Technology Brief

Color-Coating Recycled Glass

A manufacturer of niche market colored crushed glass was having problems with the durability of colored coatings on glass, especially under conditions of high moisture. Research was conducted to develop an effective organic coating system for coloring clear glass.

Previous Coating System
The manufacturer was using a butadienne rubber-modified styrene polymer coating for coloring clear glass. The coatings are solvent-soluble, evaporative drying, and maintained a level of translucence, while providing vivid colors. Under high moisture conditions, however, the coatings were flaking off. The manufacturer already had a considerable investment in application equipment for this coating formulation, and was pleased with the aesthetics.

The goal of the project was to find an additive that would improve the durability of the coatings.

Adhesion Issues
Laboratory analysis revealed that the coatings developed weak molecular binding forces, no covalent chemical bonds, and little mechanical adhesion (for adhesion definitions see *ASTM D 907*). When the coating was stressed by water immersion, the weak molecular bond forces were overcome, with resultant delamination. The process was accelerated by water of high purity or high temperature. Microscopic examination showed that delamination occurred on both freshly fractured glass faces and original smooth surfaces.

Key Words

Materials:	Recycled Glass.
Technologies:	Organic coatings for coloring glass.
Applications:	Colored glass
Market Goals:	A niche market for aesthetic, crafts, and art applications.
Abstract:	Results of research to find a coating system for coloring glass.

Coupling Agents
Interfacial chemical bonds can be established with dramatic increases in bond strength by the use of coupling agents. Chrome complexes, titanates, and silanes have been reported to be effective in establishing interfacial chemical bonds. Eight commercial products were tested.

Products
The following products were tested:
Dow Chemical 6040
Dow Chemical 6032
Dow Chemical 6030
Dow Chemical 6020
GE Silicones 1708
Wacker P-010
Titanate TYZOR TBT
Plasticizer Flexol EP-8

Test methods

NIST MEP
Environmental Program

 # GL-97-8

Adhesion tests ASTM D 3359-91, methods A and B, were used. All products were tested under method A. The most successful products under method A were then tested under the more rigorous method B.

In addition, coated samples were tested by coating, drying for three days, then immersing in water, with periodic visual examination for delamination.

Results

The most successful coupling agents were Dow 6020 and GE Silcones 1708. These coupling agents, when added to the coating at a level of .9% by weight, demonstrated excellent adhesion with only slight delamination in the immersion test.

Coating Technique

Coating technique is extremely important for the durability of the coating. Effective coupling depends on satisfying the following criteria:

1) Good mechanical dispersion of the silane into the coating to insure uniform coupling;

2) Recent mechanical dispersion, because silanes have a tendency to diffuse or migrate to the inorganic surface;

3) Proper moisture conditioning of the glass to help assure that the silane does not remain unhydrolyzed and fail to couple.

Addition of Water

The addition of a small amount of acidified water to the glass particles prior to coating should greatly enhance the coupling efficiency. The water can be acidified by adding one ounce of glacial acidic acid to one gallon of water. Add approximately three fluid ounces of acidified water to 100 pounds of crushed glass, mixing thoroughly before adding the silane-modified coating.

References

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Ahagon, A., and Gent, A. N., *Journal of Polymer Science*, Physics, vol. 13, 1975, page 1285.

Dow Corning Guide to Silane Coupling Agents, pp 1-13.

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For More Information

For more information call CWC at (206) 443-7746, email info@cwc.org, or visit the CWC Internet Website at www.cwc.org.

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