

# Industry & Trade Summary

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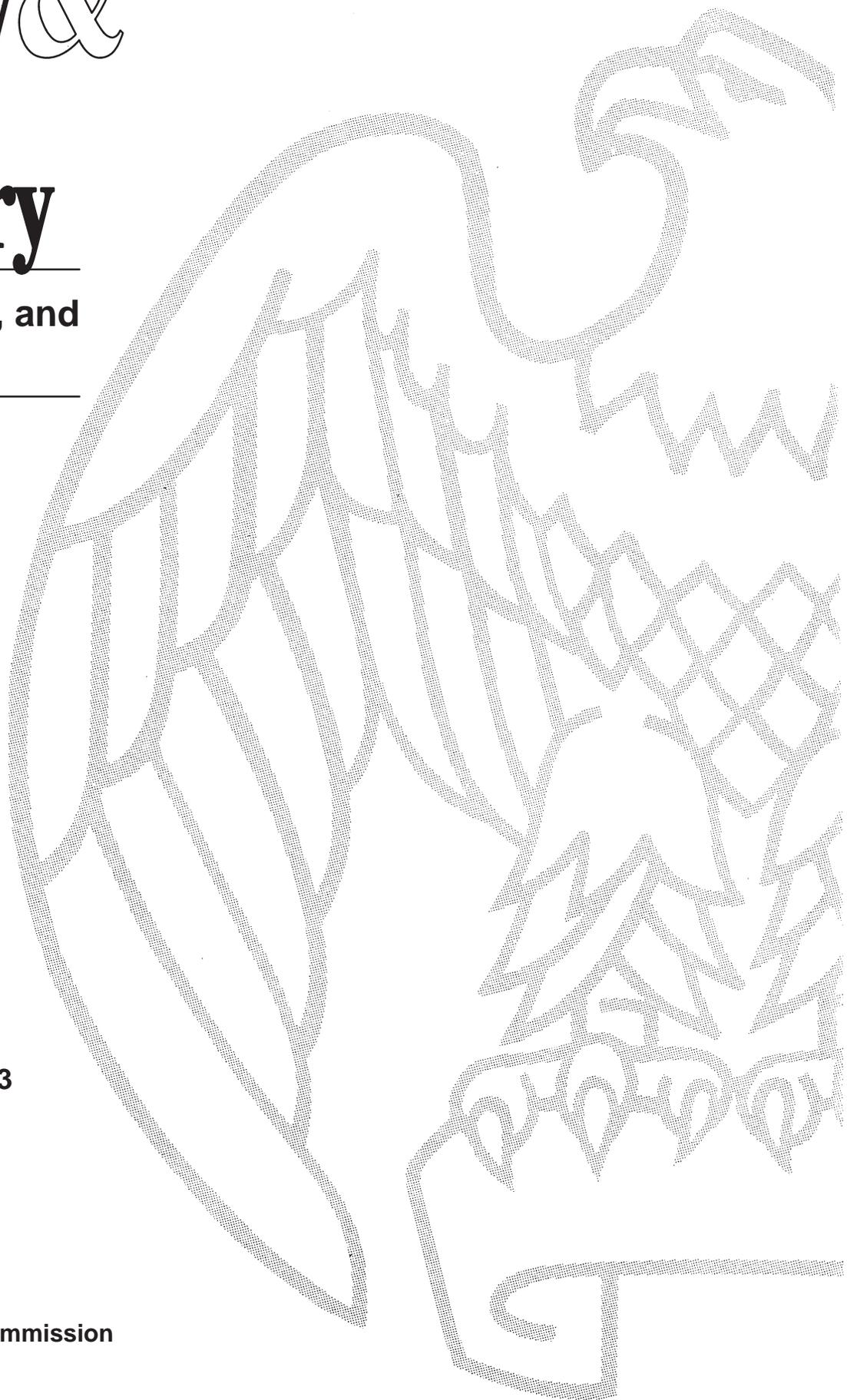
**Adhesives, Glues, and  
Gelatin**

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**USITC Publication 3093**

**March 1998**

**OFFICE OF INDUSTRIES  
U.S. International Trade Commission  
Washington, DC 20436**



**UNITED STATES INTERNATIONAL TRADE COMMISSION**

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# PREFACE

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In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.<sup>1</sup>

This report on adhesives, glues, and gelatin covers the period 1992 through 1996. Listed below are the individual summary reports published to date on the energy, chemicals, and textiles sectors.

## *USITC*

<i>publication number</i>	<i>Publication date</i>	<i>Title</i>
<b>Energy and Chemicals:</b>		
2458	November 1991 . . . . .	Soaps, Detergents, and Surface-Active Agents
2509	May 1992 . . . . .	Inorganic Acids
2548	August 1992 . . . . .	Paints, Inks, and Related Items
2578	November 1992 . . . . .	Crude Petroleum
2588	December 1992 . . . . .	Major Primary Olefins
2590	February 1993 . . . . .	Polyethylene Resins in Primary Forms
2598	March 1993 . . . . .	Perfumes, Cosmetics, and Toiletries
2736	February 1994 . . . . .	Antibiotics
2739	February 1994 . . . . .	Pneumatic Tires and Tubes
2741	February 1994 . . . . .	Natural Rubber
2743	February 1994 . . . . .	Saturated Polyesters in Primary Forms
2747	March 1994 . . . . .	Fatty Chemicals
2750	March 1994 . . . . .	Pesticide Products and Formulations
2823	October 1994 . . . . .	Primary Aromatics

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<sup>1</sup> The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

# PREFACE—*Continued*

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<i>USITC publication number</i>	<i>Publication date</i>	<i>Title</i>
<b>Energy and Chemicals—<i>Continued</i>:</b>		
2826	November 1994 . . . . .	Polypropylene Resins in Primary Forms
2845	March 1995 . . . . .	Polyvinyl Chloride Resins in Primary Forms
2846	December 1994 . . . . .	Medicinal Chemicals, except Antibiotics
2866	March 1995 . . . . .	Hose, Belting, and Plastic Pipe
2943	December 1995 . . . . .	Uranium and Nuclear Fuel
2945	January 1996 . . . . .	Coal, Coke, and Related Chemical Products
3014	February 1997 . . . . .	Synthetic Rubber
3021	February 1997 . . . . .	Synthetic Organic Pigments
3081	March 1988 . . . . .	Explosives, Propellant Powders, and Related Items
3093	March 1988 . . . . .	Adhesives, Glues, and Gelatin
<b>Textiles and apparel:</b>		
2543	August 1992 . . . . .	Nonwoven Fabrics
2580	December 1992 . . . . .	Gloves
2642	June 1993 . . . . .	Yarn
2695	November 1993 . . . . .	Carpets and Rugs
2702	November 1993 . . . . .	Fur Goods
2703	November 1993 . . . . .	Coated Fabrics
2735	February 1994 . . . . .	Knit Fabric
2841	December 1994 . . . . .	Cordage
2853	January 1995 . . . . .	Apparel
2874	April 1995 . . . . .	Manmade Fibers

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# ABSTRACT

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This report addresses the adhesives and gelatin industries and is concerned mostly with events during 1992-96. These two industries are related now principally in the context of trade in the Harmonized Tariff System. But in earlier years, gelatin (in the form of animal glue) was a major adhesive.

- The products of the U.S. adhesives industry continue to replace other types of fasteners and, benefiting from the improved adhesiveness of continually-improving synthetic resins, appear to be more than adequately competitive in worldwide terms. The U.S. adhesives industry's annual shipments in 1996 were about \$4.7 billion, an increase of 13 percent above their 1992 level. Exports are almost triple imports, though neither is large compared with national consumption. Exports of adhesives increased 77 percent during 1992-96; imports increased by 28 percent. Imports, sourced largely from Canada, Germany, and Japan, were valued at \$141 million in 1996. European firms are this country's most serious competitors in adhesives; the European companies have competed in recent years mostly by buying prominent U.S. adhesives companies. In the gelatin industry, which is much smaller than the adhesives industry, imports account for almost half of U.S. consumption. Imports of gelatin, \$130 million in 1996, up 40 percent from 1992, came mostly from France, Germany, Japan, and the United Kingdom. Foreign technology is very competitive and U.S. exports of gelatin are relatively small.
- Though the adhesives industry is much smaller than several other segments of the overall chemical industry, adhesives are widely used in many other U.S. industries: packaging, construction, automobiles, and hundreds of other types of products. Replacing many other types of fasteners in these markets has significantly reduced end-products' cost of production, and completely new uses (e.g., Post-it® Notes, laminated (wood) beams and stratified wood, carbon fiber composites for golf clubs and other sporting equipment, the Norian "glue" for rejoining broken bones) continue to emerge. Gelatin is consumed in food products, photographic film, capsules for pharmaceuticals, and other applications.
- From the beginning of recorded history until well into the twentieth century, adhesives were derived mainly from natural sources like gelatin and starch. But after World War I, synthetic resins and rubbers began taking over. By the 1990s, these polymers had grown to account for 95 percent of the value of all adhesives. Examples of the leading types of synthetic resin adhesives include polyvinyl acetate, epoxy, phenolic, ureaformaldehyde, cyanoacrylate, and nearly 100 others.



# INTRODUCTION

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This report contains information on the adhesives and gelatin industries, including product uses, U.S. and foreign producers, tariff and non-tariff measures, and U.S. and foreign markets. Most of the information in this report is provided in the context of a 5-year (1992-96) time frame.

This summary is organized into four sections: U.S. industry profile, U.S. market, U.S. trade, and foreign industry profile. The U.S. industry section discusses the types of adhesives and gelatin and also describes the industry structure, costs, pricing, and distribution. The U.S. market section provides information on U.S. apparent consumption, production, and end uses. The section on U.S. trade includes information on the U.S. tariff structure as well as the tariff structures of major U.S. export markets. The foreign industry profile section examines the major world adhesives and gelatin producers and markets.

## Adhesives

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The adhesives industry dates back thousands of years, preceding the use of nails, screws, and other types of fasteners. The original adhesives, some still in use, were animal protein byproducts from blood, bones, and skin, some of which, as gelatin, also found use as food. Other sources were egg albumen and naturally-occurring bitumens. Adhesives from starch, rubber, and other vegetable sources followed. These "natural" adhesives suffered a common defect—they were not waterproof or weather resistant. This deficiency was overcome around the time of World War I with the development of phenolic resin for use as plywood glue and nitrocellulose for household use. Those synthetic resins were followed, especially after World War II, with the development of dozens of additional synthetic polymers whose adhesive, convenience-in-use, and environmental qualities<sup>1</sup> were more and more enhanced.

By common agreement the terms adhesive, glue, paste, mucilage, and cement are synonyms when they refer to a material that is used to join one surface to another in a permanent, semi-permanent, or temporary manner. Today's adhesives—U.S. value of shipments approaching \$5 billion—are based on one or more of at least 60 types of synthetic resin and 17 types of synthetic rubber. The leading adhesives, in order of value, are the synthetic resin types and include polyvinyl acetate and its copolymers, synthetic rubber, ethylene-vinyl acetate and other hot melt adhesive resins, epoxy, phenol-formaldehyde (plywood glue), acrylics, urea-formaldehyde, styrenic types, cyanoacrylates, polyesters, and polyurethanes. In addition, the

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<sup>1</sup>In the past a typical adhesive may have been a synthetic resin dissolved in an organic chemical solvent, but today it is more likely to be a different resin dissolved in water.

ancient "natural" adhesives—animal glue, starch/dextrin, and natural rubber—account for about 10 percent of the value.<sup>2</sup>

Compared with most of the manufacturers and processors it serves, the adhesives industry is quite small in value. Yet virtually every component of the gross domestic product (GDP) is affected in some manner by this complex business. Adhesives are used in the manufacture of both durable and nondurable products and in markets that range from emerging to mature. In fact, few industries can compare with adhesives in viewing every product manufactured as a potential market and every person as a potential user.

The manufacture of most adhesives is accomplished by simply dissolving or suspending the proper type of synthetic resin or rubber in water or solvent, along with chemical additives to improve its ease of application and adhesive properties. The major equipment for the manufacture of many such adhesives is merely a stirred kettle, large or small, that can be heated and cooled.

With the improved properties of adhesives, much of the growth of adhesives consumption has come from their continuing replacement of nails, screws, nuts and bolts, welding, brazing, soldering, rivets, staples, sewing thread, rope and twine, and other types of fastening or joining devices, even safety pins. Entirely new uses, such as the temporary adhesive for note paper, and the adhesive for stick-on handles for shoppers' purchases, have emerged.

Estimates of the end uses and related volumes of adhesives vary widely. A recent estimate states that the major uses of adhesives in the United States, each about 40 percent of total demand in 1996, are construction (dominated by binders for plywood and other wood panels and beams) and packaging (corrugated and paperboard, pressure sensitive tapes and labels, and other applications). About 15 percent of adhesives consumption is in automobiles and other transportation equipment, furniture, electrical and electronics equipment, carpets and rugs, textiles, footwear, and books.<sup>3</sup> Though more familiar to everyone, the retail household market accounts for no more than 5 percent of adhesives sales.

## Gelatin

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Gelatin is included in this summary because in the earlier days of this century, before synthetic resins were developed and took over most of the adhesives industry, one type of gelatin—animal glue—was one of the major adhesives; ever since, all types of gelatin have therefore been grouped with adhesives in the world's tariff classification systems, now found in chapter 35 of the Harmonized Tariff Schedule (HTS). Today animal glue has an insignificant role as an adhesive, and the value of its production is only about 2 percent of that

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<sup>2</sup> Estimated from U.S. Department of Commerce, *Census of Manufactures, 1992*.

<sup>3</sup> The Freedonia Group Inc., "U.S. Adhesives Demand to Reach 14 Billion Pounds by 2001," *Adhesives Age*, Sept. 1997, p. 38.

of all adhesives. Gelatin in the United States is produced by only eight companies,<sup>4</sup> excluding two that produce animal glue, and even with major amounts of imports, its consumption is only about 7 percent of that of adhesives. The main use of gelatin is in food products, and most of the remainder is split between use in the manufacture of photographic film and of pharmaceuticals (mostly capsules to contain the therapeutic ingredients). Animal glue, though a form of gelatin, is grouped with adhesives in this summary; its consumption is about one-fourth of the consumption of gelatin and, as noted above, is almost insignificant in the adhesives business.

Adhesives and gelatin are produced in nearly all the countries of the world, both developed and developing. However, the specialized and high-performance grades of each product grouping (e.g., high-temperature-resistant adhesives, photographic gelatin) are essentially the province of only the developed nations.

## U.S. INDUSTRY PROFILE

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### Industry Structure

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Adhesives comprise about 77 percent of Standard Industrial Classification (SIC) No. 2891, Adhesives and Sealants.<sup>5</sup> Gelatin accounts for only about 3 percent of SIC No. 2899, Chemicals and Chemical Preparations Not Elsewhere Classified, a residual, or "basket," category of many unrelated industry segments.

#### *Adhesives*

Definitionally, "adhesive" seems to be a simple concept—a bonding agent applied in a thin film between two surfaces. But confusion arises in equivocal uses where the adhesives are, as customary, a variety of formulated mixtures of synthetic resins and various adhesion-enhancing additives, but the nature of the final product may not be thought of as simply adhering one surface to another. For example, a report about one of the major types of synthetic resin (plastic) used in adhesives—epoxy resins—names four types of major end use: "(Protective) coatings, electrical/electronic laminates, composites, (and) adhesives are major

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<sup>4</sup>Official statistics indicate a much larger number, but they are including companies that merely blend and modify different grades of gelatin that come from many worldwide sources.

<sup>5</sup>The remainder, 23 percent, is comprised of sealants, or caulks, which are used to prevent the passage of (usually) air or water through a gap that exists between two surfaces, with adhesion to each surface being an important but secondary feature. Therefore, the sealant is often applied in a thick bead or ribbon, perhaps shaped after application (e.g., the putty on an ordinary window), and is formulated to accommodate the normal expansion and contraction of the surfaces due to temperature changes and other causes.

end uses"<sup>6</sup> (of epoxy resins). This statement, to some in the field, falls short of reality. In their judgment, all of these categories except protective coatings illustrate use as adhesive: for example, in the electrical laminates, the epoxy is used to bond copper foil to a circuit board; and in a typical composite the epoxy adhesive bonds together fiberglass filaments or cloth into a high-strength structure.<sup>7</sup> For these reasons, the published statistics of the adhesives industry, especially comparisons of production, imports, and exports, can often understate the situation. Thus, while the official Government statistics show the value of U.S. adhesives shipments was approximately \$4 to \$5 billion in recent years, the published estimates of many experts in the field range from \$5 billion to \$10 billion for those years.<sup>8</sup>

The (Census-based) value of U.S. shipments<sup>9</sup> of adhesives in 1996 was an estimated \$4.7 billion.<sup>10</sup> About 85 percent of the total is based on synthetic resins. The shrinking remainder is split among rubber (both synthetic and natural), the ages-old animal and vegetable sources that the industry began with, and a few materials such as sodium silicate that do not fit either of those categories.

The adhesives industry is fragmented. There are many different types of uses both large and small, employing hundreds, if not thousands, of different types of formulations, of which the primary constituents are one or more of at least 80 different base resins and rubbers. This allows for small and large players to participate alike. As suppliers of the major raw materials for adhesives, the dominant synthetic resin producers are mostly the large chemical

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<sup>6</sup> SRI International, *Chemical Industries Newsletter*, Jan.-Feb. 1991, p. 5.

<sup>7</sup> Other examples that may or may not be thought of as adhesives: old-fashioned flypaper and today's similar rodent traps; the polyvinyl butyral interliner in every automobile windshield (if the latter is shattered the plastic retains the glass fragments to reduce personal injury); the urethane foam between the inner and outer shells of a refrigerator, acting both as insulator and adhesive; carpet backing (the extrusion-coating polymers provide some adhesion but mostly they mechanically lock the tufts and fibers into place); and pure solvent (to join some types of plastic pipe, the ends are dipped in solvent then screwed together, and the solvent-softened plastic fuses into an airtight secure joint). In these examples, the companies involved in manufacturing either the organic medium or the finished objects are likely not to report them as adhesives, but a market researcher using his or her judgment is more likely to.

<sup>8</sup> McGraw-Hill World News, *Chemical Week*, Mar. 27, 1996, p. 29; Darlene Asselin, "How Changes in the U.S. Economy Affect the Adhesives Industry," *Adhesives Age*, Jan. 1996, p. 18. Both *Chemical Marketing Reporter* and *Chemical Week* have published annual reviews of the industry for many years. Joseph W. Prane summarized recent available information in his "Overview—Coatings and Adhesives Industry," American Chemical Society paper, Aug. 1995.

<sup>9</sup> Shipments (for adhesives) are somewhat less than production in terms of value. Census defines an industry as a group of establishments producing the same product or type of product. It publishes data on these establishments' value of shipments, value added by manufacture, number of employees, etc. An establishment in the plywood industry, for example, may produce its own adhesive from phenol and formaldehyde. But its reported shipments are only the plywood. However, most users of adhesives buy them from companies whose plants are classified as adhesives establishments, so the difference between production and shipments is probably small.

<sup>10</sup> U.S. Department of Commerce, *Census of Manufactures, 1992*, and *Survey of Manufactures, 1995*—modified (by Commission staff) by deletion of sealants production; and Kline & Co. estimates of growth in 1996. The Freedonia Group, consultants, estimate the U.S. market for adhesives was \$9 billion in 1996, increasing 3 percent per year.

companies to whom the markets for plastics products such as film and bottles are much more important than the smaller potential for adhesives. Therefore only a few of them integrate downstream to formulate the finished adhesives. Instead, they sell the resins to formulators, more than 600 in number, who mix (formulate) them with additives that differ in identity and amount, depending on the needs of their individual customers.<sup>11</sup> These firms, most of which have sales of less than \$25 million per year, constitute the core of the adhesive business.<sup>12</sup>

Because of the different opinions of where to draw the line on the identities of adhesives, referred to just above, there is considerable discrepancy in published market information. For example, a recent analysis of 1994 corporate sales listed the top 10 U.S. adhesives producers, which account for about 40 percent of the market: the leader is 3M with 9 percent of the market, then, in descending order, National Starch and Chemical, H.B. Fuller, Loctite, Findley Adhesives (recently bought by Elf Atochem (European)), Swift Adhesives, Morton International, Bostik, Tremco, and DAP (1 percent).<sup>13</sup>

A second, similar, compilation lists 3M only as No. 3, presumably because its adhesives for Scotch® Tape, Post-it® Notes, and hosts of other products are mostly captively consumed rather than sold on the merchant market. This second compilation of the top 10 U.S. companies, which combines the companies' 1995 sales of adhesives with sales of sealants, is shown below:<sup>14</sup>

H.B. Fuller	\$500 million
National Starch and Chemical	500
3M	300
Morton International	275
Swift Adhesives	275
General Electric	250
Loctite/Henkel	225
BF Goodrich	175
Borden Inc.	170
Dow Corning	150
All others	<u>6,355</u>
Total <sup>15</sup>	\$9,175 million

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<sup>11</sup> Some resins are not formulated but are ready to be used as adhesives as soon as they are discharged from the polymerization equipment—e.g., phenol-formaldehyde plywood glue and polyvinyl acetate dispersions. (Additives, if any, are charged to the reaction kettle along with the raw materials.) With the adhesives that are formulated, the additives, in order of descending dollar value, include tackifiers (for stickiness), plasticizers, fillers, waxes, curing agents, diluents, reinforcements, pigments, and a number of others. *Chemical Marketing Reporter*, Nov. 15, 1993.

<sup>12</sup> John Beagle and Trent Myers, "Merger Activity in Adhesives Industry," *Adhesives Age*, Sept. 1995, p. 8.

<sup>13</sup> Ira Breskin, "Volume Gains, Price Hikes Spur Performance; 1995 Prospects Are Almost As Strong," *Chemical Week*, Mar. 1, 1995, p. 25.

<sup>14</sup> George Peaff, "Growth is Moderating for Adhesives and Sealants," *Chemical and Engineering News*, July 22, 1996, p. 31. For a listing of the top world producers, see section of this report entitled Foreign Industry Profile.

<sup>15</sup> Adhesives should represent about 77 percent of this total, or about \$7.05 billion. That  
(continued...)

## Adhesives mergers

The increase in mergers and acquisitions that occurred in many U.S. industries in the 1980s was paralleled in adhesives. Merger activity peaked, for the first time in adhesives, in the late 1980s and has continued, as some of the new combinations named above show. According to an adhesives and sealants consulting firm, the 35 transactions in 1995 probably set a record (following 19 in 1992, 30 in 1993, and 26 in 1994). The fact that the adhesives industry has approached the slower-growing, more mature phase of its development, with reduced technical advances, has apparently made acquisitions a favored avenue to continued growth. Smaller companies may also be more willing to be acquired because of the increased costs of environmental compliance, such as the problems involved in replacing organic chemical solvents with water.

Referring to the above sales tabulation, in 1996-97 the ownership of National Starch and Chemical changed from (AngloDutch) Unilever to Imperial Chemical Industries (the largest United Kingdom chemical company); Loctite is now wholly owned by Germany's Henkel; and B.F. Goodrich sold its adhesives business to Sovereign Specialty Chemicals. The latter firm moved up in the ranking of companies because of the acquisition above and because it also bought Pierce and Stevens, another adhesives producer.<sup>16</sup> A newer theme (for adhesives as well as in other industries) that emerged in recent years has been the type of joint venture in which a U.S. company enters a foreign market by forming an alliance with a local partner. The purpose is often not so much to acquire technology and new products but rather to secure strong marketing organizations (and therefore market entry) worldwide. Such joint venture and merger activity is expected to continue for U.S. companies as they seek entrance into the markets of other regions. (The largest examples of this type in 1996, however, were in the opposite direction—the acquisition by Elf Atochem, a French company, of Findley Adhesives, which, with about \$200 million in annual sales, had been the largest privately held adhesives firm in the United States, and the acquisition of Loctite, one of the largest U.S. adhesives firms, by Henkel KgaA, a large German adhesives company.)

## Manufacture of adhesives

Most adhesives today are based on specialized synthetic resins that are produced by large chemical companies. Typically, they sell these resins to adhesives companies, also referred to as formulators, that mix or dissolve the resins in solvents or water and add any of a number of additives, such as tackifiers—or stickiness agents—so that the final mixture can be sold as an adhesive. However, other adhesives, such as old-time plywood (phenol-formaldehyde) glue, possess all the adhesive qualities they need at the end of the original chemical reaction when the liquid product is drained from the reaction kettle. They are, in effect, pre-formulated (and in the foreign trade statistics, are usually classified as plastics materials rather than

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<sup>15</sup> (...continued)

proportion, however, would not apply to any single company. The more official total, based on Census data, is \$4.5 billion. The difference is either adhesives that are not officially recognized as such, or the companies' sales of items that are neither adhesives or sealants.

<sup>16</sup>Peter Chapman, "Adhesives Stick It Out," *Chemical Week*, Apr. 30, 1997, p. SR16.

adhesives). Nonetheless, most of the adhesives are produced by companies that buy the synthetic resins and add the various performance-enhancing chemicals depending on the type of adhesive that is desired.

Entry into the adhesives business has been easy for many of the specialized small firms, each with a small number of customers and a narrow span of technology, because the major equipment for many formulations is merely a stirred kettle, large or small, that can be heated and cooled. But there are barriers at the high-value end, namely the need for sophisticated R&D, access and information regarding foreign markets, and availability of capital.<sup>17,18</sup> One industry source stated, "Because adhesives find usage in every segment of the economy, it is difficult for a single company to supply everything. . . All a small entrepreneurial company needs to do is maintain a relationship with one or two customers to stay in business. Small companies will always be there; it is the medium-sized ones that are more likely to disappear."<sup>19</sup> Users of adhesives sometimes do their own formulating, rather than buying from adhesives suppliers. Other users—e.g., plywood producers—even buy or themselves produce the chemical raw materials, and react them together to produce the base resins; they then formulate the end products.

Postage-stamp adhesives in recent years can be taken as an exemplification of the formulation process. Typically the base resin has been a food-grade dextrin (i.e., modified starch), fortified with gelatin. Modifiers (e.g., glycerin, glycols, emulsified waxes, and salts) are added to improve flexibility, spreading and leveling qualities, ease of rewetting, tack (stickiness), and resistance to blocking (i.e., premature adhesion). Preservatives and flavoring agents are also added. These adhesives are deposited as aqueous solutions or dispersions, roller-coated onto the printed paper webs, oven-dried, and then composite moisture-equilibrated and rewound. Because of problems such as coming unstuck in the automated sorting machines, the current adhesives are being replaced by improved formulations, including pressure-sensitive types.<sup>20</sup> More than 80 resins and rubbers on which today's adhesives are based, along with the natural adhesives, are combined with additives (for stickiness, flexibility, viscosity, lengthened shelf life, and so forth) into at least 25,000 different commercial formulations.

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<sup>17</sup>W. David Gibson, "Adhesives: Market in Motion in the 90's," *Chemical Marketing Reporter*, Aug. 28, 1989, p. SR3.

<sup>18</sup>A recent profile describes a 50-year-old intermediate-size adhesives company, with about \$6 million in sales in 1997: Serving about 500 accounts (some as small as \$500 per year and one almost \$1 million), its adhesives find their way into a broad diversity of products: Disney inflatables, life rafts, footwear, handbags, tank linings—even powder puffs. A customer with a technical problem can expect the company to send a person to help the next day. The company's adhesives line includes more than 500 active formulations, 200 of which are made on a regular basis, plus a few specialty coatings. Toll manufacturing (for other adhesives companies) accounts for 30 percent of revenues. (Daniel J. McConville, "Gradual Growth Suits Clifton," *Chemical Week*, Nov. 5, 1997, p. 58.)

<sup>19</sup>Peter Chapman, "Adhesives Stick It Out," *Chemical Marketing Reporter*, Apr. 28, 1997, p. SR16—quoting William Broxterman, a prominent adhesives consultant.

<sup>20</sup>"Postal Service Tries Pressure-Sensitive Adhesives, UV Curing," *Adhesives Age*, Jan. 1989, p. 44; and "The Post Office Is Closer To Licking Its Stamp Mystery," *Business Week*, July 25, 1988, p. 69.

In addition to the normal evolution of the industry entailing the entrance of continually-improved base resins, it is also changing fast because of environmental imperatives, particularly the regulations on volatile organic compounds and increased recycling. In the earlier years, with many of the adhesives, it had been necessary first to dissolve the elastomers or synthetic resins in organic solvents such as one of the chlorinated hydrocarbons, toluene, or methyl ethyl ketone (rather than water). Now, however, for environmental reasons, those solvents are rapidly being displaced, some immediately and others during the passage of a stated number of years. This presents a difficult problem for many adhesives where some of the most effective resins are not soluble in water and the initial water-soluble replacement resins or rubbers may not be such good adhesives. Therefore, other alternatives have been and are presently being developed that use no solvent at all. Hot melt adhesives were early arrivals and, as the name suggests, are formulations that melt when heated, are applied in the melted state, and both solidify and bond as soon as cooled (rather than requiring the lengthy time span for evaporation of solvent or water). Sixteen percent of the industry shipments in 1995 were reported to have been hot melts.<sup>21</sup> Still newer are extrudable adhesives, reactive systems, and other non-solvent combinations. For those solvent-borne adhesives that are deemed essential in certain applications, their producers attempt to shift to less hazardous (exempt) solvents or high-solids formulations, and install more efficient solvent-recovery systems.

### **Industry specifics**

The many types of adhesives can be categorized by end use (see Introduction), by the synthetic resin or other polymer they are based on, by their physical state such as solvent-borne or hot melt (see figure 1), or by the process that sets or cures them (e.g., radiation curable, hot melt, reactive systems, pressure-sensitive (i.e., generally peelable)). One approach seems to be the groupings used in *Adhesives Age's* annual Manufacturers Directory. The 1997 edition covers 576 producers of adhesives and sealants manufacturing the various types of adhesives listed in table 1.<sup>22</sup>

The location of the U.S. adhesives (and sealants) industry seems to relate as much to the country's demography as to any other economic factor. (Proximity to customers is an important factor, since the way an adhesive is applied is often as important as the nature of the adhesive itself.) The latest Census of Manufactures shows that almost two-thirds of the 685 establishments (in the order of the number of establishments therein) are in 9 States: California (with 75), Ohio (53), New Jersey (53), Illinois (48), Pennsylvania (40), Texas (38), Georgia (38), Michigan (36), and New York (29).

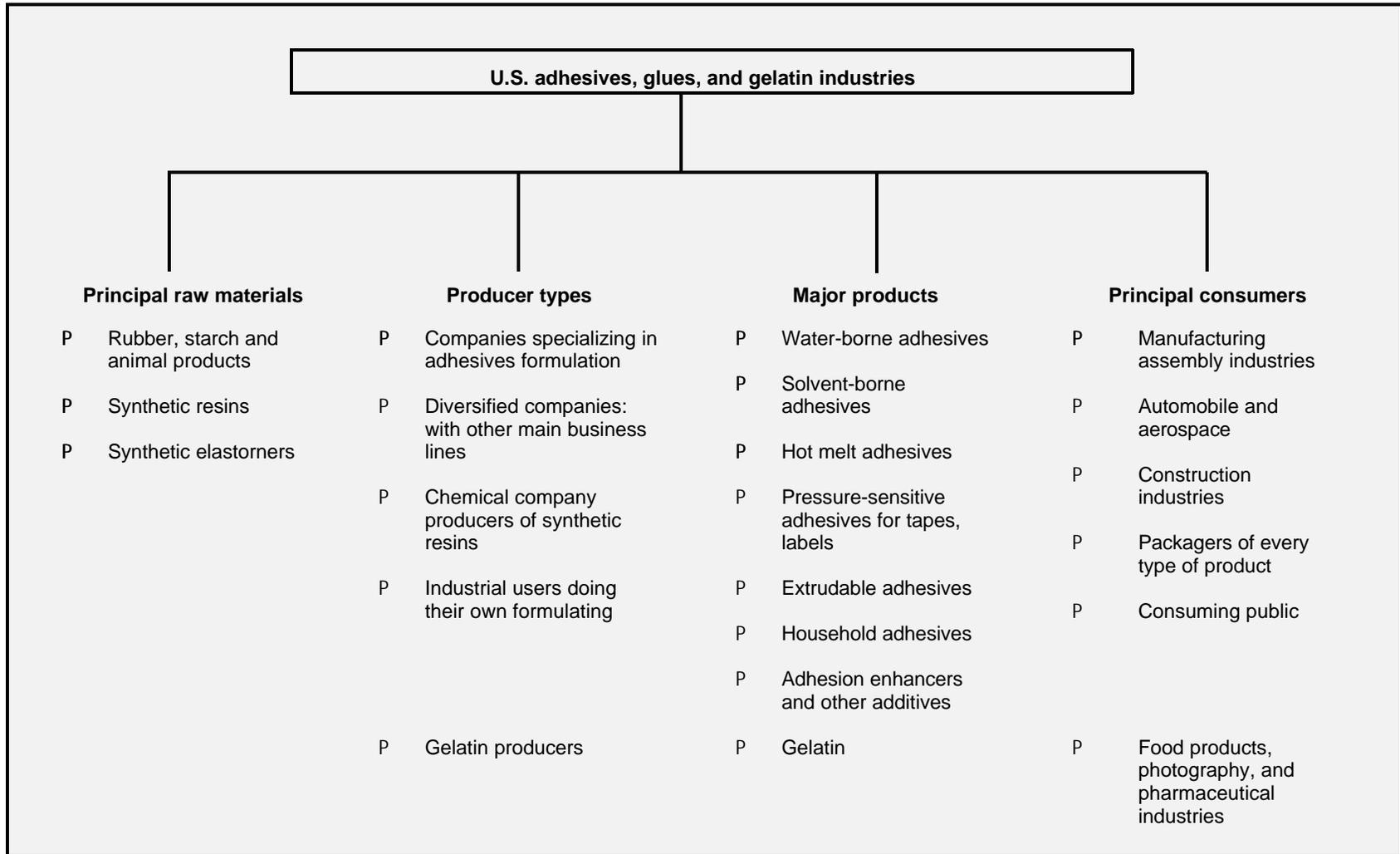
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<sup>21</sup> Esther Ward and Mike D'Amico, "Squeezing Out Profits: Adhesives Makers Get Set for Growth," *Chemical Week*, Mar. 27, 1996, p. 29.

<sup>22</sup> This listing is somewhat different and more detailed than the *Census of Manufactures'* tabulation of resin-categorized adhesive types, and it omits some companies that make adhesives only for their own consumption.

**Figure 1**

**U.S. adhesive, glues, and gelatin industries: Principal raw materials, producer types, major products, and principal consumers**



Source: Various trade publications and interviews with industry sources.

**Table 1**  
**Adhesives types and number of producers**

<b>Number of companies</b>	<b>Adhesive type</b>
32	Anaerobic
109	Contact
100	Cyanoacrylate
	Hot melt (polyamides, polycarbonates, polyesters, and polyvinyl acetate) ---
128	Thermoplastic
32	Reactive
144	Pressure-sensitive (solvent-borne, water-borne, hot melt, radiation cured)
66	Protein-based (animal glue, blood glue, casein glue, fish glue, shellac, and soybean glue)
58	Radiation-curable (ultraviolet, electron beam, visible light)
259	Rubber-based (17 types of elastomer)
285	Thermoplastic resin (35 types of plastic)
286	Thermosetting resin (18 types of plastic)
115	Two-polymer (9 types, i.e., acrylic rubber-phenolic resin, neoprene-phenolic, nitrile-phenolic, nylon-epoxy, phenolic-silicone, polyvinyl phenolic, epoxy-polysulfide, epoxy-polyurethane, and nitrile-epoxy)
82	Vegetable (dextrin, starch, and oleoresins)
162	Other types: Bitumin-asphaltic, bitumin-latex, ceramic, lacquer, silicates (soluble), varnishes
Many	Adhesive systems and combinations: Adhesive tapes —Type: Cloth, foil, paper, plastic, one-sided, and two-sided. —Function: Bundling, decorative, insulating, masking, protective, reinforcing, sealing, splicing, stenciling, surgical, and transfer. Adhesive labels (Cloth, foil, paper, plastic, and rubber). Adhesive-backed sheet, film, fabric, release liners, others.

Source: Directory Issue, *Adhesives Age*, June 27, 1997, pp. 53-66.

Although the U.S. adhesives industry is considered to be neither labor- nor capital-intensive, labor costs (total payroll) generally account for more of the value of the final product than capital costs. However, as is the case with much of the chemical industry, other operating costs are much larger than either labor costs or capital costs. In 1992, when the payroll cost was 12 percent of the value of shipments, the cost of raw materials, fuel, utilities, and other operating costs was 53 percent of the value of shipments. During 1987-92, the value added per employee increased 32 percent, while shipments were up 21 percent. Employment was essentially unchanged. Production workers were 55 percent of total employment in 1992, little changed from 57 percent in 1987.<sup>23</sup>

The profitability of the U.S. adhesives industry cannot be estimated. Of the hundreds of U.S. adhesives producers that have facilities located in the United States, only three or four among the largest are generally thought of (and justify the designation) as "adhesives companies." But these three or four account for only about 20 percent of the industry's sales. The remainder of

<sup>23</sup> U.S. Department of Commerce, *Census of Manufactures, 1992*.

the larger participants, as indicated in figure 1, and the names of the top ten adhesives companies mentioned earlier are mostly in other industries, and adhesives is a minor part of their activity; in any case they publish no segregated financial data on adhesives. Foreign ownership of several of the larger U.S.-located companies also adds to the data problem.<sup>24</sup>

## *Gelatin*

In the gelatin industry (including animal glue), manufacturers start with the most basic of raw materials—animal skins, bones, and tendons—and employ technology that has changed but little since ancient times. All but one or two of the eight U.S. gelatin manufacturers are affiliated with the meatpacking and food industries. The pieces of animal (mostly pig) skin are soaked in a lime slurry, then the gelatin is removed by dissolving it in hot water, dried by vacuum evaporation of the water, ground into powder, and packed in airtight containers. One of the remaining gelatin producers, producing the highest quality gelatin needed for photographic film, extracts the gelatin from imported bone by a more complex process. Gelatin is 97 percent protein, mostly collagen, and can absorb up to ten times its weight in water. Animal glue is essentially the same as gelatin, but being extracted from less carefully collected animal parts, mostly of cattle origin, it is less pure. Inedible, or technical, gelatin is produced from the same raw materials and processed in the same manner as animal glue, though it frequently contains less grease and is sometimes considered purer.<sup>25</sup>

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<sup>24</sup> *Moody's Industrial Manual, 1996*, provides financial data only for Loctite among adhesives-only companies.

<sup>25</sup> International Trade Centre, UNCTAD/GATT, "Gelatin: An Overview of the World Market with Special Reference to the Potential for Developing Countries," 1984; undated release of Eastman Kodak Company; and comments of Hudson Industries Corp. to the Commission, Nov. 4, 1994.

# U.S. MARKET

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## Consumer Characteristics and Factors Affecting Demand

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### *Adhesives*

There is no uniformity in the marketing or distribution of adhesives. As previously stated, adhesives are usually used in small amounts in almost every industry, and the nature of that industry determines the marketing and distribution approach. For example, with the postage stamp adhesive described above, there is only one large customer. At the opposite end of the marketing spectrum are the many suppliers to the myriad retail establishments in a large city, almost all of which are potential users of labels and tapes made of a host of materials.<sup>26</sup> These goods can be coated with a great variety of adhesives, usually pressure sensitive but with great variability in ease of removal (one aspect being the need to dispose of attached adhesives when paper and plastics goods are recycled). The marketing to users in this latter example is often the province of the formulator (i.e., the adhesives producer who mixes synthetic resin, solvent, and additives to yield the final product). But, in a third example, the application might be glued-on door or roof panels for automobiles made of sheet-molded plastic. For that type of large use, with only a limited range of acceptable adhesives, the major producer of the base synthetic resin might formulate and market its own products. However, in the case of other applications, the same firm could act merely as a supplier of resin to formulators. In short, there is no common thread linking the many types of industries that are the consumers of adhesives, nor is there any one industry segment that has predominated to the extent it could be used as a model.

Demand for adhesives keeps increasing because of continuing improvements that make them more economical and effective to use in comparison with other types of fastening devices such as staples, nails, screws, nuts and bolts, and the like. Like them, the adhesives are not end products but are part of the manufacturing process for cars, houses, and structures of all kinds. It seems hardly likely that the older types of fasteners could reverse this evolution. Other developments include instances of replacement of paint—for example, many traffic markers that originally had been painted on streets, and now much of the artwork on the skins of airplanes and on the sides of large trucking fleets, are glued-on decals. In October 1997, in the first vehicle to break the sound barrier on land—the Thrust SuperSonic Car—the engine nacelles, nose cone, air inlets, and cockpit canopy were composed of adhesive-bonded carbon and fiberglass composites, and structural adhesives were also employed in this vehicle.<sup>27</sup>

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<sup>26</sup> Even paper, the most common, comes from many suppliers and will vary in type of surface and other characteristics.

<sup>27</sup> Andrew Wood, "Cytex Gets a Boost from Thrust," *Chemical Week*, Oct. 29, 1997, p. 52.

## *Gelatin*

With gelatin, the competitive situation is different. Edible, pharmaceutical, and photographic gelatin must all meet appropriate chemical, physical, and bacteriological specifications, though these are less demanding for edible gelatin.<sup>28</sup> In photographic film, requiring the highest quality, the leading U.S. film company makes its own gelatin for its production of photographic film. Therefore, the other companies that manufacture photographic film mostly import their gelatin, mainly from Europe. U.S. producers of capsules and other pharmaceutical products also import large quantities from European high-quality producers. Price competition from imports in the less-sensitive applications on various occasions in recent years, and limitations on domestic supplies of raw materials, have discouraged the domestic industry from expanding its production capacity. Overall, though the eight U.S. producers apparently are technologically competitive, in recent years U.S. imports have been more than double U.S. exports and more than half as large as U.S. shipments.

## **Consumption<sup>29</sup>**

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With adhesives imports growing but holding steady at about 3 percent of U.S. apparent consumption in recent years, and exports both larger and growing more rapidly, there is nevertheless not much difference between consumption and production. In 1996, U.S. apparent consumption of adhesives was valued at about \$4.5 billion. However, this total is likely to be understated. As noted elsewhere in this report, import data for adhesives do not include large amounts of uncompounded/unformulated synthetic resin adhesives which, by the rules of the HTS, must be classified as unidentified plastics materials. However, such resin adhesives, including polyvinyl acetate/alcohol, polyvinyl acetate, polyolefin, urea-formaldehyde, and phenolic resins,<sup>30</sup> do add to more than one-fourth of the officially-reported total value of U.S. production of adhesives.

Gelatin is different; imports in 1996 were 40 percent of consumption, as they have been for some years. Thus, though estimated production of gelatin in 1996 was less than 6 percent of the production of adhesives, imports of gelatin were almost as large as those of adhesives—\$130 million for imports of gelatin and \$141 million for those of adhesives. However, estimated consumption of gelatin in 1996, valued at \$323 million, was only 7 percent of that of adhesives.

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<sup>28</sup> International Trade Centre, UNCTAD/GATT, "Gelatin: An Overview of the World Market with Special Reference to the Potential for Developing Countries," 1984, p. 13.

<sup>29</sup> Production (or shipments) + imports - exports.

<sup>30</sup> Robert D. Mitchell, "Overview of Industrial Adhesives in the Americas," *Adhesives Age*, Jan. 1996, p. 26.

Combined data for both adhesives and gelatin in 1992-96 are presented in table 2.<sup>31</sup> (Animal glue, a grade of gelatin that was once a major adhesive, now represents only a tiny overlap of the two industries; its combined production and imports, estimated to be about \$110 million in 1995, is less than 3 percent of adhesives consumption.)

**Table 2**  
**Adhesives, glues, and gelatin: U.S. shipments,<sup>1</sup> exports of domestic merchandise, imports for consumption, apparent U.S. consumption,<sup>1</sup> and ratio of imports to apparent consumption,<sup>1</sup> 1992-96**

Year	U.S. shipments <sup>2</sup>	U.S. exports	U.S. imports	U.S. apparent consumption <sup>3</sup>	Ratio of imports to apparent consumption
	))))))))) Million dollars)))))))))				Percent
1992 .....	4,335	256	205	4,285	4.8
1993 .....	4,522	290	215	4,446	4.8
1994 .....	4,520	344	224	4,400	5.1
1995 .....	4,702	391	240	4,552	5.3
1996 .....	4,940	441	271	4,770	5.7
Subtotal (1996):					
Adhesives .....	4,700	394	141	4,447	3.2
Gelatin .....	240	47	130	323	40.3

<sup>1</sup> Estimated by the staff of the U.S. International Trade Commission, from official statistics of the U.S. Department of Commerce.

<sup>2</sup> Shipments of adhesives are somewhat less than production. Census defines an industry as a group of establishments producing the same product or type of product. It publishes data on these establishments' value of shipments, value added by manufacture, number of employees, etc. An establishment in the plywood industry, for example, may produce its own adhesive, from phenol and formaldehyde. But its reported shipments are only the plywood. However, most users of adhesives buy them from companies whose plants are classified as adhesives establishments, so the difference between production and shipments is probably small.

<sup>3</sup> Apparent consumption = U.S. shipments + imports - exports.

Apparent consumption of adhesives, glues, and gelatin increased at an average annual rate of about 2.7 percent during 1992-96; the annual rate for U.S. shipments was about 3.3 percent. Measured in constant dollars, the growth was less than half that rate. For adhesives alone, a consultant's report says that growth of adhesives during 1989-95 was 3.4 percent per year. Correcting for inflation, the real annual growth was only 1.3 percent per year, compared with 2.1 percent for the nation's GDP. More recent forecasts state that for the next 3 years the adhesives market will grow about 3.0 percent per year.<sup>32</sup> This growth is the result of adhesives' penetration of almost every manufacturing industry, and their continuing replacement of other

<sup>31</sup> Segregated trade data for gelatin alone and for adhesives alone are given in tables B-1 to B-4. For adhesives, the international HTS tariff system does not agree with Census SIC statistical system but, instead, requires that unformulated (and some formulated) adhesives such as phenolics, ureas, and polyvinyl acetates be grouped with plastics imports and exports. Therefore the foreign trade data throughout this report are understated. Further details are in footnote 38.

<sup>32</sup> Darlene Asselin, "How Changes in the U. S. Economy Affect the Adhesives Industry," *Adhesives Age*, Jan. 1996, p. 18; "Adhesives and Sealants," *Chemical Week*, Mar. 18, 1998, p.21.

types of fasteners, paint, and novel packaging applications. Almost all of the growth in production and consumption of the products of this report has come from adhesives rather than from gelatin.

For gelatin, domestic shipments and exports combined increased by only \$86 million during 1992-96. U.S. consumption of gelatin did increase moderately from a spurt in demand in the late 1980s due to the emergence of the gummy candy market, but grew only slowly in the next few years; in 1996, shortages of its pork-skin raw material increased the prices of some grades as much as 30 percent, with an equivalent increase in dollar volume for the year. (The shortages of pork skins came from demands of the leather industry, the snack-food industry for deep-fried “poppers,” the pet health market (which uses pork skins to make organic pet chews), and other causes.) In 1997, there was slower demand for leather, pet novelty chews, and poppers, and gelatin prices, which had attained historical highs in the fourth quarter of 1996, declined steadily, though not down to the more traditional range.<sup>33</sup> However, this respite may not last. The European Commission’s decision to ban bovine-source materials, including gelatin, for any purpose beginning in January 1998 may bring shortages of that type of gelatin, normally used in the pharmaceutical and cosmetics industries. Formerly the ban was only for food. Both time and money will be required for slaughterhouses and other suppliers of bovine products to be certified as being free of bovine spongiform encephalopathy (BSE) or “mad cow” disease. (In response to protests of the U.S. Government, in November 1997 the European Commission tentatively decided to exempt pharmaceuticals from the ban, but this possible compromise then went forward for further discussion by the European Commission.)<sup>34</sup>

In terms of quantity, approximately half of all gelatin winds up in food products; about 40 percent is used in pharmaceuticals (mostly the capsules themselves); and 10 percent in photography. However, in dollars, since the price of photographic gelatin is more than double that of the other types, the latter market is much more prominent. (Worldwide, pharmaceutical use is lower and photography higher than the U.S. percentages.)<sup>35</sup>

## Production

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### *Adhesives*

Official U.S. Government shipments<sup>36</sup> statistics for the “Adhesives and Sealants” industry combine many of the numbers for adhesives with those for sealants. In 1992, there were 517 companies and 685 establishments in the combined segments, almost exactly the same as during all of the previous 4 years. Adhesives establishments are shown to outnumber sealants

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<sup>33</sup>Matthew Lerner, “Gelatin Prices Are Declining, as Raw Material Crimp Loosens,” *Chemical Market Reporter*, Sept. 8, 1997.

<sup>34</sup>Sean Milmo, “New ‘Mad Cow’ Based Regulations To Hit Gelatin and Oleochemicals,” *Chemical Market Reporter*, Aug. 11, 1997, p. 8, and “BSE Risk—EC Compromise on Imports of US-Made Gelatin,” *Chemical Market Reporter*, Nov. 24, 1997, pp. 6, 33. *European Chemical News*, Nov. 23, 1997, p. 17.

<sup>35</sup>Communication from gelatin industry, June 2, 1992; and *Chemical Marketing Reporter*, July 18, 1994; July 23, 1993; and Jan. 1, 1996, pp. 7, 14.

<sup>36</sup>Shipments: See footnote 2 under table 2.

establishments by a ratio of 4 to 1. Because some companies produce both types of products, it is estimated that there are about 500 U.S. producers that sell them in the merchant market, but industry sources put the total somewhat higher. In addition, there may be more than 100 captive producers that make their own adhesives and/or adhesive formulations (many of which are not counted in the statistics).

With consumption of adhesives increasing annually, and imports almost negligible, official U.S. shipments statistics for 1992, \$4.1 billion, detailed in table 3, noted an all-time record. Table 3 is an adjusted excerpt from the most recent Census of Manufactures, 1992, giving the number of companies with shipments of \$100,000 or more and the value of shipments (not adjusted for HTS compliance, see footnote 31) in millions of dollars. Compared with the previous Census of Manufactures (1987), this tabulation shows shipments of the “natural” adhesives increased 23 percent whereas those of the synthetic resin and rubber adhesives advanced 26 percent. For the natural adhesives, this advance is the first since World War II; natural adhesives are now only 5 percent as large in dollar value as the synthetics, and the downward trend will resume. (These numbers, based on the SIC system, are for all adhesives, whereas, as explained below, the foreign trade statistics omit a large fraction of the true imports and exports.) By 1996, government-estimated shipments (excluding gelatin) increased to \$4.7 billion, though other industry estimates indicated the 1995 or 1996 totals had been between \$5.8 billion and \$9 billion.<sup>37</sup>

## *Gelatin*

U.S. gelatin production, according to industry reports, grew to about \$240 million in 1996, from only \$170 million in 1992, not counting the small increment of animal glue. Its markets in pharmaceuticals and photography have grown, but this growth has been offset by the effect of losses from competition with other products in the larger food products market (such as the popularity of many newer desserts and bakery goods that have replaced Jell-O® and marshmallows). However, as noted earlier, major price increases were largely responsible for the inflated dollar totals of 1996.

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<sup>37</sup> Bruce Gain, “Adhesives & Sealants, Customizing the Formula,” *Chemical Week*, Mar. 26, 1997, p. 22; “Adhesives—Sticking With It,” Dec. 1997/Jan. 1998, pp. 25, 28; “Report Projects Steady Growth for Adhesives and Sealants,” *Adhesives Age*, Dec. 1995, p. 51.

**Table 3**  
**Industry shipments and number of producers of adhesives, 1992**

Type	No. of companies	Value <i>Million dollars</i>
Natural base glues and adhesives (except rubber adhesives):		
Animal glue . . . . .	12	47
Protein adhesives: casein, soybean, fish, etc. . . . .	8	29
Starch, dextrin . . . . .	17	102
Other except rubber (gums, silicates, asphalt, etc.) . . . . .	-	30
Subtotal, natural . . . . .	-	208
Synthetic resin and rubber adhesives, including laminating, bonding:		
Epoxy . . . . .	62	301
Phenolic and resorcinol type . . . . .	14	247
Urea and modified urea-formaldehyde . . . . .	11	175
Polyvinyl acetate . . . . .	71	624
Polyvinyl chloride and other vinyl types . . . . .	37	96
Acrylic (acrylate) . . . . .	49	221
Cyanoacrylate . . . . .	11	122
Urethane . . . . .	29	80
Polyester . . . . .	9	84
Styrenic . . . . .	14	153
Hot melt adhesives incl. vinyl, polyamide, polyolefin . . . . .	52	423
Adhesive films/tapes, pressure-sensitive adhesives . . . . .	9	313
Rubber cement . . . . .	37	272
Rubber-synthetic resin combinations . . . . .	36	558
Cellulosic, polyamide, anaerobic, etc. . . . .	43	250
Subtotal, synthetic resin and rubber . . . . .	-	3,919
GRAND TOTAL . . . . .		4,127

Source: Partially estimated by staff of the U.S. International Trade Commission from 1992 *Census of Manufactures*.

## U.S. TRADE

### Overview

In this summary, the consumption of adhesives outweighs that of gelatin by a factor of 14 to 1, and imports of adhesives are relatively small. But U.S. imports of gelatin are very important to that industry; they are more than half as large as U.S. production of gelatin, and, in 1996, 93 percent as large as imports of adhesives. In both industries, the major types of imports are relatively sophisticated and their sources are mainly the developed countries.

The U.S. merchant trade balance for adhesives in 1996 was a positive \$253 million, reflecting the large excesses of exports over imports with Canada (+\$80 million), Mexico (+\$55 million), and Japan and the other countries of the Asian Pacific Rim (+\$67 million). U.S. exports to Europe of \$57 million were more than matched by imports of \$59 million.

In contrast, the trade balance for gelatin in 1996 was a negative \$84 million, 80 percent of which was with the EU, the result of relatively large imports mostly from France, Germany, the United Kingdom, and the Netherlands. And the preponderance of imports from Brazil, Colombia, and Argentina raised the negative trade balance with Latin American countries to \$17 million.

## **U.S. Imports**

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According to official import statistics compiled by the Bureau of the Census, U.S. imports of adhesives in 1996 amounted to \$141 million. This total may be broken down approximately as follows:

Adhesives packaged for retail sale (<1 kg) . . . . .	\$49 million (~35%)
Adhesives based on rubber or synthetic resins . . . . .	58 million (~41%)
Other adhesives, based on “natural” materials . . . . .	34 million (~24%)

However, this breakdown is not consistent with the data in the Department of Commerce’s Census of Manufactures or with data reported by industry and foreign country sources—all of these would indicate that the synthetic resins and rubber percentage should be enlarged at the expense of the other two categories.<sup>38</sup>

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<sup>38</sup> According to several published consultant and industry sources, adhesives packaged for retail sale account for less than 5 percent of U.S. consumption of adhesives (e.g., Rick Mullin, “Managing Growth Through Another Tough Year,” *Chemical Week*, Mar. 10, 1993, pp. 26). Therefore, the official trade data, which indicate that retail-packaged product accounted for about 35 percent of imports, seem too high. Most U.S. imports of adhesives come from advanced producers in Japan, Germany, and Canada, which produce these products mostly for bulk shipment and for end use in bulk applications, rather than packaged for retail sale. Another question about the official import data relates to the classification of 24 percent of imports being based on non-synthetic polymers, compared with the much lower 5 percent given for overall U.S. shipments of such types, as evidenced by the official *Census of Manufactures* data.

These discrepancies in the statistics appear to arise from two sources in the Harmonized System. First, potential misunderstanding arises from the wording for the four 8-digit subheadings under HS heading 3506. Some importers and analysts believe (erroneously) that all four subheadings (3506.10.10, 3506.10.50, 3506.91.00, and 3506.99.00) cover only imports of adhesives that are put up for retail sale, in packages not exceeding a net weight of 1 kilogram each (e.g., Census reflects this error in its monthly “National Trade Data Bank” statistics on imports). However, actually only the first two of the four subheadings of 3506 are applicable to retail sale. Second, while the HTS definition (though not the classification) of retail-packaged adhesives is relatively straightforward, the Explanatory Notes (EN) to the international Harmonized System with respect to the far more important bulk shipments of plastics-based adhesives seem to be difficult to interpret. Such explanation in the EN is given not only in chapter 35 for adhesives (heading 3506), but also in chapter 39 (for plastics), and these two sources may seem contradictory in their advice on how to classify imports and exports of bulk adhesives based on synthetic polymers, either plastics or rubbers.

(continued...)

## *Principal Suppliers and Import Levels*

### **Adhesives**

Official data show that imports of adhesives were less than 3 percent of the value of production in 1996, and were less than half the value of exports as well as having grown more slowly than exports in recent years. However, as noted above, the true level of imports is greatly understated because most adhesives where the performance-enhancing additives (like those in plastics) were added to the mix of adhesives raw materials at the start of the chemical reaction instead of being mixed in after the formation of the adhesive polymer are classified as plastics rather than as adhesives.

Importers of adhesives play only a small role in spite of the low U.S. tariffs on adhesives, and the small penetration of adhesives imports indicates the domestic industry is very competitive. (With thousands of different types of adhesives and a great variety of end uses, a blanket statement comparing U.S., European, and Japanese technology is not possible.) Another

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<sup>38</sup> (...continued)

For example, the EN to heading 3506 (p. 534), by far the most important adhesives category, provides that adhesives based on plastics may be classified as adhesives only if not already covered by a more specific heading, particularly as a heading in the HTS plastics chapter, No. 39. That is, only such preparations that are specifically formulated for use as adhesives can be included in 3506, even though many unformulated solutions of resins (right out of the reaction kettle) are among the leading types of adhesives but their imports cannot be classified as adhesives. Approved-by-heading-3506 adhesives therefore are mostly specialty plastics which, apart from any of the customary plastics additions named in chapter 39 (fillers, plasticizers, solvents, pigments, and so forth), must, to be accepted (classified) as adhesives, also contain specialized added substances other than those named in chapter 39. (As an example of such a non-plastics-type additive, the EN names “waxes.” However, according to the Society of the Plastics Industry, Inc. (SPI, the leading trade association of that industry), this EN may be out of date. In the SPI’s view, waxes (and also fatty acid derivatives not mentioned in the EN) are indeed normal plastics additives, and their addition to a plastics formulation should not necessarily preclude classification in chapter 39.) Waxes are only one of at least a dozen types of additives that are common to both plastics and adhesives formulations, so the difference in whether any given mixture of polymers and additives formally qualifies it as an adhesive or a plastic may lie in the proportions used, or certain specific properties of a given additive or of the basic polymer itself. However, though these additives are normal in a practical sense, they have no bearing on HTS classification. At any rate, classification becomes muddled because of the additives that must be taken into account.

The U.S. Customs Service has not disputed the difficulty of classifying adhesives in the Harmonized System and generally has agreed with the foregoing analysis of the problem (communication from U.S. Customs, Feb. 6, 1992). They have indicated that to deal with the existing problems, they often ascertain the recipient of the import and if that party appears to be in the adhesives business, Customs is likely to classify the import as an adhesive. The Customs Cooperation Council (CCC, now named World Customs Organization) also took notice of the problem (Report of the Scientific Subcommittee, 5th Session, Annex A/7, Feb. 6, 1992) and indicated that the EN should be clarified in this regard.

Additional details are in footnote 31.

reason for the unimportance of imports is the fact that an adhesive beyond all else is a performance chemical product rather than a specification product. This necessitates on-the-spot technical service availability in many applications. Customers' problems are not necessarily centered on the adhesives themselves; they may be caused by the substrates. But the solution comes from the adhesives specialist. For example, a buyer of an adhesive for sealing (corrugated) paperboard for packaging might find a problem of adhesiveness after switching, for a better price, to paperboard from another supplier. If so, he immediately needs someone to check his operation and recommend a different formulation or a change in the application of the adhesive. This type of service is not so likely to be available for an imported product. Another factor that inhibits both imports and exports is the limited shelf life of many adhesives. Price plays an important role in some uses such as packaging, where the adhesive need be no stronger than the paper or cardboard it is applied to. But in such items as automobiles and aircraft, where strength and durability are vital, and the cost of the adhesives is only a tiny fraction of the cost of the products, price becomes a secondary factor.

## **Gelatin**

Imports of gelatin, relatively small in magnitude but very large in relation to its domestic production, grew from \$94 million in 1992 to \$130 million in 1996. Almost half was high-grade photographic gelatin mostly from France, and most of the other half, grouped in a single category as "edible gelatin," was actually high-grade pharmaceutical gelatin (primarily for capsules) mostly from France and other European countries, along with edible gelatin mostly from Brazil and Colombia.<sup>39</sup> For all types combined, Japan has been the second- or third-ranked supplier (after France) throughout the period. In 1996, U.S. imports of gelatin were about 3 times the magnitude of exports and were 54 percent as large as estimated U.S. shipments.

Combined imports of both adhesives and gelatin in 1996, as indicated in table 4, amounted to \$271 million, 32 percent more than in 1992. More than half of the imports came from Germany, France, the United Kingdom, and other European countries, followed by Japan and Canada. Duty-free imports, almost entirely from Brazil and other countries benefiting from the Generalized System of Preferences (GSP) program, were 7 percent of total imports and a negligible fraction of domestic consumption. The importance of European trade stems in part from the many acquisitions and joint ventures in recent years of the leading companies on both sides of the Atlantic Ocean.

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<sup>39</sup>Prices for edible gelatin fall significantly below those for pharmaceutical gelatins and even more below those commanded by photographic gelatin. Though all three types must satisfy appropriate chemical, physical, and bacteriological specifications, the physical and bacteriological specifications for edible gelatin are less critical and less demanding than those for the other types. For these reasons, the import market of edible gelatin has been satisfied more by supplies from developing countries. (In addition to these three types, a small fraction of the gelatin market is a lower grade product—technical gelatin that is used in the production of abrasive papers, in sizing paper and textiles, and in the production of printers' rollers and matches.) — From UNCTAD/GATT International Trade Centre, "Gelatin: An Overview of the World Market with Special Reference to the Potential for Developing Countries," 1984.

**Table 4**  
**Adhesives, glues, and gelatin: U.S. imports for consumption, by principal sources, 1992-96**

Source	1992	1993	1994	1995	1996
	))))))))) Million dollars )))))))				
Germany . . . . .	34	39	44	39	52
Canada . . . . .	25	29	30	34	42
Japan . . . . .	44	43	47	45	35
France . . . . .	35	33	31	35	37
United Kingdom . . . . .	15	12	13	18	20
Brazil . . . . .	14	15	13	13	20
Netherlands . . . . .	4	5	7	8	13
Belgium . . . . .	6	7	8	8	8
Korea . . . . .	3	3	3	5	8
Mexico . . . . .	1	2	2	1	2
All other . . . . .	24	27	26	34	34
Total . . . . .	205	215	224	240	271

Source: Compiled from official statistics of the U.S. Department of Commerce.

### *U.S. Trade Measures*

Table 5 shows the U.S. rates of duty, as of January 1, 1997, applicable to imports of adhesives, glues, and gelatin under the Harmonized Tariff Schedule of the United States (HTS). The table shows the column 1 duty rates for countries considered for general or most-favored-nation (MFN) treatments as well as duty rates under column 1 for countries qualifying under special tariff programs.<sup>40</sup> Under various U.S. trade agreements, imports of adhesives and gelatin from Canada, Mexico, Israel, Caribbean Basin and Andean countries, and most of the developing (GSP) countries are imported free of duty.

The 1997 column 1 U.S. general rate of duty for almost all adhesives, under HTS heading 3506, is 2.1 percent ad valorem. For the minor imports of adhesives under headings 3501, 3503, and 3505 (based on animal and vegetable sources), the general rates of duty vary from 1.5 cents per kilogram plus 2 percent ad valorem to 3.6 cents per kilogram plus 4.9 percent ad valorem.<sup>41</sup> For gelatin, the general rate of duty under heading 3503 is 3.6 cents per kilogram plus 4.9 percent ad valorem.<sup>42</sup>

<sup>40</sup> See appendix A for an explanation of rate of duty columns.

<sup>41</sup> A number of polymers that are used as adhesives are classified in Chapter 39 (Plastics and Articles Thereof) of the HTS. Data on these products, however, are not identified within that chapter.

<sup>42</sup> With the exception of certain adhesives, the duty rates on the products covered in this summary are being reduced year by year in a staging process that will end in 2004. The duties on the largest-volume adhesives, classified in HTS 3506.10.50, 3506.91.00, and 3506.99.00, are not scheduled to change during the staging process. By 2004, those for the remaining adhesives will have been reduced an average of about 20 percent. The duty on gelatin will have been reduced 22 percent.

**Table 5**  
**Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1997;**  
**U.S. exports, 1996; and U.S. imports, 1996<sup>1</sup>**

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1 1997—		U.S. exports, <sup>2</sup> 1996	U.S. imports, 1996
		General	Special <sup>3</sup>		
				))) 1,000 dollars )))	
	<b>Adhesives (and gelatin used as adhesive):</b>				
3501	Casein and derivatives:				
3501.90.20	Casein glues . . . . .	6.8%	Free (A,CA,E,IL, J,MX)	715	132
3503	Gelatin and derivatives:				
3503.00.10	Fish glue . . . . .	1.5¢/kg + 2%	Free (A,CA,E,IL, J,MX)	( <sup>4</sup> )	727
3503.00.20	Inedible gelatin and animal glue, valued under 88¢/kg . . . . .	1.5¢/kg + 4.1%	Free (CA,E,IL, J,MX)	( <sup>4</sup> )	118
3503.00.40	Inedible gelatin and animal glue, valued 88¢ or more/kg . . . . .	3.6¢/kg +4.9%	Free (CA,E,IL, J,MX)	( <sup>4</sup> )	7,152
3505	Dextrins and starches:				
3505.20.00	Starch and dextrin glues . . . . .	2.4¢/kg + 3.3%	Free (A,CA,E,IL, J,MX)	6,274	2,160
3506	Glues for retail; other adhesives:				
3506.10.10	Animal glue packaged for retail sale . . . . .	6.8%	Free (CA,E,IL, J); 4.3% (MX)	( <sup>5</sup> )	39
3506.10.50	Adhesives, other than animal glue, for retail sale . . . . .	2.1%	Free (CA,E,IL, J,MX)	( <sup>5</sup> )	48,687
3506.91.00	Adhesives based on rubber or plastics . . . . .	2.1%	Free (A,CA,E,IL, J,MX)	253,790	58,026
3506.99.00	Other adhesives . . . . .	2.1%	Free (A,CA,E,IL, J,MX)	67,848	24,370
	<b>Gelatin:</b>				
3503	Gelatin and derivatives:				
3503.00.55	Edible, photographic, and other gelatin . . . . .	3.6¢/kg + 4.9%	Free (A,CA,E,IL, J,MX)	46,425	130,060

<sup>1</sup>Many adhesives are also classified under HTS subheadings for plastics, where they are not identified as adhesives, and the data are therefore suppressed.

<sup>2</sup>Some data are aggregated differently under Schedule B (export) subheadings.

<sup>3</sup>Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); North American Free Trade Agreement, goods of Canada (CA) and Mexico (MX); Caribbean Basin Economic Recovery Act (E); the United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J).

<sup>4</sup>Separate data are not available; value included under Schedule B subheading 3503.00.60.

<sup>5</sup>Separate data are not available; value included under Schedule B subheading 3506.10.00.

Source: Harmonized Tariff Schedule of the United States and official statistics of the U.S. Department of Commerce.

There are no known significant domestic nontariff import restrictions, although some countries (e.g., Japan) have expressed concern that the Food and Drug Administration's pharmaceutical approval process, more rigorous than theirs, is an import restriction in all but name.<sup>43</sup> No statutory investigations have been instituted under U.S. trade laws within the past 5 years that have involved adhesives or gelatin.

## U.S. Exports

### *Principal Markets and Export Levels*

U.S. exports of adhesives, glues, and gelatin increased from 6 to 8 percent of producers' shipments during 1992-96, and the average annual growth rate was over 15 percent for adhesives and 8 percent for gelatin. The major market by far was Canada, followed by Mexico, Japan, the United Kingdom, and Germany, as shown in Table 6.

**Table 6**  
**Adhesives, glues, and gelatin: U.S. exports of domestic merchandise, by principal markets, 1992-96**

Market	1992	1993	1994	1995	1996
	))))))))))))) Million dollars )))))))))))				
Canada .....	76	92	104	114	131
Mexico .....	35	50	63	55	58
Japan .....	24	23	24	29	35
United Kingdom .....	8	12	15	19	21
Germany .....	22	14	13	19	18
Korea .....	7	7	11	14	17
Brazil .....	3	5	9	16	15
Netherlands .....	8	6	9	11	11
Taiwan .....	3	4	5	7	9
All other .....	68	77	90	108	126
Total .....	256	290	344	391	441

Source: Compiled from official statistics of the U.S. Department of Commerce.

The negative trade balance with Europe during all 5 years was offset in recent years mainly by increased exports to Canada and Mexico. The positive trade balance with those two countries, probably stimulated by the tariff-cutting provisions of the North American Free Trade Agreement, grew from \$86 million in 1992 to \$145 million in 1996. The European imbalance is a combination of a minuscule negative trade balance in adhesives (-\$2.2 million with the EU) being augmented with the larger negative trade balance in gelatin—\$66 million in 1996. An \$11.6 million negative trade balance with Japan in 1996 in gelatin was almost exactly offset by a positive trade balance in adhesives. (The latter was a major change because in 1995 the

<sup>43</sup> *The Economist*, Apr. 22, 1995, pp. 65-67.

trade balance in adhesives with Japan had been a negative \$890,000, and in the 3 years before that this negative trade balance had averaged almost \$9 million per year.) Segregated details are given in appendix B in tables B-1 and B-2 for adhesives and tables B-3 and B-4 for gelatin, and for the combined totals for both groups in table B-5.

The product mix of adhesives exports, excluding gelatin, in millions of dollars in 1996, was, officially, as follows:

Animal glue . . . . .	\$25
Casein glues. . . . .	1
Glues based on starch and dextrin . . . . .	6
Adhesives packaged for retail sale . . . . .	40
Adhesives based on synthetic resins and rubber . . . . .	254
Other adhesives . . . . .	<u>68</u>
Total adhesives . . . . .	\$394

Source: Official statistics of the U.S. Department of Commerce.

The "Other adhesives" number in this tabulation seems far too large, suggesting the same type of classification problems that are discussed above in connection with import statistics. Most of such exports probably belong in the line just above it.

U.S. exports of adhesives that are based on synthetic resins and rubber (the largest single group) in 1996 went to about 93 countries, including 29 in Europe (including small amounts to several Eastern European countries), 23 in Latin America and the Caribbean, 15 Asian/Oceanic countries, 11 in Africa, and 16 others (mostly Middle Eastern countries). Canada is the largest market for this product grouping.

U.S. exports of edible, pharmaceutical, and photographic gelatin in 1996 were \$46 million, about one-fifth as large as U.S. production. The major markets have been Canada, the United Kingdom, Germany, and Japan—countries whose end-use patterns are not too different from those of the United States. Excluded from the overall total are exports of \$25 million classified under Schedule B subheading 3503.00.60 and consisting of unidentified gelatin derivatives whose statistics are mixed with those for animal glue, fabricated gelatin products such as capsules for pharmaceuticals, and colored rectangular sheets for theater lighting.

### ***Foreign Trade Measures***

Foreign duty rates for adhesives and gelatin are much higher than those of the United States. For example, in 1997-98, in the European Union, the duty on major adhesives is 6.5 percent ad valorem compared with 2.1 percent in the United States. For gelatin, the percentages are 10.6 for the EU and about 5 for the United States. Table 7 summarizes average rates of duty for important trading partners.<sup>44</sup>

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<sup>44</sup>Duties compiled from tariff schedules of the leading trading partners.

**Table 7**  
**Adhesives, glues, and gelatin: Tariffs charged by indicated countries**

Market	Average rate of duty on adhesives and gelatin
	<i>Percent</i>
Canada . . . . .	9.2 for major types of adhesives. 10 for gelatin. (United States duty free)
Mexico . . . . .	15 for major adhesives; 5 for photographic gelatin; and 15 for edible and pharmaceutical gelatin. (United States duty free)
European Union . . . . .	6.5 for major adhesives; 10.6 for gelatin.
Japan . . . . .	4.6 for major adhesives; 3.9 for photographic gelatin; and 3 for edible and pharmaceutical gelatin.

Source: The tariff schedules of the countries mentioned.

No specific nontariff barriers were identified that affect either adhesives or gelatin. As previously noted, though not strictly a relevant non-tariff measure, the European Commission's decision (now likely to be modified) to ban bovine-source materials for any purpose (formerly the ban was only for food) beginning in 1998 will affect that type of gelatin, normally used in the pharmaceutical and cosmetics industries in many products.<sup>45</sup> Though most U.S.-produced gelatin is made from pork skin, some is produced from cattle bones and their exports to Europe will be threatened. Much more important is the very large value of U.S. imports of gelatin from Europe that are derived from cattle bone. Around two-thirds of degreased bones imported into the EU for gelatin manufacture come from the United States. Though the U.S.

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<sup>45</sup>U.S. and European firms say that the health risk is minute and that the ban could hit 80 percent of medicines on sale in Europe, deprive sick people of vital drugs, and affect some \$4.5 billion a year of EU drug imports from the United States. European Commission Vice President Leon Brittan recently said constructive work was underway to solve the problem. Little information is available to estimate the possible specific effect on gelatin, exports of which to the EU in 1996 were about \$18 million and imports from the EU were about \$84 million. (Washington Trade Daily (Trade Reports International Group), Nov. 10, 1997, p. 4, and letter to the Commission from the Pharmaceutical Research and Manufacturers of America in regard to investigation No. 332-382, Sept. 26, 1997.)

Subsequently, as previously noted, the European Commission tentatively decided to exempt pharmaceuticals from the ban, and this possible compromise then went forward for further discussion by the European Commission. (Sean Milmo, "BSE Risk—EC Compromise on Imports of US-Made Gelatin," *Chemical Market Reporter*, Nov. 24, 1997, pp. 6, 33.) On December 10, 1997, the European Commission endorsed a proposal to delay by three months a ban on animal products containing specified risk materials, and requested more information from its Scientific Steering Committee and other sources. (Samuel Goldreich, "EC Proposes Delay in Ban on Beef Parts," *The Washington Times*, Dec. 11, 1997, pp. B7, B9.)

In regard to the U.S. market, the outcome may affect the large U.S. imports of gelatin. European industry officials say, "The need for certification could cause some difficulties .... Slaughterhouses and renderers will have to alter their working practices, which could take time and push up costs and prices....Supplies of raw material will be reduced by around 15 percent following the ban. This will push up costs so that prices of bovine-sourced gelatin will probably have to rise." ("New 'Mad Cow' Based Regulations To Hit Gelatin and Oleochemicals," *Chemical Market Reporter*, August 11, 1997, p. 8.)

Government insists that imports from the United States should be exempted from the proposed measures because this country is free of BSE, the Commission's scientific advisors claim there is a risk of BSE here. Defensively, a number of EU gelatin makers had established their own arrangements for certifying that their U.S. bone supplies are SRM-free well before the Commission's planned import ban became a reality. This was in response to the demands of EU pharmaceutical manufacturers who wanted assurances that gelatin used in medicines was safe.<sup>46</sup>

## FOREIGN INDUSTRY PROFILE

Adhesives and gelatin, at least the less advanced types, are based to some extent on widely available raw materials such as starch and bones and are produced in practically every nation. However, the highest quality products, such as the improved and newer synthetic resin adhesives and photographic gelatin, are products of the developed countries, mainly the United States, the major western European countries (in order of value, Germany, France, the United Kingdom, Italy, and Spain), and Japan.

About 600 companies compete in the European market, but many are distributors or agents of foreign companies.<sup>47</sup> Estimates of the world market for adhesives in 1995, valued at approximately \$14 billion, are shown in table 8.<sup>48</sup>

**Table 8**  
**Adhesives markets in the principal regions of the world, 1995**

Market	Billion pounds	Million dollars
United States . . . . .	5	5,800
Canada . . . . .	-	329
Mexico . . . . .	-	85
Europe . . . . .	3	3,500
Far East and Oceania (ex Japan) . . . . .	1.4	1,900
Japan . . . . .	1.4	2,000
Total . . . . .	10.8	13,614

Source: Presentations to Adhesives and Sealants Council, 1996.

<sup>46</sup> Sean Milmo, "Gelatin Market Still Caught in 'Mad Cow' Mess," *Chemical Market Reporter*, Dec. 29, 1997, pp. 5, 29.

<sup>47</sup> "Adhesives Market Perspectives On Europe, Latin America, Far East," *Adhesives Age*, Jan. 1995, p. 42.

<sup>48</sup> Estimates presented by participants at the year-end 1996 meeting of the Adhesives and Sealants Council, "ASC International Conference Emphasizes Global Marketplace," *Adhesives Age*, Dec. 1996, p. 51.

Official statistics on adhesives production in Europe are not available. Most analysts estimate Western European production as being less than that of the United States. The European end-use pattern covers the same applications, but differs in emphasis from that of the United States (see summary in the "Introduction" section). Published estimates of end uses differ widely, but one of the most complete lists them in order of magnitude (from 29 percent for the first to 1.4 percent for the last) thus: paper and packaging, building, woodworking, retail and general, vehicles, tapes and labels, textiles and nonwovens, bookbinding, and footwear.<sup>49</sup>

The leading adhesives producers, both U.S. and European, have become emphatically multinational. The world's top ten producers of adhesives and their 1990 sales (more recent data in footnote below) in millions of dollars are as follows:<sup>50</sup>

Henkel (Germany) . . . . .	1,050
National Starch and Chemical (U.K.-owned) . . . . .	760
H.B. Fuller (U.S.) . . . . .	650
Loctite (U.S.) . . . . .	575
Total Chemie (France) . . . . .	400
Borden (U.S.) . . . . .	385
Konishi (Japan) . . . . .	290
Morton (U.S.) . . . . .	265
Teroson (Germany) . . . . .	240
Ceca, Div. of Atochem (France) . . . . .	230

European adhesives, in general, are not regarded as being superior to those of the United States, judging from perusal over the years of the many articles in U.S. and European periodicals that specialize in this industry. The large investments of European firms in the U.S. adhesives industry, and vice versa, have transferred much know-how in both directions. Also, since most adhesives are formulations that are nearly half composed of water or solvents, and, in addition, their shelf life can be limited, it is often regarded as being more advantageous to export and import the basic synthetic resins (and other components if necessary) and do the formulating in the countries where they will be marketed. Though U.S. exports of adhesives in recent years have been increasing about 16 percent per year, only in 1995 did they rise to 10 percent of domestic (adjusted) production. Tariff and non-tariff barriers are said to be not a problem.

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<sup>49</sup>O. Lacoste, "Industrial Adhesives Market Trends," *European Adhesives and Sealants*, Sept. 1995, pp. 2, 4; and "Report Projects Steady Growth For Adhesives and Sealants," *Adhesives Age*, Dec. 1995, p. 20.

<sup>50</sup>Atochem, with its 1996 acquisition of the U.S.'s Findley, has moved from the bottom of the list to at least halfway to the top. National Starch, though U.S.-located, was owned by British-based Unilever and is now owned by British-based ICI. Henkel had owned 25 percent, then 35 percent, of Loctite and in December 1996 acquired the remainder of that company. Most of Total Chemie's sales are those of its U.S. subsidiary Bostik. ("Adhesives and Sealants: Innovating Under Pressure," *Chemical Week*, Mar. 11, 1992, p. 27, and "Adhesives '89," *Chemical Marketing Reporter*, Aug. 28, 1989, p. SR#3, and Nov. 4, 1996, p. 1.)



**APPENDIX A**  
**TARIFF AND TRADE AGREEMENT**  
**TERMS**

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In the *Harmonized Tariff Schedule of the United States* (HTS), chapters 1 through 97 cover all goods in trade and incorporate in the tariff nomenclature the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description. Subordinate 8-digit product subdivisions, either enacted by Congress or proclaimed by the President, allow more narrowly applicable duty rates; 10-digit administrative statistical reporting numbers provide data of national interest. Chapters 98 and 99 contain special U.S. classifications and temporary rate provisions, respectively. The HTS replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989.

Duty rates in the *general* subcolumn of HTS column 1 are most-favored-nation (MFN) rates, many of which have been eliminated or are being reduced as concessions resulting from the Uruguay Round of Multilateral Trade Negotiations. Column 1-general duty rates apply to all countries except those enumerated in HTS general note 3(b) (Afghanistan, Cuba, Laos, North Korea, and Vietnam), which are subject to the statutory rates set forth in *column 2*. Specified goods from designated MFN-eligible countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the *special* subcolumn of HTS rate of duty column 1 or in the general notes. If eligibility for special tariff rates is not claimed or established, goods are dutiable at column 1-general rates. The HTS does not enumerate those countries as to which a total or partial embargo has been declared.

The *Generalized System of Preferences* (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 for 10 years and extended several times thereafter, applies to merchandise imported on or after January 1, 1976 and before the close of June 30, 1998. Indicated by the symbol "A", "A\*", or "A+" in the special subcolumn, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 4 to the HTS.

The *Caribbean Basin Economic Recovery Act* (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984. Indicated by the symbol "E" or "E\*" in the special subcolumn, the CBERA provides duty-free entry to eligible articles, and reduced-duty treatment to certain other articles, which are the product of and imported directly from designated countries, as set forth in general note 7 to the HTS.

Free rates of duty in the special subcolumn followed by the symbol "IL" are applicable to products of Israel under the *United States-Israel Free Trade Area Implementation Act* of 1985 (IFTA), as provided in general note 8 to the HTS.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn followed by the symbol "J" or "J\*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the *Andean Trade Preference Act* (ATPA), enacted as title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 11 to the HTS.

Preferential or free rates of duty in the special subcolumn followed by the symbol "CA" are applicable to eligible goods of Canada, and rates followed by the symbol "MX" are applicable to eligible goods of Mexico, under the *North American Free Trade Agreement*, as provided in general note 12 to the HTS and implemented effective January 1, 1994 by Presidential Proclamation 6641 of December 15, 1993. Goods must originate in the NAFTA region under rules set forth in general note 12(t) and meet other requirements of the note and applicable regulations.

Other special tariff treatment applies to particular *products of insular possessions* (general note 3(a)(iv)), *products of the West Bank and Gaza Strip* (general note 3(a)(v)), goods covered by the *Automotive Products Trade Act* (APTA) (general note 5) and the *Agreement on Trade in Civil Aircraft* (ATCA) (general note 6), *articles imported from freely associated states* (general note 10), *pharmaceutical products* (general note 13), and *intermediate chemicals for dyes* (general note 14).

The *General Agreement on Tariffs and Trade 1994* (GATT 1994), pursuant to the Agreement Establishing the World Trade Organization, is based upon the earlier GATT 1947 (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) as the primary multilateral system of disciplines and principles governing international trade. Signatories' obligations under both the 1994 and 1947 agreements focus upon most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national treatment for imported products; the GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, dispute settlement, and other measures. The results of the Uruguay Round of multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as Schedule XX.

Pursuant to the *Agreement on Textiles and Clothing* (ATC) of the GATT 1994, member countries are phasing out restrictions on imports under the prior "Arrangement Regarding International Trade in Textiles" (known as the **Multifiber Arrangement** (MFA)). Under the MFA, which was a departure from GATT 1947 provisions, importing and exporting countries negotiated bilateral agreements limiting textile and apparel shipments, and importing countries could take unilateral action in the absence or violation of an agreement. Quantitative limits had been established on imported textiles and apparel of cotton, other vegetable fibers, wool, man-made fibers or silk blends in an effort to prevent or limit market disruption in the importing countries. The ATC establishes notification and safeguard procedures, along with other rules concerning the customs treatment of textile and apparel shipments, and calls for the eventual complete integration of this sector into the GATT 1994 over a ten-year period, or by Jan. 1, 2005.



**APPENDIX B**  
**IMPORT AND EXPORT TABLES**

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**Table B-1**  
**Adhesives and glues: U.S. imports for consumption, by principal sources, 1992-96**

Source	1992	1993	1994	1995	1996
<b>Quantity (1,000 kilograms)</b>					
Canada .....	10,405	13,302	15,962	17,735	21,389
Germany .....	4,841	5,158	5,922	4,683	5,153
Japan .....	2,619	2,121	1,611	3,719	1,363
United Kingdom .....	749	882	1,482	1,915	2,281
Korea .....	358	401	223	415	1,036
Brazil .....	1,932	2,303	2,339	2,586	2,192
France .....	249	220	345	474	346
Ireland .....	77	76	80	105	91
Taiwan .....	1,109	1,237	1,156	1,137	1,236
Switzerland .....	28	655	1,114	298	676
All other .....	5,634	6,313	6,284	7,243	3,634
<b>Total .....</b>	<b>28,001</b>	<b>32,667</b>	<b>36,517</b>	<b>40,311</b>	<b>39,399</b>
<b>Value (1,000 dollars)</b>					
Canada .....	22,035	25,797	27,684	30,932	37,558
Germany .....	25,411	26,560	31,459	27,573	35,146
Japan .....	32,103	29,006	32,221	27,553	19,631
United Kingdom .....	3,561	3,452	5,189	6,892	8,542
Korea .....	2,816	2,526	2,699	4,589	7,360
Brazil .....	3,098	3,513	3,685	4,951	4,860
France .....	3,825	5,013	4,555	5,549	4,204
Ireland .....	2,322	2,263	3,324	4,235	4,197
Taiwan .....	4,333	4,878	4,411	4,039	4,060
Switzerland .....	277	1,574	3,272	3,101	3,443
All other .....	11,814	13,119	15,246	18,491	12,409
<b>Total .....</b>	<b>110,595</b>	<b>117,702</b>	<b>133,746</b>	<b>137,906</b>	<b>141,410</b>
<b>Unit Value (dollars per kilogram)</b>					
Canada .....	2	2	2	2	2
Germany .....	5	5	5	6	7
Japan .....	12	14	20	7	14
United Kingdom .....	5	4	4	4	4
Korea .....	8	6	12	11	7
Brazil .....	2	2	2	2	2
France .....	15	23	13	12	12
Ireland .....	30	30	42	40	46
Taiwan .....	4	4	4	4	3
Switzerland .....	10	2	3	10	5
All other .....	2	2	2	3	3
<b>Average .....</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>4</b>

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table B-2**  
**Adhesives and glues: U.S. exports of domestic merchandise, by principal markets, 1992-96**

Source	1992	1993	1994	1995	1996
<b>Quantity (1,000 kilograms)</b>					
Canada .....	23,631	29,983	32,973	35,052	39,261
Mexico .....	15,381	20,312	20,543	21,172	26,755
Japan .....	6,524	4,876	4,893	4,939	5,299
Korea .....	2,199	1,308	2,333	2,530	2,782
United Kingdom .....	1,284	2,150	1,813	2,949	2,274
Germany .....	2,608	1,631	1,625	1,998	1,837
Brazil .....	450	674	1,320	3,079	3,380
Saudi Arabia .....	2,357	2,846	2,885	2,778	2,856
Netherlands .....	2,202	1,195	1,406	1,547	1,324
Singapore .....	1,263	764	632	1,069	1,133
All other .....	15,507	16,697	20,476	23,428	37,253
Total .....	73,405	82,434	90,899	100,540	124,155
<b>Value (1,000 dollars)</b>					
Canada .....	66,478	78,345	91,532	101,637	117,345
Mexico .....	33,628	47,055	58,731	52,060	55,661
Japan .....	22,494	21,919	22,750	26,664	31,093
Korea .....	6,839	6,932	10,045	11,743	14,529
United Kingdom .....	5,903	9,456	10,350	14,853	13,221
Germany .....	14,176	8,873	9,317	12,133	12,100
Brazil .....	1,809	4,286	7,204	13,957	11,356
Saudi Arabia .....	7,332	7,836	7,914	8,807	9,294
Netherlands .....	7,658	6,345	8,528	8,700	9,104
Singapore .....	5,246	4,788	5,250	8,020	8,895
All other .....	50,792	60,071	76,205	89,881	111,711
Total .....	222,355	255,905	307,825	348,454	394,309
<b>Unit Value (dollars per kilogram)</b>					
Canada .....	3	3	3	3	3
Mexico .....	2	2	3	2	2
Japan .....	3	4	5	5	6
Korea .....	3	5	4	5	5
United Kingdom .....	5	4	6	5	6
Germany .....	5	5	6	6	7
Brazil .....	4	6	5	5	3
Saudi Arabia .....	3	3	3	3	3
Netherlands .....	3	5	6	6	7
Singapore .....	4	6	8	8	8
All other .....	3	4	4	4	3
Average .....	3	3	3	3	3

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table B-3**  
**Gelatin: U.S. imports for consumption, by principal sources, 1992-96**

Source	1992	1993	1994	1995	1996
<b>Quantity (1,000 kilograms)</b>					
France .....	4,552	4,321	3,847	3,788	4,187
Germany .....	1,470	1,868	1,865	1,666	2,462
Japan .....	2,062	2,201	2,238	2,610	2,240
Brazil .....	3,203	2,930	2,531	2,038	3,269
United Kingdom .....	1,466	1,309	1,179	1,741	1,608
Netherlands .....	358	613	877	1,102	2,306
Belgium .....	596	621	654	982	1,196
Canada .....	1,026	822	528	951	1,095
Colombia .....	1,071	1,191	926	738	1,025
Argentina .....	418	587	510	650	1,026
All other .....	1,706	1,711	1,223	1,285	1,326
<b>Total .....</b>	<b>17,929</b>	<b>18,174</b>	<b>16,378</b>	<b>17,551</b>	<b>21,739</b>
<b>Value (1,000 dollars)</b>					
France .....	31,596	28,259	25,707	29,892	33,281
Germany .....	8,828	11,773	12,352	11,434	16,687
Japan .....	12,446	13,669	15,266	17,702	15,777
Brazil .....	10,517	11,375	9,525	7,820	14,806
United Kingdom .....	10,986	9,140	8,146	11,603	11,690
Netherlands .....	1,311	2,555	3,665	4,801	11,528
Belgium .....	2,725	2,876	3,261	5,114	5,950
Canada .....	3,350	3,119	2,017	3,227	4,674
Colombia .....	4,110	5,065	3,516	2,772	4,478
Argentina .....	1,495	2,022	1,761	2,177	4,129
All other .....	7,054	7,204	5,006	5,129	7,060
<b>Total .....</b>	<b>94,417</b>	<b>97,057</b>	<b>90,221</b>	<b>101,671</b>	<b>130,060</b>
<b>Unit Value (dollars per kilogram)</b>					
France .....	7	7	7	8	8
Germany .....	6	6	7	7	7
Japan .....	6	6	7	7	7
Brazil .....	3	4	4	4	5
United Kingdom .....	7	7	7	7	7
Netherlands .....	4	4	4	4	5
Belgium .....	5	5	5	5	5
Canada .....	3	4	4	3	4
Colombia .....	4	4	4	4	4
Argentina .....	4	3	3	3	4
All other .....	4	4	4	4	5
<b>Average .....</b>	<b>5</b>	<b>5</b>	<b>6</b>	<b>6</b>	<b>6</b>

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table B-4**

**Gelatin: U.S. exports of domestic merchandise, by principal markets, 1992-96**

Source	1992	1993	1994	1995	1996
<b>Quantity (1,000 kilograms)</b>					
Canada .....	1,959	2,557	2,267	2,606	2,518
United Kingdom .....	409	562	883	848	1,192
Germany .....	1,882	1,123	798	1,464	1,229
Japan .....	276	124	189	466	491
Brazil .....	145	52	137	177	308
Mexico .....	217	365	508	426	517
Korea .....	61	65	226	255	425
Belgium .....	291	403	143	296	245
Netherlands .....	58	11	269	771	612
Australia .....	138	76	111	73	111
All other .....	1,121	713	717	997	432
<b>Total .....</b>	<b>6,557</b>	<b>6,050</b>	<b>6,247</b>	<b>8,379</b>	<b>8,081</b>
<b>Value (1,000 dollars)</b>					
Canada .....	9,986	13,416	12,544	12,052	13,389
United Kingdom .....	2,428	2,876	4,491	3,919	7,652
Germany .....	7,837	5,287	3,948	7,134	5,754
Japan .....	1,458	765	1,063	2,492	4,277
Brazil .....	1,004	710	1,828	1,626	3,438
Mexico .....	1,724	3,185	3,800	2,567	2,734
Korea .....	405	355	1,168	2,096	2,089
Belgium .....	1,156	2,397	893	2,076	1,570
Netherlands .....	304	91	845	2,404	1,541
Australia .....	1,580	1,068	1,485	629	1,325
All other .....	5,362	4,378	3,645	5,385	2,656
<b>Total .....</b>	<b>33,245</b>	<b>34,529</b>	<b>35,710</b>	<b>42,382</b>	<b>46,425</b>
<b>Unit Value (dollars per kilogram)</b>					
Canada .....	5	5	6	5	5
United Kingdom .....	6	5	5	5	6
Germany .....	4	5	5	5	5
Japan .....	5	6	6	5	9
Brazil .....	7	14	13	9	11
Mexico .....	8	9	7	6	5
Korea .....	7	6	5	8	5
Belgium .....	4	6	6	7	6
Netherlands .....	5	8	3	3	3
Australia .....	11	14	13	9	12
All other .....	5	6	5	5	6
<b>Average .....</b>	<b>5</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>6</b>

Source: Compiled from official statistics of the U.S. Department of Commerce.

**Table B-5****Adhesives, glues, and gelatin: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by select countries and country groups, 1992-1996**

<b>Source</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
	<i>(Thousand dollars)</i>				
U.S. exports of domestic merchandise :					
Canada .....	76,464	91,761	104,076	113,689	130,734
Japan .....	23,953	22,684	23,813	29,156	35,369
Germany .....	22,013	14,160	13,265	19,267	17,854
Mexico .....	35,352	50,240	62,531	54,627	58,395
France .....	4,032	2,889	4,507	5,733	5,965
United Kingdom .....	8,331	12,332	14,841	18,772	20,873
Brazil .....	2,813	4,997	9,032	15,583	14,794
Korea .....	7,245	7,287	11,214	13,839	16,618
Netherlands .....	7,962	6,436	9,372	11,104	10,645
Belgium .....	6,197	7,724	6,202	8,996	10,453
All other .....	61,240	69,926	84,683	100,069	119,035
Total .....	255,600	290,435	343,535	390,836	440,735
EU-15 .....	56,557	52,418	58,109	72,483	75,070
OPEC .....	12,173	12,604	12,790	15,150	20,604
Latin America .....	49,785	68,324	89,939	92,686	100,731
CBERA .....	5,892	5,706	8,173	10,474	10,302
Asian Pacific Rim .....	55,094	59,926	73,392	88,110	109,330
ASEAN .....	10,004	14,042	13,975	18,077	26,552
Central and Eastern Europe .....	760	518	506	1,232	1,025
U.S. imports for consumption :					
Canada .....	25,384	28,916	29,701	34,158	42,232
Japan .....	44,549	42,675	47,487	45,256	35,409
Germany .....	34,239	38,333	43,811	39,007	51,833
Mexico .....	1,047	1,807	1,988	1,464	1,689
France .....	35,421	33,272	30,262	35,441	37,485
United Kingdom .....	14,546	12,593	13,335	18,495	20,232
Brazil .....	13,614	14,888	13,210	12,771	19,666
Korea .....	2,858	2,526	2,799	4,818	8,011
Netherlands .....	3,620	4,935	6,774	7,803	13,387
Belgium .....	5,787	6,730	7,856	8,421	8,402
All other .....	23,874	27,329	26,729	31,375	33,118
Total .....	205,013	214,759	223,967	239,577	271,470
EU-15 .....	101,853	105,081	111,646	120,942	143,574
OPEC .....	266	232	868	1,227	952
Latin America .....	20,859	24,102	20,641	19,636	30,328
CBERA .....	0	8	18	150	35
Asian Pacific Rim .....	54,600	52,617	57,808	60,112	50,482
ASEAN .....	710	778	1,536	1,870	1,731
Central and Eastern Europe .....	1,515	1,132	123	65	8
U.S. merchandise trade balance:					
Canada .....	51,079	62,844	74,375	79,531	88,502
Japan .....	-20,596	-19,991	-23,675	-16,100	-39
Germany .....	-12,226	-24,173	-30,546	-19,740	-33,979
Mexico .....	34,305	48,434	60,543	53,163	56,707
France .....	-31,390	-30,383	-25,754	-29,708	-31,520
United Kingdom .....	-6,215	-260	1,505	276	641
Brazil .....	-10,801	-9,892	-4,178	2,812	-4,873
Korea .....	4,387	4,761	8,415	9,021	8,607
Netherlands .....	4,342	1,501	2,598	3,300	-2,742
Belgium .....	410	994	-1,653	576	2,051

**Table B-5—Continued**

**Adhesives, glues, and gelatin: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by select countries and country groups, 1992-1996**

Source	1992	1993	1994	1995	1996
	<i>(Thousand dollars)</i>				
All other .....	37,366	42,597	57,953	68,694	85,916
Total .....	50,588	75,676	119,568	151,259	169,265
EU-15 .....	-45,296	-52,663	-53,537	-48,459	-68,504
OPEC .....	11,907	12,372	11,922	13,923	19,652
Latin America .....	28,926	44,222	69,298	73,050	70,403
CBERA .....	5,892	5,698	8,154	10,323	10,266
Asian Pacific Rim .....	494	7,309	15,584	27,998	58,848
ASEAN .....	9,295	13,264	12,440	16,208	24,820
Central and Eastern Europe .....	-756	-615	383	1,167	1,017

Import values are based on Customs value; export values are based on f.a.s. value, U.S. port of export.

Note.—Because of rounding, figures may not add to totals shown. The countries shown are those with the largest total U.S. trade. (U.S. imports plus exports) in these products in 1996.

Source: Compiled from official statistics of the U.S. Department of Commerce.