

# Cleaner Technologies Substitutes Assessment Case Studies: Mattress Manufacturing



EPA 744-R-00-006



June 2000

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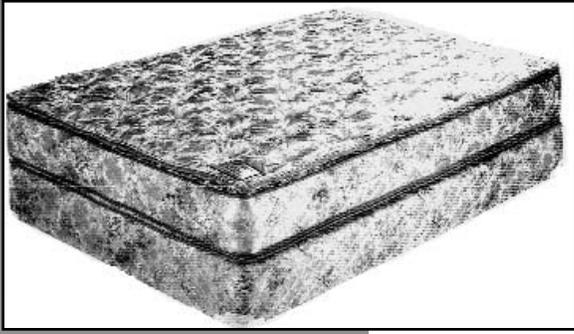
## Alternatives to Chlorinated Solvent Adhesives in the Mattress Manufacturing Industry

The Institute for Research and Technical Assistance (IRTA), a nonprofit organization located in Santa Monica, California, analyzed the cost and performance of alternative adhesive technologies used by the furniture and sleep products industries. This project was sponsored by the U.S. EPA with a grant from the Design for the Environment (DfE) Program. The Cleaner Technologies Substitutes Assessment (CTSA) is a partnership with industry including the International Sleep Products Association (ISPA), Southern California Edison (SCE) and the Association of Woodworking & Furnishings Suppliers® (AWFS®).

### Industry Description

Flexible slabstock polyurethane foam is produced by 23 companies in about 75 pouring plants in the United States. In 1997, approximately 830 million pounds of slabstock foam were produced. By 1998, slabstock foam production doubled to about 1.6 billion pounds.

Flexible slabstock foam is fabricated (cut and shaped) into pieces to be used in carpet underlay, furniture, bedding, packaging, transportation



Pillow top mattresses like this one require adhesive or sewing to bond the pillow top to the mattress itself.

## About IRTA

IRTA is a nonprofit organization established in 1989 to assist companies in adopting low- and non-solvent technologies. IRTA provides technical assistance in general and precision cleaning, drycleaning, paint stripping and coating, adhesive and ink operations.

seating, and other products where a durable and resilient cushioning material is required.

Mattress manufacturers purchase foam from foam manufacturers or from foam fabricators and they use the foam to manufacture their bedding. There are an estimated 1,270 mattress manufacturers in the United States. Ninety percent of the mattresses are manufactured by 260 plants. Most manufacturers have between one and 50 employees. Perhaps 200 mattress manufacturers make pillow top mattresses which are generally considered a high-end bedding item. These mattresses are manufactured by using adhesive to bond the mattress itself to the pillow top.

## Adhesive Alternatives

In the 1980s and early 1990s, most of the adhesive used by mattress manufacturers was based on 1,1,1-trichloroethane (TCA), a chlorinated solvent. TCA was an effective carrier for the adhesive because it evaporates rapidly leaving an instant bond, it is fairly low in toxicity, it does not have a flash point and it is not classified as a Volatile Organic Compound (VOC) that contributes to photochemical smog.

In the 1990s, TCA was designated as a class one ozone depleting substance and, in 1996, its production was banned for that reason. Although TCA inventory was still available, the chemical had become very expensive because of a Federal tax on ozone depleting substances. Virtually all adhesive formulators stopped making TCA adhesives and began offering adhesives based on methylene chloride (METH), also a chlorinated solvent. Like TCA, METH evaporates quickly, does not have a flash point and is not classified as a VOC. However, METH is a suspected carcinogen. In 1997, the Occupational Safety and Health Administration (OSHA) issued a regulation on METH that lowered the worker exposure level from 500 ppm to 25 ppm measured as an 8-hour time weighted average. The regulation also set an action level at 12.5 ppm. Companies with worker exposure above that level are required to institute monitoring and medical surveillance.

Alternatives to TCA and METH for bonding pillow top mattresses include hot melt adhesives, sewing and aerosol adhesives. Hot melt adhesives are 100 percent solids. They are applied with special spray

guns that heat the resins in the hot melt adhesives to 300 degrees F or higher so they can flow. In some non-mattress applications where there can be no bond line, hot melt adhesives are not a suitable alternative. In this application, however, hot melt adhesives are especially suited because workers are bonding two large thick items together.

Some mattress manufacturers join the mattress to the pillow top by simply sewing them together. Special equipment is required for the sewing. Although the equipment is expensive, it does not require spray equipment or the use of adhesives.

Many smaller manufacturers use aerosol adhesives for bonding the pillow tops to the mattresses. These aerosol adhesives are often based on acetone, a non-chlorinated solvent. Acetone is low in toxicity and like TCA and METH, readily evaporates leaving a quick bond. It does have a very low flash point, however, and measures must be taken to minimize the chance of fire or explosion. The National Fire Protection Association (NFPA) has rated acetone as an NFPA 704 level 3 flammability hazard. State building codes and fire codes are based on NFPA guidelines. These codes vary according to location and local fire departments have regulations that affect the amount of the flammable adhesive that can be stored and require explosion proof motors and high air flow ventilation systems. Most, if not all, of the aerosol adhesives based on acetone also contain other chemicals like heptane, hexane and mineral spirits. The other chemicals in these formulations are classified as VOCs and some are toxic.

Mattress manufacturers that wish to continue using METH adhesives have to purchase and install effective ventilation systems that reduce the worker exposure to the legal OSHA limit. In some cases, if the use of the acetone aerosols is very high, manufacturers might also have to install ventilation systems to keep the concentration of the acetone below the lower explosion limit.

## About SCE

SCE, the flagship of the Edison International family of companies, is the nation's second largest investor-owned electric utility company. Central to the growth of the region's economy, SCE continues its decades-old commitment to assist businesses seeking to start, expand, or relocate to its service territory.

## About ISPA

ISPA, is committed to promoting the mattress industry through active public policy, public affairs and informational initiatives. Working together with manufacturers and suppliers, ISPA seeks to enhance the growth, profitability and stature of the sleep products industry throughout the world.

## Characteristics of Alternatives

Adhesive	Classified as VOC	Toxicity	Ozone Depleter	Flash Point	Issues
1,1,1-Trichloroethane	No	Medium	Yes	No	Production banned
Methylene Chloride	No	High	No	No	Heavily regulated
Acetone Blends	Yes	Some high	No	Yes	Fire regulations
Hot Melt	No	Low	No	No	High-temperature application
Sewing	N/A	N/A	N/A	N/A	High equipment cost

### About AWFS®

AWFS® was incorporated to fulfill a major need to represent the interests of companies and individuals who supply the home and institutional furnishings manufacturing industries. Today, AWFS® has an international membership that includes manufacturers and distributors of machinery, hardware, lumber, upholstery materials, bedding, wood products and other supplies to furniture and cabinet manufacturers.

# Mattress Manufacturer Converts to Hot Melt Adhesive



Jamison Bedding has four plants in the United States. The company makes a mid- to high-end product and is the largest private label mattresses manufacturer in the country. The company sells their retail bedding primarily east of the Mississippi. Jamison is the fourth largest contract bedding manufacturer and sells to hotels like the Marriott chain and motels. In the past, the company had their own spring machinery but today they purchase the springs that are used in the production process.

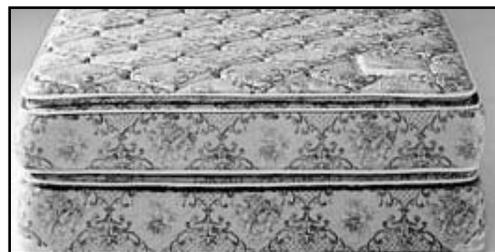
Jamison operates a plant near Nashville, Tennessee which employs 75 people. About 50 of the employees work in the factory. Approximately 95 percent of the workforce has been with Jamison for many years. The plant makes 300 to 400 mattresses each day but only a few are of the same type. An average of 75 pillow top mattresses require gluing per day. The pillow top market has blossomed and likely will continue to grow.

“We are not interested in using solvent-based adhesives again...Even though the hot melts are not ideal, the workers like them better. The hot melts are also better for the environment.”

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In the manufacture of the bedding, the company uses adhesive for two types of bonding. First, glue is used to bond the inner mattress to a non-woven material which functions as an inner cover. Second, the glue is used to bond the foam surface of the mattresses to the non-woven quilted material.

Historically Jamison used METH- and TCA-based adhesives. A few years ago, when TCA adhesives were used, Jamison



Jamison Bedding believes the pillow top market has blossomed and will continue to grow.

decided to make a conversion to hot melt adhesives. Today the company uses a pressure sensitive hot melt glue but is not entirely satisfied with the results. "The problem we face in the manufacturing is to get a long enough open time with the glue so the workers can reposition the mattress components," says Clay Finney, the Manager of the Nashville plant. "Another problem is that the adhesive sometimes remains tacky and the people that sleep on the mattresses will hear a velcro sound when they lie down on them," he says.

The company purchased several spray guns to apply the hot melt adhesives. Two of the inexpensive guns have proved inadequate for the process but the more expensive spray equipment has worked well. The company does not have to clean the application equipment since they converted to hot melt glues. When the company used solvent-based adhesives, the maintenance time was substantial.



Jamison Bedding is the exclusive mattress manufacturer for Marriot, Hyatt, Hilton, and Holiday Inn hotels and resorts.

Jamison is investigating non-pressure sensitive hot melt glues as well as water-based adhesives to try to improve their process further. "We are not interested in using solvent-based adhesives again," says Clay Finney. "The workers did not like the solvent products. They complained about the smell. Even though the hot melts are not ideal, the workers like them better. The hot melts are also better for the environment."

Jamison's costs for using the hot melt glues and the TCA-based adhesives are comparable. The table below shows the costs of both processes.

Annual Cost Comparison for Jamison Bedding		
	TCA-Based Adhesive	Hot Melt Adhesive
Capital cost	—	\$2,690
Adhesive cost	\$4,780	\$2,535
Labor cost	\$61,200	\$61,200
Maintenance cost	\$1,320	—
Electrical cost	—	\$2,350
<b>Total cost</b>	<b>\$67,300</b>	<b>\$68,775</b>

# Bedding Company Uses Hot Melt and Solvent-Based Adhesives



McKinney Bedding Company is located in Springfield, Missouri. The company makes high-, medium- and low-end bedding. About 80 percent of the mattresses are sold under the trade name Restonic and 20 percent under the trade name Futurama.

McKinney makes 100 different styles of contract bedding and produces between 250 and 500 pieces per day. Pillow top mattresses represent about five percent of their total production.

McKinney uses hot melt adhesives on their lower end line. The hot melts are used to bond foam to fabric, foam to insulator pads and foam to quilted material.

McKinney is currently using a methylene chloride-based adhesive for bonding the pillow top mattresses and for bonding the soft side water beds. The solvent adhesives used by the company come in a 26 pound pressurized container. Spray guns are

"We know the aerosol cans work for our applications."

attached to the pressurized container and the adhesive is sprayed on the bedding.

The company has compared the cost of continuing to use the methylene chloride-based adhesive in pressurized containers with the cost of using acetone aerosol adhesives. Because of the Occupational Safety and Health Administration (OSHA) regulation on methylene chloride, the company would have to make an investment in a spray booth to reduce the worker exposure to the chemical. Even with this capital investment, the cost of using acetone aerosol adhesives is higher because aerosol packaging is an expensive product.

"We're looking at the costs of all the options right now," says Lloyd McKinney, owner of McKinney Bedding. "We know the aerosol

cans work for our applications and we are considering converting to them even with the higher cost," he says.

	Methylene Chloride Adhesive	Acetone Aerosol Adhesive
Capital cost	\$489	—
Adhesive cost	\$2,762	\$4,397
Labor cost	\$1,200	\$1,200
<b>Total cost</b>	<b>\$4,451</b>	<b>\$5,597</b>

# Bedding Manufacturer Converts Away from Glues Altogether

*Justice*

Justice is an upholstered furniture and bedding manufacturer located in Lebanon, Missouri. About 15 employees are involved in the bedding operation and 45 to 50 in furniture manufacturing. The company makes recliners, sofas, loveseats, chairs and mattresses.

Justice makes mid- and high-end bedding. The company manufactures between 250 and 400 pieces of bedding each day. They purchase the foam and fabricated foam for their manufacturing process from Leggett & Platt, located across the street from Justice.

Until 1992, Justice used adhesive in their mattress manufacturing line for bonding pillow tops to their mattresses. At that stage, the company decided to make an investment in an alternative technology for making mattresses. The company now uses sewing to join the non-woven material to the ticking, the polyester and the polyurethane in their mattresses.

"We have cut our costs by about \$15 per mattress by adopting the sewing process."

"We decided we didn't want to use the glues any longer," says Dan Wampler, Plant Manager at Justice. "The solvents in the adhesives have all kinds of problems and we just didn't want to deal with that any longer."

In spite of the capital investment the company made for the sewing equipment, Justice has saved money through the conversion. "I estimate we have cut our costs by about \$15 per mattress by adopting the sewing process," says Dan Wampler.



Premium pillow top models are made for extra plush comfort.

## About the Design for the Environment (DfE) Program

The Design for the Environment (DfE) Program is a cooperative effort between the Environmental Protection Agency (EPA), industries, research institutions, environmental/public interest groups, and other government agencies. Working with these partners, the DfE program identifies cost-effective alternatives to existing products and processes that reduce risks to workers and the environment while maintaining or improving performance and product quality. Through the DfE program, EPA encourages businesses to incorporate environmental considerations into their products, processes, and technical and management systems. To help industry implement some of the ideas and technologies identified, the DfE program has published a number of case studies of companies which have found that environmental improvements can also lead to economic benefits. The case studies encourage other vendors, as well as other businesses, to learn from these environmental successes and adapt the techniques to their own processes.

## For More Information

**To obtain additional copies of this or other case studies, or for more information contact:**

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**Check Out DfE's Adhesives Web Site:**

<http://www.epa.gov/opptintr/dfe/adhesive/adhesive.html>

**Check IRTA's Web Site:**

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