxides, Silicates, Carbonates, Carbon
- I5 – Sulfides, Selenides, Phosphides, Carbides, Nitrides
- I6 – Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide
- I7 – Arsenates, Cyanides, Cyanates
- I8 – Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates
- I9 – Acids (except Nitric); Nitric Acid is isolated and stored by itself.
- I10 – Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide
- IM – Inorganic miscellaneous

### **Flinn Organic Compatible Family Codes**

- O1 – Acids, Amino Acids, Anhydrides, Peracids
- O2 – Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides
- O3 – Hydrocarbons, Esters, Aldehydes, Oils
- O4 – Ethers, Ketones, Halogenated Hydrocarbons
- O5 – Epoxy Compounds, Isocyanates
- O6 – Peroxides, Hydroperoxides
- O7 – Sulfides, Polysulfides, Sulfoxides, Nitriles
- O8 – Phenols, Cresols
- O9 – Dyes, Stains, Indicators
- OM – Organic miscellaneous

### **Free Online Safety Training**

Every science instructor should take advantage of Flinn Scientific's free online Lab Safety Course. Instructors have the option of viewing individual videos or following a course sequence and completing online assessments to become Flinn Safety Certified. To learn more go to <http://labsafety.flinnsci.com/home.aspx>

### **Flinn Scientific Values Your Support**

Please continue to support our efforts to improve safety in science education by ordering your laboratory chemicals and science supplies from Flinn Scientific.

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