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Technical Bulletin

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Industrial Paint Hazards

Description

The prevalent use of paints and coatings across many industries and organizations presents a variety of workplace hazards. In many cases, selection and use of appropriate personal protective equipment (PPE) is necessary to help control exposures. Respiratory and skin contact hazards are common across most applications. Depending on the type of paint or coating and the specific use conditions, other hazards may be present. These can include fire and explosion hazards, electric shock, fall hazards, excessive noise and other. Prior to selecting PPE for any painting operation, a hazard assessment completed by a qualified health and safety professional is necessary to evaluate exposure risks potentially present.

Types of Paint

Industrial paints and coatings can be categorized under two types: those that are liquid, which include both water-based and solvent-based; and those that are solid, which include powder coatings. The hazards present can be uniquely different for each.

Water-based and solvent-based paints are distinguished by the amount and type of organic solvent (volatile organic compounds/VOC's) present. Water-based paints, often referred to as emulsion paints generally have a lower amount of VOC's. As their name would suggest, solvent-based paints, sometimes referred to as oil-based or alkyd paints contain a higher level of organic solvents. Common organic solvents include xylene, toluene, and ethyl acetate. In comparison to solvent-based paints, the lower amount of VOC's in water-based paints reduces exposure risk due to respiratory and skin contact hazards.

Industrial powder coatings are typically produced by blending together resins, curing agents, pigments and additives. The resulting mixture is milled into fine particles or powders. These powders are applied via a pressurized spray application system that includes electrostatic charging of the particles to efficiently transfer the powder coat to the workpiece. The process is completed by transporting the painted workpiece through a curing oven. The powder coating process often results in minimal or no VOC exposure to the operator.

Respiratory Hazards

The type of paint and application method determine the operator exposure risk to respiratory hazards. Water-based and solvent-based paints include some exposure to gases and vapors (VOC's), regardless of application method. In most cases, brushing or rolling the paint results in VOC exposure only. When the paint is applied by spray, such as a pressurized industrial sprayer or simple aerosol container, an additional aerosol (particle) exposure is created. This becomes important when selecting an air purifying respirator to control exposure, as a cartridge and filter capable of capturing both VOC's and aerosol may be needed. As previously described, powder-coat paints present aerosol exposure only, in most cases.

Respiratory hazard severity is often greater for solvent-based paints due to their composition. Exposure risk is increased while using solvent-based paints, due to use of reducing agents (organic solvents), and clean-up solvents, such as mineral spirits or turpentine. Water-based paints can usually be cleaned with a warm, soapy water solution minimizing additional VOC exposure.

Isocyanates

Isocyanates are a class of chemical compounds that are found in certain solvent-based paints. They react with other chemical compounds containing alcohol groups to produce polyurethane polymers. A chemical containing two isocyanate groups is called a diisocyanate. Common examples are toluene diisocyanate (TDI), hexamethylene diisocyanate (HDI), and methylene diphenylmethane diisocyanate (MDI). Isocyanates description that includes diisocyanates) are the raw materials that make-up all polyurethane products, including polyurethane paints.

Health effects of isocyanate exposure can include skin irritation, chest tightness and difficulty breathing. Isocyanates are known to have severe adverse effects to the respiratory tract in some individuals. It is estimated that 5% - 20% of workers can become sensitized to isocyanates. Sensitization is the body's allergy-like response to a substance that has been inhaled or touched by a susceptible individual. These sensitized individuals may react to isocyanate exposure, even at very low levels below the occupational exposure limit that may not affect others. When spraying polyurethane paints, the major hazard is breathing the aerosol droplet (mist) and absorbing the isocyanate and other components into the lungs.

Controlling Exposures to Respiratory Hazards

Exposure controls for paint operations typically start with local exhaust ventilation, such as a downdraft system. These systems are designed to remove airborne VOC's and aerosol away from the painter's breathing zone. Any local exhaust system must be designed properly and inspected and maintained to ensure they function correctly.

Respiratory protection is often used as a secondary control strategy with local exhaust ventilation. In certain cases where local exhaust ventilation or other administrative controls are not practical or feasible, respiratory protection may be the primary control strategy.

Respirator Selection for Painting

Respirator selection depends on the paint type (water-based, solvent-based, or powder coat), and specifically the paint contaminants and their airborne concentrations. Respiratory protection used for painting operations can include most respirator types. These include air purifying respirators using a cartridge or filter to remove contaminants from ambient air to supplied air systems, where breathable air is provided to the wearer from a remote source, such as industrial compressor or ambient pump.

The following is a general discussion of respirator types commonly used for painting operations:

- **Disposable respirators,** also referred to as filtering facepiece respirators, are designed primarily for aerosols (dust or spray mist). Disposable models are available with activated carbon manufactured into the facepiece, which is intended for nuisance level of organic vapors less than the occupational exposure limit, such as an OSHA PEL. Disposable respirators may be an option in powder coating and for certain water-based paints, such as latex coatings.
- **Reusable respirators**, also referred to as elastomeric respirators, which include tight fitting half facepiece and full facepiece models, may be configured with a gas and vapor cartridge (e.g., organic vapor) and 95 or 100 class particle filter (N95, R95, P95, P100, etc.) for both water-based and solvent-based paints. Due to reduced performance over time, a cartridge/filter change schedule must be implemented to determine end of service life based on the conditions of use. Elastomeric respirators are the most common type of respiratory protection used in painting applications.
- **Powered Air Purifying Respirators (PAPR)** also use a cartridge to filter contaminants from ambient air. PAPR's may be configured with tight fitting reusable respirators, and with loose fitting hoods and helmets. Like reusable respirators, a cartridge change schedule must also be determined for PAPR cartridges. In contrast to a tight-fitting respirator, fit testing is not required for any loose-fitting headgear. This allows use by wearers with limited amounts of facial hair. Depending on configuration, PAPR's offer a high level of respiratory protection with Assigned Protection Factors (APF) up to 1000. PAPR's are used in a wide range of painting applications.
- **Supplied Air Respirators (SAR)** may also be configured with either tight-fitting reusable respirator or loose-fitting headgear. SAR's include both continuous flow and pressure demand types. Although an SAR does not include a cartridge

or filter, breathable air must meet Grade D requirements specified by OSHA. Most supplied air respirators provide a similar level of respiratory protection as a PAPR. SAR's are primarily used for solvent-based paints.

The use of NIOSH-certified respirators in workplace environments must be accompanied by a full respiratory protection program as specified in OSHA 29 CFR 1910.134. Important components of a respiratory protection program include points such as written standard operating procedures, medical evaluation, fit testing (where applicable), user training, respirator cleaning and maintenance, and cartridge/filter change schedule for air purifying respirators.

When selecting a tight-fitting air purifying respirator, it is very important to read and follow the donning instructions carefully and to conduct a user seal check every time the respirator is put on.

Skin Hazards

Many paint components, including organic solvents and isocyanates, present skin contact hazards requiring PPE or other exposure controls. Organic solvents (VOC's) found in both water-based and solvent based paints are known to cause a variety of health effects due to direct skin contact. Many organic solvents cause defatting of the fats and oils of the skin causing it to become dry, scaly and irritated. Prolonged contact to certain organic solvents may result in allergic skin contact dermatitis. Other organic compounds may be absorbed through the skin causing long term systemic effects to the liver, kidneys and heart. An increased risk of skin exposure may occur during the painting process such as mixing and clean-up tasks where direct contact is more likely. Also, Skin contact due to the paint aerosol (mist or powder) is possible if the paint is sprayed.

Protection of the skin becomes more critical when spraying or using diisocyanate-based paints, such as polyurethanes. These products can cause irritation to both skin and eyes. Some studies suggest that direct skin contact can also cause respiratory sensitization as previously discussed. Refer to the Safety Data Sheet (SDS) for common health effects for the paint or coating used.

Controlling Skin and Eye Exposures

Controlling exposure to the skin and eyes is typically accomplished through a combination of PPE and safe work practices. PPE may include protective coveralls, faceshield and/or eye protection and chemical resistant gloves. Protective coveralls should provide resistance to liquid splashes and/or hazardous dusts depending on type of paint applied.

Protective eyewear should meet the requirements of the American National Standards Institute (ANSI) Standard Z87.1 for safety eyewear. As per Z87.1-2015 requirements, impact rated eyewear will be marked "+" or "Z87+". Protective eyewear will be marked "D3" when designed splash protection and D4 for dust protection. Safety glasses with a foam seal around the lens area forming a partial seal are also suitable for dusty environments, such as powder coating operations. Face shields are considered supplemental protection and should be used only in combination with approved safety glasses or goggles.

Protective glove selection may vary depending on the paint and use conditions. Nitrile and neoprene or common glove materials that may offer skin protection against paints.

Work practices are also important in minimizing skin and eye exposures. Substituting solvent-based paints for water-based paints usually results in lower VOC (organic solvent) content. Worker training, such as safe mixing, spraying and clean-up techniques, can also be effective.

Fire and Explosion Hazards

Solvent-based paints present the highest risk of ignition that could lead to fire and explosion. These hazards are present for solvent-based paints in both storage and use areas. Organic solvents are rated for flammability by their flashpoint, which is the minimum temperature at which a liquid gives off vapor to form an ignitable mixture. OSHA defines a flammable liquid to mean any liquid having a flashpoint below approximately 200 degrees F. Solvent-based paints generally have a lower flash point compared to water-based paints and therefore, present a higher fire risk.

Powder coatings, which consist of fine organic particles, can result in explosions under the right conditions of use. For both solvent-based paints and powder coatings, an explosion may occur when both the concentration of contaminant (solvent vapor or dust) in the air is between the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL), and a source of ignition is present. Sources of ignition can include hot surfaces or flames, electrical discharges or sparks and electrostatic discharges.

To prevent fire and explosions in solvent-based paint and powder coating operations, equipment must be designed to isolate potential ignition sources. Consideration for intrinsic safety rating may be applicable to certain PPE, such as PAPR's, when used in these hazardous locations. Refer to the PAPR manufacturer to confirm equipment specifications meet the intrinsic safety requirements of the painting operation.

References

1. OSHA, Isocyanates, https://www.osha.gov/SLTC/isocyanates/index.html
2. CEPE, Safe Powder Coating Guideline, 7th Edition http://powder-coater.com/safe-powder-coating-guidelines.pdf

Personal Safety Division
3M Center, Building 235-2W-70
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