Safe Gelling

"Gels" used in conservation are solvent-based formulations thickened with a polymer or other material, such as Carbopol or Pemulen, to create a clear, viscous material that holds the cleaning agents on the surface of the object, allowing controlled solvent release. Other active ingredients can be added to alter its working properties including emulsifiers (i.e., Ethomeen), enzymes, or chelating agents. There are many benefits of using gel systems, such as increased solvent retention on the surface, more controlled application and penetration, cleaning selectivity, and reduced solvent waste. The reduced amount of solvent required in a gel-based application versus a free solvent application suggests that there may also be health and safety benefits.

A simple experiment was conducted to determine how much the gel formulation slows solvent evaporation, a property of the gel system that would further reduce solvent exposure for the conservator. The choice and amount of solvent and gelling medium will affect rate of evaporation, but in a simple test with acetone, a Carbopol-based gel significantly decreased the evaporation rate of the solvent. For this test, the time for half of the amount of acetone (by weight) to evaporate from an open container was found to be approximately three times faster than the same amount of acetone contained in the Carbopol gel. While more in-depth experimentation would give a broader sense of how gels affect evaporation rates, this experiment does provide an indication of how much gels can reduce solvent evaporation rate, resulting in less exposure over time.

It should be noted that while using solvent gels potentially reduces solvent exposure, they also introduce additional materials that pose their own health hazards for the conservator. It is important to consider the safety issues associated with the gel components or pre-made gels; this information is readily available in the Safety Data Sheet (SDS) for a given material.

Carbopol polymers are lightly cross-linked polyacrylic acids with different poly alkenyl polyether bridges or cross-links that combine with common bases to make clear, viscous gels (Wolbers and Stavroudis 2012). Carbopol 934, 940, 941, and EZ-4 are common thickeners used to make conservation gels. As powders, respiratory irritation and inhalation toxicity are of concern, so careful and cautious handling will prevent aerosolization. Carbopols may form a combustible (explosive) dust air mixture, so be sure to handle in small amounts; do not let dust accumulate; minimize dust when vacuuming a dry spill or emptying a container; and keep storage containers tightly closed between use. Keep powders away from heat, sparks, open flames, or hot surfaces.

Ethomeen C-25 and Ethomeen C-12 (both tertiary amine ethoxylates) are polymeric emulsifiers that function as weak basic detergents and form links with Carbopol to help form the gel (Stulik, et al 2004). Ethomeen C-25 is designated with a category 4 acute oral toxicity hazard and a category 1 serious eye damage hazard. Ethomeen C-12 can cause severe skin burns, eye damage, and other health issues if not properly handled with appropriate personal protective equipment (PPE).

Pemulen TR-1 and TR-2 are polymeric emulsifiers (high molecular weight copolymers of acrylic acid and a hydrophobic comonomer) that act as the gelling agents. They may be harmful if inhaled and cause eye irritation. Although Pemulen TR-1 and TR-2 are chemically stable and the powder has a low dust explosion risk, it would be wise to handle in small amounts and minimize dust when vacuuming a dry spill or emptying a container.

Although the experiment demonstrates that the use of gels slows evaporation, thus presenting less inhalation concern than using free solvents, gels should not replace prudent health and safety practices. Gels reduce the amount of solvent exposure in a given time, but the conservator will still be exposed during the duration of their use, therefore proper ventilation and PPE should still be used. Gelling polymers can be very specifically sensitive to solvent choice, and their longer contact time with a treatable surface requires adjustment in solvent mixture and treatment technique. The conservator should also consider using less toxic solvent alternatives, when possible. Always consult the Safety Data Sheets for any chemical that you are using.

—Miranda Dunn, student member of the AIC Health and Safety Committee, Winterthur/University of Delaware Program in Art Conservation, and other members of the AIC Health and Safety Committee

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Wearing Masks During Pregnancy

Researchers from the National Institute for Occupational Safety and Health (NIOSH) participated in three studies that provide information on wearing an N95 toxic dust mask during pregnancy, as cited below. In two studies, 22 healthy non-smoking pregnant women and 22 non-smoking non-pregnant women had physiological and subjective measurements taken with and without wearing an N95 mask during exercise and postural sedentary activities over a one-hour period.

The studies show that the effects of wearing N95 masks are mild (average of one breath-per-minute decrease in the breathing rate, two beats-per-minute increase in heart rate, 1 – 7 mm Hg increase in diastolic blood pressure and 1- 2 mm increase in mean arterial pressure). These measurements were the same for both pregnant and non-pregnant women.

More importantly, wearing an N95 mask for one hour by healthy pregnant women was not found to have an effect on