Heartland Resources Technologies Toxic Adhesives-

The Challenging Problem

There are many adhesives used today that are considered toxic. Of these, Urea formaldehyde (UF) is the most prevalent because of the high concentration of formaldehyde in the formulas.

Formaldehyde is used predominantly as a chemical intermediate. It also has minor uses in agriculture, as an analytical reagent, in concrete and plaster additives, cosmetics, disinfectants, fumigants, photography, and wood preservation. One of the most common uses of formaldehyde in the U.S is manufacturing urea-formaldehyde resins, used in panelboard products such as plywood, particleboard, and medium density fiberboard.

Formaldehyde, a colorless, pungent-smelling gas, can cause watery eyes, burning sensations in the eyes and throat, nausea, and difficulty in breathing in some humans exposed at elevated levels (above 0.1 parts per million). High concentrations may trigger attacks in people with asthma. There is evidence that some people can develop sensitivity to formaldehyde. It has also been shown to cause cancer in animals and humans. Health effects include eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; severe allergic reactions, cancer and can cause other effects listed under "organic gases." Studies suggest a higher risk of cancer among people who work with formaldehyde as well as the off-gassing in the finished products. These groups include morticians, pathologists, and chemical workers.

> The chemical formula for formaldehyde is CH_2O and the molecular weight is 30.03 g/mol.
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> The vapor pressure for formaldehyde is 10 mm Hg at -88 °C, and its log octanol/water partition coefficient (log K_{ow}) is -0.65. (1)
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> Formaldehyde is a colorless gas with a pungent, suffocating odor at room temperature; the odor threshold for formaldehyde is 0.83 ppm. (1,8)
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> Formaldehyde is readily soluble in water at room temperature. Commercial formaldehyde is produced and sold as an aqueous solution containing 37 to 50 percent formaldehyde by weight.

Interior wood products such as the panelboards listed above as well as commercial and residential furniture use large amounts of adhesives, most of which contain urea formaldehyde (UF). Urea formaldehyde releases free formaldehyde into the air over time, going from its solid form in the adhesive to a gaseous form that is ingestible by humans. Given that formaldehyde was recently classified as a

carcinogen, new regulations have been enacted to reduce formaldehyde emissions from such products. The rate at which formaldehyde is released is accelerated by heat and humidity.

The California Air Resource Board (CARB) recently enacted strict formaldehyde off-gassing limits for all interior products sold and used in the State. Additionally, there has been a bill introduced on the federal level with the full support of the panelboard industry that will severely restrict formaldehyde in interior products similar to California's CARB law.

On December 11th 2009, the US Senate Committee approved legislation sponsored by Mike Crapo (RIdaho) and Amy Klobuchar (D-Minn) to update consumer product protections under the Formaldehyde Standards for Composite Wood Act. This bipartisan legislation is also supported by the panelboard industry in contrast to the opposition to the legislation that the industry maintained during the CARB process. The bill has passed committee and now goes to the full Senate with no opposition expected.

The United States has one of the most stringent regulations on formaldehyde emissions. On December 3, 2008, EPA's Office of Prevention, Pesticides & Toxic Substances published in the Federal Register an advance notice of proposed rulemaking (ANPR) that: describes EPA's initial steps to investigate potential actions to protect against risks posed by formaldehyde emitted from pressed wood products used in manufactured homes and other places; and "policing" and enforcement of regulations will take years to enforce- especially products entering the United States from other countries.

"There had been no comprehensive look [at formaldehyde] for about 15 years," said Thomas J. Kelly, PhD, chemist at the Battelle Memorial Institute in Columbus, Ohio. "In the 1980s, the Consumer Product Safety Commission did testing, but things have changed since then."

Dr. Kelly and colleagues recommended more research on surface coatings that reduce emissions from bare wood products, as well as additional study of human exposure to high formaldehyde emissions from products such as clothing, cosmetics, paints, and wallpapers. They added acid-cured finishes and a person's activity patterns during application of wet products are important areas for more study. We are finding more and more formaldehyde in products that we never would dream of seeing in the past.

Dry construction products with high emission rates included UF particleboard and cabinet doors with a white acid-cured finish. Household products with high emission rates included new permanent press draperies, shirts, and sheets. Wet construction products with high emission rates included paint, wallpaper, and commercially applied floor finishes including base coats and top coats, with emissions from the base coat higher than emissions from the top coat. The study noted that since the

floor finishes tested are applied only by qualified contractors, the exposure to the general public probably is less because of the lag time between application and exposure to residents of homes where the coats have been applied.

Is there a viable solution? Yes, Heartland Resource Technologies has developed a superior proprietary (patented) low-cost soy protein-based adhesive technology for use in engineered wood products. These Soyad® adhesives provide a cost-competitive, environmentally friendly alternative for today's demanding wood products currently using UF.

Heartland Resource Technologies has also developed a unique dispersion technology to be used as a substitute for phenol formaldehyde adhesive and isocyanate adhesive, as well as extenders for PVA and latex adhesives. The technology reduces the amount of toxins normally found in these adhesives even though formaldehyde off-gassing does not occur with these existing resins. Some of the many products that use these adhesives are carpet, gypsum board, packaging, insulation and wood assembly. The characteristic of the adhesive addresses the challenges of the adhesive industry –toxic chemicals, high costs, and the dependency on petroleum based raw materials.

Heartland Resource Technologies formaldehyde free adhesive is considered "green" and is the lowest price formaldehyde free adhesive currently available for the engineered wood products industry. The technology is already being used by several panel board manufacturers worldwide.

For future information

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