# Crystal Cabinet Works Eliminates Methylene Chloride

In 1997, Crystal Cabinet Works, Inc., manufactured cabinetry and millwork, employing 600 people. Using conventional air spray guns, Crystal used about 4,000 gallons of methylene chloride based adhesive a year to create laminated products. Each gallon of adhesive was 88 percent methylene chloride.

The methylene chloride based adhesive sprayed easily and dried quickly. The adhesive was not flammable and was considered a non-VOC (volatile organic compound).

## Incentives for Change

Methylene chloride is a potential carcinogen. Because of its human health hazard, the Occupational Safety and Health Administration (OSHA) lowered the limit on worker exposures. Complying with OSHA would have required Crystal to have a costly program for routine air monitoring and medical surveillance of affected employees.

Because of methylene chloride's environmental hazard from being a hazardous air pollutant (HAP), the U.S. Environmental Protection Agency (EPA) developed the Wood Furniture Manufacturing National Emission Standard for Hazardous Air Pollutants (NESHAP). This sets limits for emissions from methylene chloride adhesives.

## Solvent-based Alternatives

Switching to another solvent-based adhesive was not an option because it would:

- most likely be flammable and considered both a HAP and a VOC.
- jeopardize Crystal's Option B Registration Air Permit that has a 2,000 gallon a year limit on the use of VOC-containing materials.
- be a compliance concern with the NESHAP, OSHA, and National Fire Protection Act (NFPA) standards for spraying flammable liquids.

## Investigating Waterbased Adhesives

Crystal decided to investigate waterbased adhesives. Its primary criteria for an alternative was bond strength. Because no industry standard existed, Crystal set 100 pounds as the acceptable minimum using the methylene chloride bond strength as their benchmark. It also had to develop a technique to test bond strength.

The company determined which criteria to test, ensuring that all variables were considered. Crystal designed several experiments to test alternative adhesives. The most effective experiment used the same substrates as Crystal's products. Boards were glued together and bond strength was tested at four different intervals, from one hour to 30 days.

The company found that the more heat applied—up to 140 degrees Fahrenheit—the faster an adhesive dried. Also, the more pressure applied when the glue was laying up after the substrates were joined, the stronger the bond that was formed.

## Waterbased Spray Contact Adhesive

Crystal tested the bond strength of numerous waterbased adhesives under different application, pressure, substrate and curing scenarios. Crystal found that the waterbased adhesive it was using got stronger as it cured, unlike the methylene chloride adhesives. A neoprene rubber waterbased adhesive was selected because it had the highest bond strength.

## Application Equipment

Crystal replaced all conventional air spray guns used for adhesives with high-volume/low-pressure (HVLP) guns. These high transfer efficiency guns reduce overspray, making less mist. This improves materials use, decreases employee exposure and reduces the need for cleanup.

Roll coating was eliminated as an application option because it would only work on flat parts.

## Delivery System

Crystal anticipated problems using pumps to deliver adhesive to the spray guns. Because waterbased adhesives are rubber based, heat generated by the pistons could cause the adhesives to coagulate, clogging the equipment. Pressure

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pots—which use air pressure—were purchased to push the adhesive from the container to the gun.

## Infrared Curing Equipment

For waterbased adhesives, the time it takes for the adhesive carrier—water—to evaporate is dependent on ambient conditions like temperature and humidity To minimize dry time and prevent production bottlenecks, infrared (IR) curing equipment was added.

Various types of IR light fixtures and ovens were ordered to accommodate all part shapes and sizes. Dry time was much faster than air drying methylene chloride adhesives. Going from 15 minutes to under two greatly increased throughput.

## Results

Initially the process changes slowed down Crystal's workflow. By changing the type of IR lights used and training the employees how to use the new equipment, overall workflow was as good as before.

Less waterbased adhesive was needed because it had a higher solids content than the methylene chloride glue. Although the waterbased adhesive costs more per gallon, it saved $32,000 a year.

Switching to the waterbased adhesive reduced Crystal's reportable toxic chemical emissions by 32,000 pounds per year and it also helped to avoid OSHA's methylene chloride standard and stay in compliance with EPA's NESHAP for the wood furniture industry. Using OSHA estimates, complying with the methylene chloride standard would have cost Crystal over $100,000.

Using waterbased spray contact adhesive eliminated the use of methylene chloride in both Crystal facilities.

## Additional Efforts

Crystal also switched to using low-VOC and low-HAP solvent-based wood coatings. This helped reduce the toxic chemicals managed by 65 percent. It also reduced the company's VOC emissions by 68 percent.

Crystal Cabinets estimated that converting to HVLP and air-assisted airless spray guns from airless and conventional guns saved 16,500 gallons of coatings per year and $200,000.

## Update

Over time, Crystal's product mix changed, making the waterbased adhesive system unnecessary. In 2003, the company converted to a nonflammable, no HAP solvent-based adhesive to bond laminated products.