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IN•TOUCH®

INFORMATION ON FLEXIBLE POLYURETHANE FOAM

IN•TOUCH® is a regular publication of the Polyurethane Foam Association (PFA). It covers topics of interest to users of flexible polyurethane foam and is designed as a quick reference for background information on key issues. To get more detailed information about a particular topic, consult a PFA member.

Flexible Polyurethane Foam Fabrication: Adhesives Update

This issue serves as a companion piece to INTOUCH® Volume 1, Number 5, entitled Foam Fabrication and to INTOUCH® Volume 9, Number 1, entitled Flexible Polyurethane Foam Fabrication: Equipment and Capabilities Update. The prior INTOUCH® bulletins provide information on flexible polyurethane foam (FPF) fabrication, cutting and post treatment technologies.

This issue discusses current adhesive composition technologies used for bonding FPF to other porous surfaces such as FPF, fabric and cardboard, and to non-porous surfaces such as plastic, metal or wood. Basic processing, environmental, health and safety considerations of adhesives selection are summarized. This information, based on scientific information available at the time of publication, supplements PFA members' efforts to educate their customers on the characteristics of various adhesive technology options.

Production of most FPF slabstock material requires fabrication, and many fabricated foam product designs require the bonding of foam to various surfaces, including: foam to foam, foam to fiberfill, foam to fabric, and to other surfaces such as: paper products, wood, metal, or plastic. Effective adhesives are necessary to achieve an adequate bond, in which the foam will tear before the bond separates.

Many FPF fabrications require the use of adhesives to bond foam to foam, foam to fiber, or foam to non-porous surfaces such as plastic, metal or wood.

Adhesive Components

There are essentially two component categories in an adhesive coating: the solids (including bonding compound and tack agent) and the carrier (delivering solids to the FPF surface and evaporating, thus allowing the bonding compound to cure). While tack agents (the compound used to make the adhesive initially stick) are generally rosin-based products, there can be numerous options for bonding compounds and carriers.

When fiber is applied to foam, fast tack time with a longer open time is necessary to allow the fiber to be worked into place.

Serving Environmental and Health Objectives

Twenty years ago, selecting adhesives for FPF fabrication was far less complicated than it is today. Most product fabrication designs that required bonding FPF to porous or non-porous surfaces could be achieved by using simple 111- trichloroethane -carried adhesives. Trichloroethane made an effective adhesives carrier because it was highly volatile, evaporated quickly, had low toxicity, had favorable economics, and made a fast bond. However, use of trichloroethane in this bonding process decreased after it was identified as an ozone depleting substance.

Methylene chloride also made an effective adhesives carrier from a volatility standpoint, but its use in industry is limited by its classification as a hazardous air pollutant, which severely restricts emission levels. In addition, OSHA closely regulates the Permissible Exposure Limit (PEL) of methylene chloride for workers in the United States, and the PEL is set at a level that essentially makes methylene chloride an impractical adhesive carrier for many FPF fabrication applications.

So, today's adhesive carriers are typically either water-based or non-hazardous air pollutant solvent based formulations. In fact, some adhesive formulations, such as hot melt systems, are 100% solids and require no carrier at all.

Matching the Adhesive to the Job

To satisfy environmental, health and safety objectives as well as serve the specialized bonding needs of advanced FPF fabrication designs, it was necessary to develop and offer the industry a variety of adhesives formulations. Selection of an adhesive today requires an understanding of adhesives components and the properties that they contribute. Adhesives suppliers can knowledgeably provide product recommendations based on information from the foam fabricator. As a supplemental tool, this issue of INTOUCH® addresses some of the basic considerations used to match an adhesive to a FPF bonding job.

Adhesive Performance Considerations

Selection of bonding compounds and carriers regularly involves several performance considerations:

Bonding Compound Considerations

- Tack
- Open Time
- Bonding Time
- Viscosity
- Pliability
- Chemical Compatibility
- Melt Temperature

A fairly fast **tack** (initial sticking capability) is desirable for most FPF fabrication applications. Adhesives with slow tack may require extra hand pressure or delay workflow. Even with a fast tack, adequate **open time** (the time that the surfaces remain workable) is required when substrates must be positioned or shaped, like when a fiberfill cap is applied to a seat cushion. **Bonding time** (the amount of time required for an adhesive to form a permanent bond) is important from a production standpoint. Maintaining acceptable manufacturing costs or workflow is difficult when production is slowed to accommodate extended bonding requirements. With some adhesives, open time is independent of bonding time. Open time may be short, while bonding time may be relatively lengthy. This discrepancy can occur with some water-based adhesives.

When FPF products are used as part of household furnishings, such as cushioning for upholstered furniture or bedding, it is necessary to maintain **pliability** of the finished product, which includes adhesive layers. If the adhesive becomes hard or brittle, it could be felt through the upholstery. However, a brittle adhesive may be appropriate if applied over a solid substrate such as molded fiberglass, wood decking, or a cardboard container surface.

Special adhesives are available for applying foam to composite plastics.

The **viscosity** of the bonding compound influences the application technique. Low viscosity compounds, such as formulations containing a high percent of solids, may require high-pressure application equipment. Some hot melt adhesives may be applied using a heated roller instead of a spray gun.

The adhesive chemistry must also be **compatible** with the substrate composition. With foam-to-foam applications, this is rarely a problem, but when bonding FPF to substrates containing certain types of plastizers (some vinyl, fiberglass and plastic composites products), chemical compatibility may affect adhesive cure performance. Melt

In bonding foam to foam, the objective is to create a joint where the foam will tear before the bond separates.

temperature can also influence long-term bond performance. A low melt temperature can result in an adhesive that loses bonding capability at elevated temperatures, as in an automobile interior on a hot day.

Adhesives Carrier Considerations

- Open Time
- Bonding Time
- Application Equipment

The carrier also influences **open time** and **bonding time**, as already described. Some carriers evaporate quickly, speeding the curing process, whereas others evaporate slowly so that open and bonding times can be extended. **Application equipment** varies with the carrier and with the adhesive compound selection. Application equipment requirements can range from a simple pistol and pump device to elaborate systems for the application of hot melt adhesives. Make sure you are aware of the environmental, health, and safety requirements for any adhesives application systems.

Performance Comparison Chart

	Tack Time	Bonding Time	Adhesive Viscosity	Dry Pliability	Melt Temp	Equipment Investment
Water borne	Slow	Slow	Varies	Good	Varies	Low
Non-HAP solvent	Fast	Fast	Low	Good	Good	Moderate
Hot Melt	Fast	Fast	High	Poor	Varies	High

Safety Considerations

Care should be taken when applying adhesives. At the least, an air-filtering mask should be worn that is designed to provide protection from airborne particulates. Good ventilation is recommended for all adhesive applications. Ventilation hoods may be necessary for certain types of adhesives and building designs.

Additional protection may be required when applying water-based natural latex adhesives. Persons allergic to latex should not apply the product. Some carriers, such as formulations containing acetone, may have a low flash point, therefore requiring specialized fire detection and suppression equipment. Be sure to consult the manufacturer's MSDS for additional handling, storage and application safety information. Insurance carriers are also good sources of information regarding proper use and ventilation of adhesive application areas.

Summary

- 1. Adhesives are formulated to include a tack agent, bonding compound and a carrier.
- 2. Great progress has been made in formulating adhesives that provide the performance required for FPF fabrication without harming the environment or having adverse health and safety problems.
- 3. Selection of the proper adhesives for an application requires an understanding of the performance characteristics of the various adhesive components.
- 4. Different adhesives may be required for different end-product applications. Example:
  Vertical stress bonds for chair cushions may require a different adhesive than would be used for a horizontal surface such as bonding a fiberfill cap to an FPF cushion core.
- 5. Caution should be used when applying adhesives. An air filtering mask should always be worn. Workers with latex allergies should not apply natural latex adhesives. Some adhesives may require additional ventilation, fire protection or handling and storage precautions.

This information is provided as a service of the Polyurethane Foam Association to improve an understanding of key issues that affect flexible polyurethane foam cushioning. To learn more about adhesives, contact the many adhesive manufacturers supplying the FPF industry.

A complete library of PFA IN•TOUCH® issues can be found on the Internet at pfa.org.

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