

DATE : January 17, 1978

CC:

SUBJECT : Hot Melts

REFERENCE :

TO : File - Adhesives

Introduction:

This report attempts to summarize the hot melt industry. It is based on a survey of recent market studies as well as a perusal of the current literature. It is meant to serve as a starting point from which a more indepth study of opportunities in this field can be initiated.

Within the broad classification of hot melts are the following sub-classes: hot melt adhesives (HMA), hot melt pressure sensitive adhesives (HMPSA), hot melt coatings (MHC) and hot melt sealants (HMS). Although each of the above differ somewhat in technology the principal difference lies in the end use served.

Recommendations/Conclusions:

1. Although the major component of hot melts is a polymer (atactic polypropylene, ethylene ethylacrylate, EVA, SBS, SIS, polyamides and polyesters) a fairly wide variety of tackifiers, waxes and plasticizers are employed to tailor the hot melt to a particular end use.
2. Overall annual growth for hot melts is projected to be ~ 9.6%/year through 1981 falling to < 8.0% from 1981-1986. To understand this, however, requires disaggregating the various end use markets. Some, obviously, will grow more rapidly than others.
3. For example, mature markets for HMA in packaging, bookbinding, woodworking and footwear will grow at modest rates while HMA growth in disposables, motor vehicles, appliances, product assembly and PS tapes and labels will grow at impressive rates.
4. The major suppliers appear to be:
 - Eastman Chemical Products
 - National Starch and Chemical Co.
 - H. B. Fuller
 - Soctt-Wise Industries (Hercules)
 - Borden Chemical
5. The Plasticizers Division possesses some technological expertise already in hot melt additives (Arochlors, Polyphenyls, plasticizers).

6. Because this area appears to be one which will show significant growth and because it seems to lie in an area we may have the capability to serve, the Commercial Development Dept. should conduct an extensive search for new opportunities for existing or new product families.
7. It must be recognized, however, as with all products which require a variety of different additives to tailor end uses the competition will undoubtedly be fierce. In other words although properties are important the ultimate selection will be made based on cost unless the property improvement is great. The formulator also has the option of changing the base polymer to meet his needs.

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*cost/performance
applies to
new things we
sell. we are
getting better
at understanding
our products
values*

Details:

I. General Information - Hot Melts

Estimated WW Consumption of Hot Melts

	<u>M Lbs.</u>			
<u>Year</u>	<u>North America</u>	<u>Europe</u>	<u>Japan</u>	<u>Total</u>
1976	535	214	35	784
1981	890	296	56	1,242
1986	1,260	433	93	1,786

Compounded Annual Growth Rate WW

	<u>%</u>			
<u>Year</u>	<u>North America</u>	<u>Europe</u>	<u>Japan</u>	<u>Total</u>
1976-81	10.7	6.7	9.9	9.6
1981-86	7.2	7.9	10.7	7.5
1976-81	8.9	7.3	10.3	8.6

Current work is aimed at reducing the amount of hot melt needed to form an adequate bond. Although this would mean a lower volume of hot melts sold, it would give hot melts a far better competitive edge against the improved latexes and allow selling prices to increase. Raw material suppliers would be negatively affected if this strategy succeeds.

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A highly desirable, but so far elusive, development would be the creation of a thermosetting HMA which could be applied molten to insure rapid assembly by just cooling back to room temperature. Over a period of time it would cross link to form a tough, strong structural bond similar to an epoxy-polyamide.

* Hot Melt Adhesives, Coatings and Sealants, All Uses

<u>M Lbs.</u>			
<u>Type</u>	<u>1976</u>	<u>1981</u>	<u>1986</u>
HMA	304	493	740
HMC	220	344	444
HMS	11	53	77

* North America only.

The remainder of this report will discuss each of the hot melt types for North America. Europe and Japan should be studied further if there is promise domestically.

II. Hot Melt Adhesives (HMA)

HMA are normally defined as 100% nonvolatile thermoplastic materials, which are solid at room temperature but can be applied molten. On cooling they solidify in a matter of seconds to form a tough, strong bond.

HMA can be subdivided into the following classes; commodity HMA, specialty HMA and pressure sensitive HMA. The general characteristics of these three classes are shown below.

<u>Category</u>	<u>Polymers</u>	<u>Characteristics</u>	<u>End Uses</u>
Commodity HMA	EVA, EEA, LDPE, APP	low-med. price and properties	Nondurable products
Specialty HMA	polyamide, polyester, ionomers, urethanes	high price and properties	durable products
Pressure Sensitive HMA	thermoelastomers	med. price and permanent tack	durable and nondurable

EVA - ethylene vinyl
APP - amorphous polypropylene
EEA - ethylene ethylacrylate
LDPE- low density polyethylene

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A. Commodity HMA

1. Manufacturers/Suppliers

The largest four companies represent 7.8% of the total suppliers and 54.2% of market share. With the exception of Eastman Chemical Products, the other five companies listed below are expected to grow in the commodity HMA area at 15-29%/year. The following companies are listed according to the size of their market.

1. Eastman Chemical Co. (Eastman-Kodak)
Epolene polyolefin waxes (LDPE)
Eastobond (APP)
Eastorez synthetic hydrocarbon tackifier (C5)
2. National Starch & Chemical Co.
- mostly EVA based products
3. H. B. Fuller
- mostly EVA
4. Scott-Wise Industries (Hercules)
- undisputed leader in APP commodity HMA
5. Borden Chemical (Arabot Department)
- EVA
6. Amsco (Union Oil of California)
- solvents, waxes and PVAc polymers as well as EVA based HMA.

2. Markets

Commodity HMA are used to make inexpensive and nondurable end use products. Cases, cartons, trays, bags, overwraps, paperback books, and disposable diapers are examples. Some durable uses such as for furniture, major appliances and automobile sub assemblies are also served. The markets for commodity HMA should be positively affected, by government regulatory agencies actions (EPA, FDA, OSHA, and DOT) at the expense of other adhesive systems. HMA are recognized as clean and safe.

- a. Non durable Packaging and Paper Converting.

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a. Non durable Packaging and Paper Converting.

<u>End Use</u>	<u>1976 M Lbs.</u>	<u>1986 M Lbs.</u>	<u>% AG</u>
Case sealing	45	97	8.0
bags	40	59	4.0
trays	30	56	6.5
cartons	20	39	7.0
*kraft tape	20	12	-5.0
kraft overwrap	10	13	3.0
misc.	25	89	13.5
			<u>6.8</u>

*kraft tape will decline due to competition from plastic pressure sensitive tape.

b. Bookbinding

HMA are now the most popular adhesives followed by PVAc emulsions and animal glue. The market is dominated by National Adhesives, H.B. Fuller, and Illinois Adhesives (Henkel) each with ~ 30% share. A worthwhile development, which would gain rapid market acceptance, would be a commodity HMA that is repulpable in luke warm water and, of course, cost no more than conventional HMA.

Overall the bookbinding market is estimated to grow at ~ 5%/year.

c. Nonwoven soft goods

Markets here are disposable diapers, feminine napkins, and health care disposables. The business is controlled by Proctor & Gamble, Johnson & Johnson and Kimberly-Clark.

d. Product Assembly

Although advocates of commodity HMA have, for years, talked of the great future of their product in product assembly, progress has been slow. This is probably due to the plethora of application equipment necessary as well as the very diverse nature of the end uses. For instance, the furniture industry, which would be a logical outlet for HMA in product assembly, is composed of 5,350 companies, most of which are very small.

Growth in this area is not expected to be great for three reasons:

- HMA are not new
- Mass production numbers for rapid growth don't exist.
- Commodity HMA are relatively weak adhesives that do not perform well at elevated temperatures.

B. Specialty HMA

These are primarily made from polyamides, polyesters, thermoelastic copolymers and polyethylene powder.

1. Footwear

This is probably the most mature HMA market in the world. Competition from Korea and Taiwan has been disastrous to the U.S. footwear manufacturers.

End uses relating to footwear fall into the following categories: lasting, boxtoe, folding and sole attaching.

2. Textiles

High performance textile polyamide HMA are based on Nylon 12 terpolymers made principally by Chemische Werke Huls AG, the only monomer manufacturer. This, like footwear, is a very small market for specialty HMA.

3. Metal Containers

Specialty HMA producers have been largely unsuccessful in penetrating this market (side seams and ends). The move toward retortable pouches and two piece cans as well as completion from plastic or glass containers makes this an unlikely area for future growth.

4. Product Assembly

Mostly polyamide or/and polyester for electrical and electronic subassembly. General Mills is by far the leading supplier of specialty HMA in North America.

5. Future

Overall the future for growth in the area is not too good because;

- they are well studied and no new technological breakthroughs are likely.
- expensive \$1.00-\$5.00/lb.
- require rapid application.
- cannot be used above 355°F.

C. Hot Melt Pressure Sensitive Adhesives (HMPSA)

The present products are based on styrene-butadiene-styrene (SBS) and styrene-isoprene-styrene (SIS) block copolymers manufactured by Shell (Kraton®) and Phillips (Solprene®). A second generation of block copolymers is desired but not yet invented.

1. Chemistry

The formulator is limited to EVA, EEA, APP, SBS, and SIS. The latter two dominate the big market for tapes and labels. The former three polymers do not possess enough tack to qualify for tapes and labels. Apparently the best HMPSA for these markets are formulated from Kraton (SIS-Shell) and Wingtack 95 (synthetic C₅ tackifying resin - Goodyear). It is the opinion of the surveys that this best technology, however, is still not good enough to eliminate solvent-based and water-borne adhesives in the manufacture of tapes and labels.

2. Needs

- a. Better light color, high and low temperature strength, durability, electrical properties and outdoor weatherability.
- b. Better elasticity - more like solven based, natural rubber adhesives.
- c. Lower controlled viscosity (ie., Solprene®) in roller coater or slot water.

3. Markets

- a. PS Tapes and Labels
- b. Product assembly
 - floor tiles - Boler Petroleums, Borden, Amsco
 - Automotive rug and headliners
 - disposable products.

4. New Developments

- a. DuPont - developmental block copolymers from its Hytrel product line. Also looking at acrylic block copolymers.
- b. Shell - second generation Kraton® G block polymers which will all use temperature to be raised from 110°C to 120°C.

5. General

All survey indications seem to point to this area as offering bright prospects short term. Much more indepth analysis would be necessary before any valid conclusions could be drawn. Specifics are definitely lacking in this area.

III. Hot Melt Sealants (HMS)

HMS are, for the most part, consumed by manufacturers of durable goods (HMA and HMC used for nondurables) therefore although the unit consumption is greater, the total volume is less. This is because durables are manufactured in thousands to low tens of millions of units/year while disposables are made in billions of units/year. Another factor is that although something over 1B lbs. of formulated caulks, putties, and sealants were consumed in 1976 in North America approximately 90% of that was low cost, low performance asphalts, unsaturated vegetable oils and butyl rubber.

A. Major Appliances

H. B. Fuller's Thermo-Seal®, a butyl-modified APP has been widely accepted in refrigerators, air conditioners, and freezers.

B. Motor Vehicles

1. Types of sealants now used
 - vinyl plastisols
 - butyl tapes (used by Ford)
 - urethane (one part liquids)
 - silicones - used where high temperatures used
2. HMS receiving attention in Detroit because
 - rapid application speeds
 - relatively low prices
 - safety and energy considerations

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3. Needs

- a. A new adhesive/sealant that will bond, fill gaps and seal structural foam and FRP parts to themselves and to metal.
- b. Replacement for vinyl plastisols which offer superior corrosion resistance.
- c. A HMS which can withstand operating temperatures of 500°F for under-the-hood applications.
 - Product - Sol (Birmingham, Michigan) is a leader in new technology.

C. HMS in "All Other" Markets

- joint sealants
- sealing seams on elastomeric membranes and tarp.
- commercial building repair projected growth at 15%/year through 1986.

IV. Hot Melt Coatings (HMC)

A. Commodity HMC

Defined as those containing paraffin wax, which is always modified with either EVA resins, LDPE resins and tackifiers.

1. Packaging

Consumption Commodity HMC in Packaging

<u>Type of Packaging</u>	<u>M Lbs.</u>	<u>% Total</u>
Corrogated containers	150	68.2
Cartons & paperboard	50	22.7
Flexible packaging	20	9.1

2. Motor Vehicles

- there will be great breakthrough in HMA and HMS than HMC in automotive end uses. Replacement of plastisol asphalt coatings will be a goal.
- Ford Motor Co. is the most active in this area.

B. Specialty Hot Melt Coatings

Very small market now and for the future.

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References:

- *1. Hot Melt Adhesives, Sealants and Coatings, 1976-1986,
Springborn Lubs, 7/77.
2. Hot Melt Adhesives, Noyes Data Corp., 1974.
3. Materials Engineering, 6/77, pp. 51-53.

*Principal source for this summary.

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