COLORMETRICS and the MODERN HAZMAT TEAM

Goal

- The class is going to look at the application, use and limitations of the common colormetrics used by the modern hazmat team.

Objectives

- List the purpose of using colormetrics
- Discuss the NFPA 470 requirements and Risk Based Response
- Define a systematic process for the use of colormetrics
- 10.2.1.2 Identify the application, use and limitations of the following colormetrics
    - Water Paper
    - pH Paper
    - KI Paper
    - F Paper
    - M-8 Paper
    - Detector Tubes
- Given both solid and liquid samples, classify them using colormetrics

Why Colormetrics

- Readily available
- Easy to use
- Low cost
- Protection of electronic equipment
- Great information

NFPA Requirements

- **7.2.1.3.4** The hazardous materials technician shall identify the **capabilities** and **limiting factors** associated with the selection and use of the following monitoring equipment, test strips, and reagents:
- (3) Colorimetric indicators: colorimetric detector tubes, indicating papers (pH paper and meters), reagents, test strips
  These factors include but not limited to;
    - Operation
    - Calibration
    - Response time
    - Detection range
    - Relative response
    - Sensitivity
    - Selectivity
    - Inherent safety
    - Environmental conditions
    - Nature of hazard

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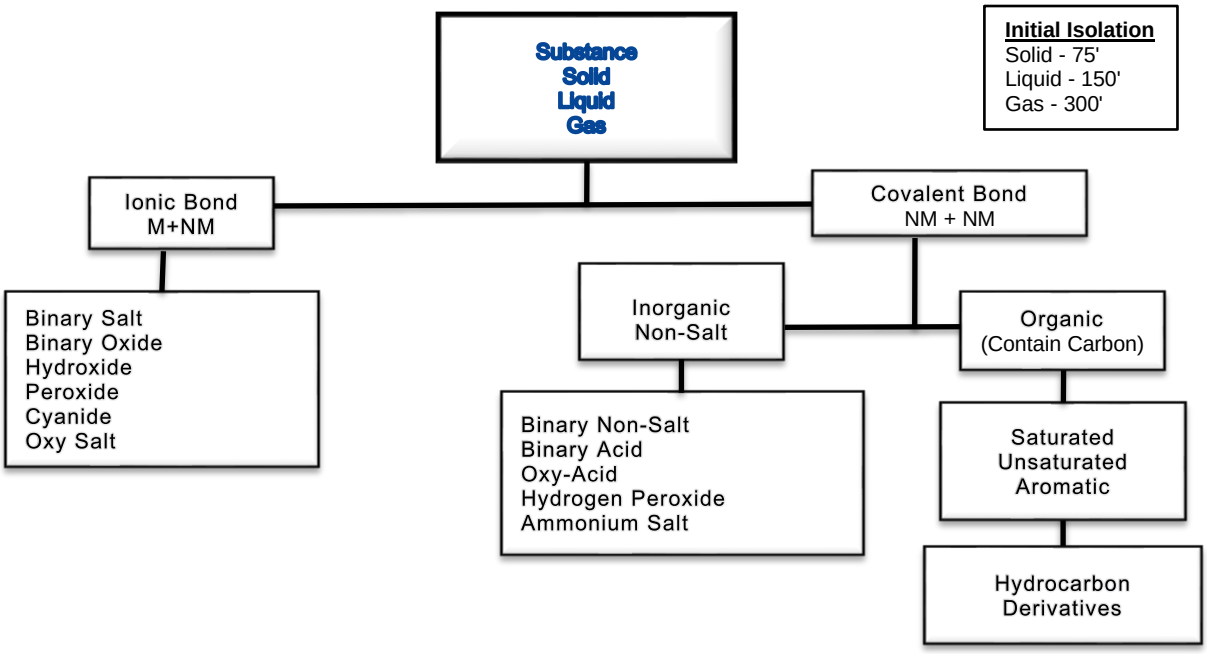
Risk Based Response

The systematic process based upon facts, science and the circumstances of the incident by which responders analyze a problem involving a hazardous material/weapon of mass destruction (WMD), assess the hazards, and consequences, develop an incident action plan, and evaluate the effectiveness of the plan.

(NFPA 470,2022)

Systematic Process

- Isolaton Distance
- PPE
- Monitoring Equipment
- Decon



IONIC BOND (Salt)

- Ionic Bond *"Transfer of Electrons"*
- A metal plus a non-metal
- Mostly solid
- Water soluble or water reactive
- Non combustible
- Tends to form caustic solutions in water
- Others may be oxidizers

Tactical Implications

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COVALENT BOND (Non-Salt)

- Covalent bond -*"Sharing electrons"*
- Non-metal plus another non-metal
- Primarily liquids and gases
- Some water insoluble
- Often fuels *"they burn"*
- Others known for their toxicity

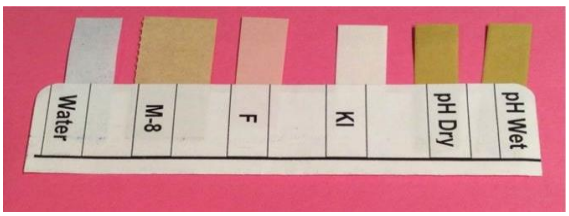
Tactical Implications

Temperature of the Material

- What can affect the temperature of the material?
  - Ambient temperature
  - Color of the container, or medium spilled upon
  - Pressure
  - Chemical reactions
  - Radiated heat

- **Infrared Thermometers**
  - Only measure surface temperatures and NOT the internal temperature
  - Can be temporarily affected by frost, moisture, dust, fog, smoke or other particles in the air
  - Do not "see through" glass, liquids or other transparent surfaces
  - A 12:1 ratio will measure the temperature of a 1" diameter circle of surface area from 12" away, a 2" diameter circle of surface area from 24" away, and so on
  - Hold the lens or opening of your infrared thermometer directly **perpendicular** to the surface being measured.

Bear Claw / Tiger Paw



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Water Paper

- Use
  - Indicates the presence of water
  - Corrosives are concentrated with water
- Technology
  - Changes color from light blue to deep blue
- Limitations
  - Methanol will test positive on the paper
- Action
  - Use in claw
  - Use Raman first, may mask FTIR response

pH Paper

- Use
  - to determine Acid vs Base
- Technology
  - Also called litmus paper
  - A Universal Indicator is a pH indicator composed of a solution of several compounds that exhibits several smooth color changes over a pH range from 1-14 to indicate the acidity or alkalinity of solutions
- Limitations
  - Can be bleached out by strong oxidizers
  - Wet vs Dry
  - Cannot be used to determine concentration
  - Bleach chemicals can bleach out the paper
- Action
  - Read leading edge
  - Use in claw
  - Should have positive response on Water Paper
  - Use Raman first, water may mask FTIR response

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Starch Paper (aka KI paper)

- Use
  - Indicates Oxidizers
- Technology
  - Paper impregnated with potassium iodide (KI) and starch for the detection of **nitrite** and free **chlorine**. **Color reaction: white to blue-violet.**
- Limitations
  - pH <1
  - All oxidizing reagents, which can liberate iodine from potassium iodide (KI), also show a positive reaction.
- Action
  - Use in claw
  - Nitrite and nitrates will not register unless the pH is <1
  - Activate paper with concentrated Phosphoric Acid for use

Fluoride Test Paper

- Use
  - Rapid determination of fluoride ions. Used to identify Anhydrous Hydrogen Fluoride gas, or liquids containing Hydrofluoric Acid
- Technology
  - In the presence of fluoride ions, the test paper shows a yellowish-white spot against a pink-red background.
- Interferences:
  - Chlorates and bromates result in a whitening of the test paper.
  - Sulfate in very large amounts also results in a whitening. The sulfate interference can be eliminated by the addition of barium chloride.
  - Oxcalic Acid will test positive on the F paper
- Action
  - Material must have a pH <1
  - Anhydrous HF will test positive on F paper and wet pH papers
  - Concentrated Phosphoric Acid will test positive on F paper, pH paper, and water paper

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M-8 Paper

- Use
  - The paper should be used to detect liquid contamination by placing the paper in contact with the suspected surface. A color change similar to that shown on the cover indicates the presence of chemical warfare agents.
  - Can be used to classify different chemical families, but this is not definitive
- **Technology**
  - Paper has three different dies which change color, classifying agent type
    - Gold – G Agent
    - Red – Blister Agent
    - Dark Blue – V Agent
  - Hydrophobic
  - Can be used to classify different chemical families
- **Limitations**
  - Designed for CWA agents only
  - Color change can indicate different chemical family
- **Use**
  - Use in claw
  - Give a few seconds for the sample to soak into the paper

Colormetric Tubes

- Use
  - to classify chemical family
- Technology
  - Glass tube filled with a chemical indicator
  - Chemical indicator inside the tube changes color in response to certain chemical(s)
- Limitations
  - Cross interferences
  - Sampling time
  - Accuracy
  - Concentration ranges
  - Shelf life
- Action
  - Use other colormetrics, electronic responses or lack of responses, anticipated materials to select tube(s)

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Sampling Solids

- Wearing full Personal Protective Equipment (PPE), collect a small amount of material, approximately 3-5 ml with the frosted scoop, and transfer into one of the provided vials.
- Sample vial opening for vapor pH.
- Using the provided 0.15 cc micro spoon, place the sample in the middle of a watch glass.
- Apply a drop of water onto the material and observe for any reaction or mixing. A reaction may also be measured with the temp gun holding it perpendicular to the disk and approximately 1/4 inch above, and squeezing the trigger for 2-3 seconds
- Observe for a steady temperature rise or fall. Caution: If water reactive, a toxic, flammable, and/or corrosive gas may be produced!
- Observe the water mixture for water solubility. Does the material dissolve completely, partially, or not at all.
- Touch pH and KI indicating papers to the solution and allow the material to wick up the paper. If the pH of the sample is <1 test with the F paper too.
- Look for the color change on the leading edge.
- If there is no change in the papers, activate the KI and F papers by placing 1-2 drops of concentrated Phosphoric Acid solution on each paper. Sprinkle a small amount of the solid on the wetted papers
- A change in the KI paper would indicate a possible nitrate/ite salt. A change in the F paper would indicate a possible fluoride salt.

Sampling Liquids

- Wearing full Personal Protective Equipment (PPE), after doing initial monitoring collect a 1-3 mL sample of the material using the provided pipette. Place the material into the provided vial.
- Remove the material to a safe location, open the vial and pass both wet and dry pH paper over the mouth of the vial and observe for a change.
- If no change, check vapors with PID and LEL detectors. Record meter response(s).
- In the watch glass, place a small strip of the provided indicating papers, pH, F, M-8, Water. Make sure the pH paper is moistened. An accurate pH can only be determined in the presence of water.
- Place a small drop of the material on each paper and observe for the appropriate positive indication.

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