7-1976

The Use of Decorative Plastic Parts in Wood Furniture Construction

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Abstract

The recent but prominent use of imitation wood plastic components in wooden furniture construction intrigued this writer and encouraged him to investigate the subject. The purpose of this study is to investigate industry and literature to see what materials and procedures are used in making decorative plastic parts which resemble wood used in the construction of wooden furniture. It is the intent of the writer to create a mold and cast some parts, to determine whether or not the fabric8tion of plastic components would be a suitable activity to 5nstitute in a high school Industrial Arts program, and if so, to plan a unit on plastic parts in furniture construction for the purpose of enriching the woodworking curriculum. This would also provide the researcher with a better understanding of the field of plastics.

THE USE OF DECORATIVE PLASTIC PARTS

IN WOOD FURNITURE CONSTRUCTION

Approved by:

Graduate Committee Chairman

June 28, 1976
Date

THE USE OF DECORATIVE PLASTIC PARTS IN WOOD FURNITURE CONSTRUCTION

Research Paper

presented to the

Department of

INDUSTRIAL TECHNOLOGY

University of Northern Iowa

In Partial Fulfillment

of the Requirements for the Degree

MASTER OF ARTS

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by

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July 1976

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CHAPTER I

INTRODUCTION

Modern technology has continually kept manufacturers searching for new and better ways to improve their products. This fact, along with the dwindling supply of various hardwoods, the increasing cost of labor and inflationary costs in general have forced some furniture manufacturers to seek a product with properties similar to those of wood (Good Housekeeping, November, 1972, pp. 136-141). In recent years, plastic in one form or another has become a popular substitute for wood products.

Since this writer teaches a woodworking course in furniture construction, but has a limited knowledge of plastics, a study of this material seems appropriate. Considering the widespread use of plastic parts in furniture construction, perhaps a unit on this topic should be included in a woodworking curriculum.

Statement of the Problem

The recent but prominent use of imitation wood plastic components in wooden furniture construction intrigued this writer and encouraged him to investigate the subject. The purpose of this study is to investigate industry and literature to see what materials and procedures are used in making decorative plastic parts which resemble wood used in the construction of wooden furniture. It is the intent of the writer to create a mold and cast some parts,

to determine whether or not the fabrication of plastic components would be a suitable activity to institute in a high school Industrial Arts program, and if so, to plan a unit on plastic parts in furniture construction for the purpose of enriching the woodworking curriculum. This would also provide the researcher with a better understanding of the field of plastics.

Importance of the Problem

As stated previously, plastics play an important role in furniture construction. Some of the advantages of using plastic include: reduction in cost, versatility, decreased fabrication time, and light weight structural strength. In view of the importance of plastics in today's world, this writer feels students should be aware of its significance in the manufacture of furniture parts.

Limitations

This report is limited to the use of decorative plastic parts or components in the making of furniture rather than the making of plastic furniture. The limitations of this study are: the eight week summer session during which the research must be completed, the absence of an industry in the State of Iowa that does this type of work, and the relative newness of the subject resulting in a dearth of available materials. Since the machines used by industry are complex and much too expensive for the school shop budget, unsophisticated equipment to carry

out the process will need to be designed and built by the researcher. This in turn may limit the size or complexity of the product that can be produced in the high school setting.

Definition of Terms

Blowing agent. Chemicals added to plastics and rubbers that generate inert gases on heating, causing the resin to assume a cellular structure (Baird, 1971, p. 300).

Draft. The degree of taper necessary to allow the removal of a pattern from a mold.

Extrusion. The compacting of a plastic material and the forcing of it through an orifice in more or less continuous fashion (Baird, 1971, p. 299).

Frame. The sides surrounding a master to hold the backing material.

Impregnate. The process of thoroughly soaking a material such as wood, paper or fabric, with a synthetic resin so that the resin gets within the body of the material (DuBois, 1974, p. 462).

Master. The actual object or pattern from which a mold is made.

Mold. A cavity in which plastic material is placed and takes the shape of the cavity.

Mold release. A lubricant to coat a mold to prevent the plastic from sticking to it, thus allowing for easier removal.

PSI. Pounds per square inch.

RTV. Room temperature vulcanizing.

Undercut. An identation in a pattern that impedes withdrawal from a two-part mold (DuBois, 1974, p. 493).

Vulcanizing. The chemical reaction which induces extensive changes in the physical properties of a rubber and which is brought about by reacting the rubber with sulphur and/or other suitable agents (Ibid., p. 494).

CHAPTER II

HISTORICAL BACKGROUND

Plastics can be traced as far back as the 1860's. A search for a substitute for the ivory used in billiard balls ultimately led to the marketing of a product called celluloid. After considerable experimentation and refinement, Bakelite was introduced to the public. This product was widely used in telephones and telephone equipment, and was a great step in the advancement of plastics.

Throughout World War I, the plastic industry grew with the development of larger firms such as the E. I. du Pont Company, who continued to develop new products. The promoting and selling done by the du Pont fortune encouraged new companies to enter the plastic field.

The Depression created a demand for plastics. Companies were looking for an inexpensive "gimmick" or "premium" to promote their products. As the American people became aware of the advantages of plastic household items, more companies expanded into this field (DuBois, 1972, pp. 38-110).

Plastic was extremely important during World War II because of its substitution for strategic metals. Molding plants sprung up throughout the country. This period fostered expansion, experimentation and innovation with plastics, and generated enthusiasm for its use. This particular time period was called the Great Thermosetting

Era. In a period of forty years they moved from handscrew presses and hot slugs of steel for mold heating, to giant plants, huge presses and electronic heating, and then to fully automatic molding machines (Ibid., p. 155).

Immediately following the war, thermoplastics appeared on the scene. In a single season one product was changed completely from a thermoset to a thermoplastic. This process of forming thermoplastic material was cheaper and faster. Thermosets still had a market for certain products, but newly developed products proceeded at a much slower pace.

The use of plastics in furniture or furniture parts is not new. In 1927 the Simmons Company of Racine, Wisconsin, explored the possibility of using plastics for furniture and developed an occasional chair. A test experiment was made using a cloth filled phenolic compound for high strength. Two major problems encountered in the test were costly molds and a rather heavy chair. Despite these drawbacks, the test chair was termed a success (Ibid., pp. 179-181). Since then, one of the greatest concentrations in the manufacture of plastic has been in the area of furniture making. In the early 1960's, Plastics Industries, Incorporated of Athens, Tennessee, started manufacturing one of the first plastic parts which was a furniture leg consisting of high impact styrene. Injection molded furniture parts began to expand in 1965-1966. By 1968 many companies were involved in this type of work. The development of

machines for injection molding foamed styrene in the late 1960's increased the use of plastic in furniture and furniture parts. Today many plastic furniture parts are molded to simulate materials such as wood (Ibid., pp. 300-321). The manufacture of plastic furniture parts has grown considerably in the last five years.

CHAPTER III

RELATED INFORMATION

Industrial-Geographical

Furniture fabricators are always faced with the problems of reducing machine and labor time and trying to eliminate material waste. The recent use of rigid polyurethane as a replacement for more intricate parts made from wood has had a decided economic advantage for any number of furniture manufacturers.

One of the most important aspects to a plastic parts company is that of having a good market for its product. This researcher learned on a field trip that if a manufacturer cannot find a market, it will soon be out of business. This not only happened to the industry visited in Iowa, but also noted in some of the correspondence received from other industries in the United States. A common solution to this problem is to sell out or become a subsidiary of a larger company.

From the information received from various industries, their prime objective in the manufacture of "imitation wood" plastic furniture parts seemed to be threefold. The initial item discussed was that of trying to make a quality part. It is imperative that the mold produce a product that compares favorably to a wooden component produced by a skillful craftsman. The second concern was adapting production to the number of parts required. With modern equipment, "set

up" time will determine cost, and cost will dictate production. The final aspect of manufacture is one of versatility by adding a new dimension to traditional manufacturing. This allows the manufacturer to be more competitive and make each product more desirable.

The geographical location of the plastic parts manufacturers of "imitation wood" plastic parts seems to coincide with that of the furniture industry. Currently, most of the manufacturing of parts and equipment is east of the Mississippi River. Most of the parts appear to be manufactured in the states of Indiana, Tennessee, North and South Carolina, Mississippi, Alabama and Georgia. However, production of plastic furniture components is not limited to the United States. Plastic Industries, Inc., for example, advertises that the sun rarely sets on their plants serving the furniture industry; because they are located in Quebec, Canada; Tokyo, Japan; and Victoria, Australia; along with the three plants in the United States. On page 10 is a map showing the geographical location of the main furniture industry centers in the United States.

There is a trend to move the plastics industry closer to oil-producing areas and refineries (DuBois, 1974, p. 25). If this continues, the geographical location of these plants will probably shift to other sections of the country.

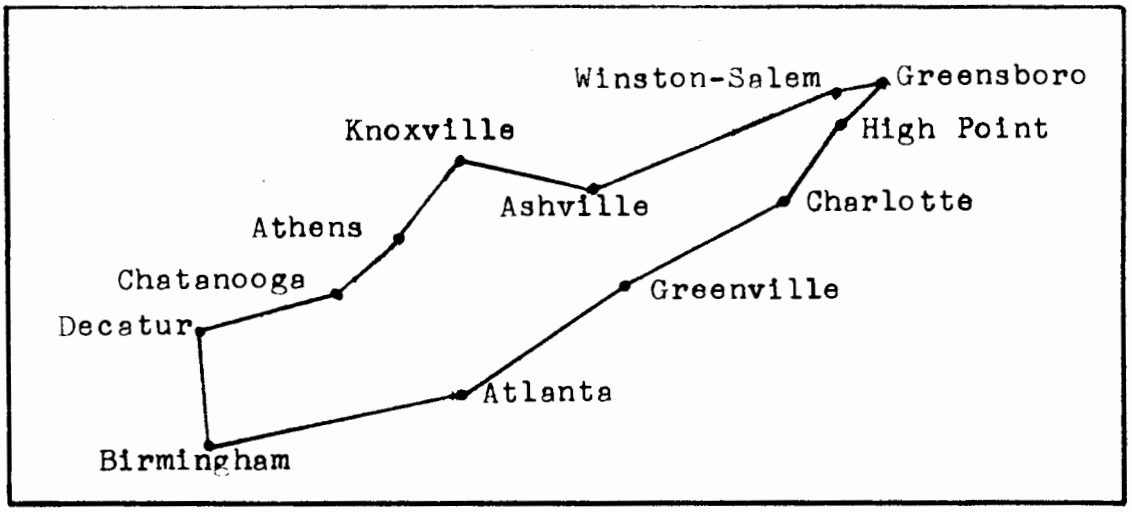

Figure 1

Furniture Industry Centers
in the United States

Occupational

The occupational opportunities in the plastics industries of Iowa seem to be similar to those of the nation. According to an interview conducted by this researcher, there is little need for trained and skilled employees in Iowa. This substantiates a committee finding in a report made by Dr. James P. LaRue to the Department of Public Instruction in the State of Iowa on the need for skilled plastic personnel in Iowa (LaRue, April, 1973, p. 1). The majority of plastic plants in this state employ small numbers of people, and the highly automated machinery allows management to use unskilled labor. These people can be trained to operate a machine in a short period of time, eliminating highly skilled employment. Figure 2 on Page 11 illustrates that most of the plastic industries in Iowa have fewer than 100 employees.

The results of a nationwide survey of plastic processing firms conducted by a joint SPE-SPI Education Committee were similar to those in Iowa. Questionnaires were sent to over 4,000 firms, and the 25 percent returned were considered a good reflection of industry. Over half of these replies came from industries with less than sixty employees. The majority of these employees were classed either as semi-skilled or unskilled workers (SPE-SPI, 1968, pp. 2-10).

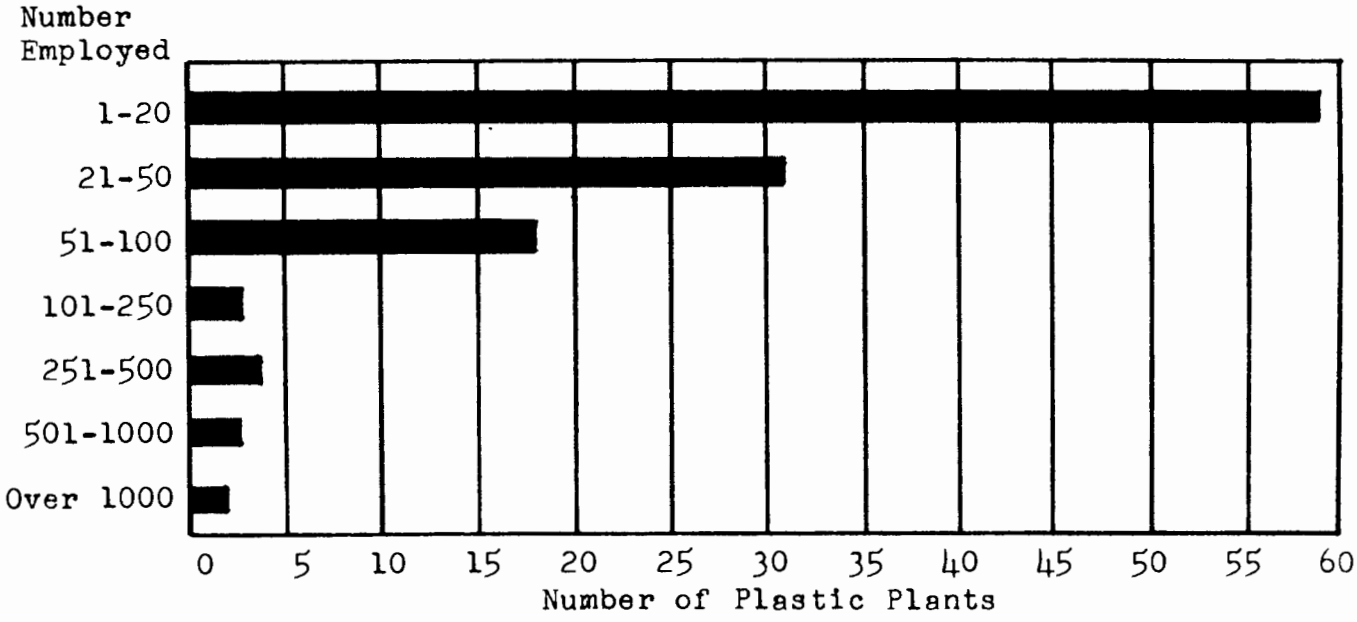

Figure 2

Employment Distribution in Miscellaneous Plastic Plants in Iowa 1973-1974

Career Opportunities

The expanding plastics industry offers many and varied job careers. Chemists, engineers, designers and

management personnel are needed in most plastic furniture component enterprises.

It is estimated that there are 15,000 processors of plastics throughout the United States, and growth is unlimited. Plastics lead all other industries in projected growth through 1980, and its volume in the 21st century will exceed that of all other materials (DuBois, 1974, p. 26). The manufacture of furniture components is only a small part of the plastics industry, but it appears that the growth in job opportunities in this area will tend to parallel that of the industry.

Financial Information

The growth shown by large chemical companies producing much of the plastics in the United States should indicate trends for the future of plastics. Many of these companies have expanded existing facilities, built new plants, and developed better plastic resins or compounds to keep up with the current demand for plastic products. At the present time, the only deterrent would seem to be whether or not the resources available will be able to meet the demand.

Three large chemical companies that show this growth are the Monsanto Company, E. I. du Pont, and Dow Chemical Company. The following information was taken from the 1974 annual report from each company.

Table 1

Earnings Per Share 1970-1974

	1970	1972	1974
Monsanto Company	$1.83	$3.40	$8.73
E. I. du Pont	6.86	8.50	8.20
Dow Chemical Company	1.13	2.07	6.03

Table 2

Dividends Per Share 1970-1974

	1970	1972	1974
Monsanto Company	$1.80	$1.80	$2.30
E. I. du Pont	1.86	3.05	2.70
Dow Chemical Company	.87	.90	1.20

Table 3

Book Value Per Share 1970-1974

	1970	1972	1974
Monsanto Company	$36.27	$39.05	$51.39
E. I. du Pont	57.67	63.49	73.05
Dow Chemical Company	24.54	50.75	55.00

Flexsteel Industries in Dubuque, Iowa, uses plastic parts in their furniture construction. The following information was secured from their 1973 annual report.

Table 4

Earnings, Dividends, and Book Value Per Share For Flexsteel Industries 1965-1972

	1965	1970	1972	1973
Earnings/share	$ .43	$ .86	$1.09	$1.36
Dividends/share	.18	.24	.24	.25
Book value/share	2.02	5.84	7.15	8.24

CHAPTER IV

TECHNICAL INFORMATION

The manufacture of decorative furniture parts consists mainly of two basic steps: making the mold and casting, or molding, the part. A variety of molds, materials and processes are used. The intricacy and size of the component and the type and number of reproductions are some of the factors considered in the selection of materials and processes.

Mold Materials

The molds used today in making plastic furniture parts are of three basic materials: silicone rubber, latex rubber and rigid materials of aluminum, steel or polyester.

Silicone rubber. This is probably the most common mold material due to its release qualities, flexibility, tear strengths and ability to make sharp undercuts. Although a mold release is not necessary, using one will extend the life of the mold. The major drawback in the use of this substance is the extremely high cost per pound. Regrinding the old molds and mixing them with new material reduces the cost. The new material should be used next to the master mold (Smith, 1968, pp. 38-41).

Latex rubber. The least expensive mold-making material is latex rubber. However, it is unsatisfactory for industrial use. It has excellent qualities for making

fine detail, but the time necessary to build up the mold makes it prohibitive for much industrial use. This material is brushed on whereas the other flexible molding materials are poured. Latex rubber can be reinforced by adding cheesecloth, fiberglass or some other suitable material between coats and drying time. The life of one of these molds is rather short. It will not withstand heat or a great deal of general use.

Rigid molds. These are used only when some form of draft is applied to the pattern, eliminating any form of undercuts. A mold release must be used each time a part is made. The outstanding feature of these molds is their almost indefinite life.

Techniques For Making Molds

When making a mold of flexible materials, it is normally not necessary to use a mold release on any non-porous pattern such as glass, metal or glazed ceramics. A pattern made of any porous material such as wood must be sealed with some type of finish so the molding material will not stick to the pattern. Sometimes bleaching is done on wood to try to raise the grain. This adds more detail to the mold. Whenever a mold release is used, do not coat the mold too heavily; it will cover up the fine detail that is desired.

The two basic types of flexible molds are skin molds and cast molds. The difference is in the way the master and

frame are set up. In both cases the use of the mold making materials are the same.

Skin mold. This type of mold is preferred when there are severe undercuts, very high and low places, when the pattern is too large or awkward to lie flat, and when mold materials must be conserved. The finished mold is one-eighth to one-half inch in thickness.

The first step in making a skin mold is to mount the master pattern to a board so it will be stationary at all times. From this point, two different procedures may be used.

One method is to brush the molding material on the master until it is built up to a covering of at least one-eighth inch with all undercut eliminated. After the mold is cured, a frame is made around the pattern and mold. It should be at least one-half inch higher than the highest point of the mold. The cavity created is then filled with a hard plaster or other castable material (Smith, 1968, p. 40).

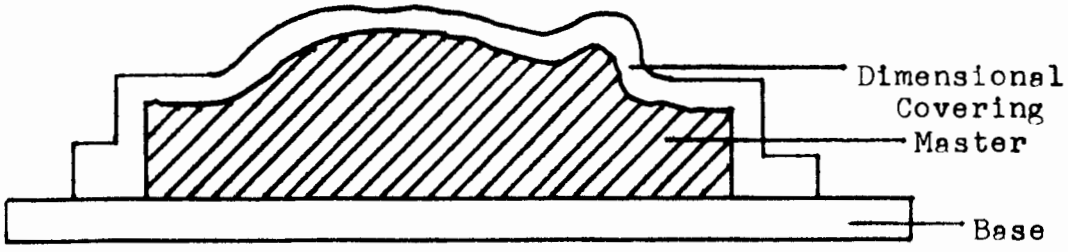

Figure 3

Set-Up Stage

The other method is to place a uniform covering of clay or wax over the master (Figure 3). Since care must be taken with clay that it does not come in contact with the master, it is necessary to put some type of covering, such as a plastic film, over the mold. This covering should be sprayed with a mold release. The same procedures described above can be used for construction of the mold and for filling the cavity.

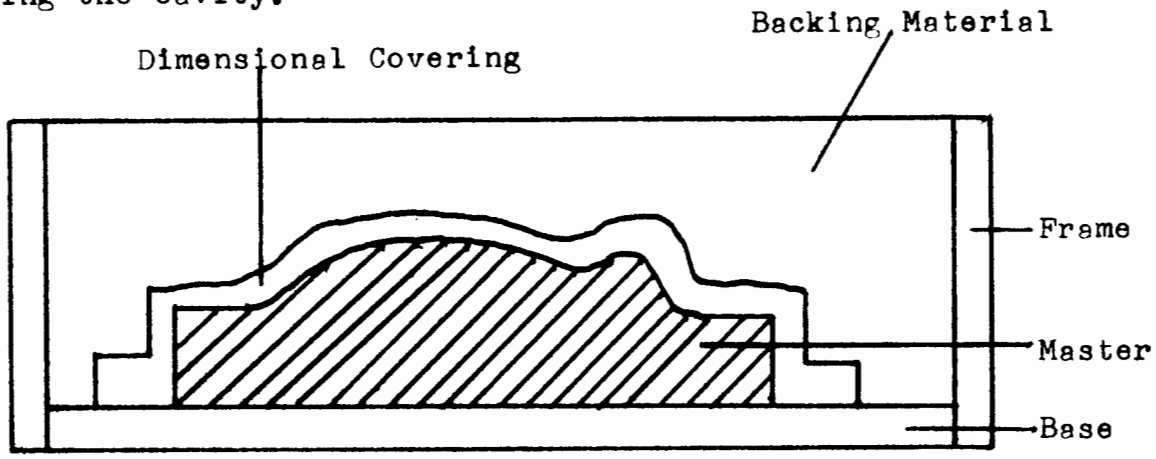

Figure 4

Framing Stage

It is imperative that some identifying marks or keys be made on the frame and backing material so that it may be replaced in the correct position after the dimensional covering has been removed. The frame and backing material are then removed from the mold, and the dimensional covering is taken off the master. After a pouring hole and some vent holes are drilled into the backing material, the frame is replaced over the master, using the identifying marks or keys for precise realignment. The molding material is

then poured into the pouring hole until it backs up into the vent holes.

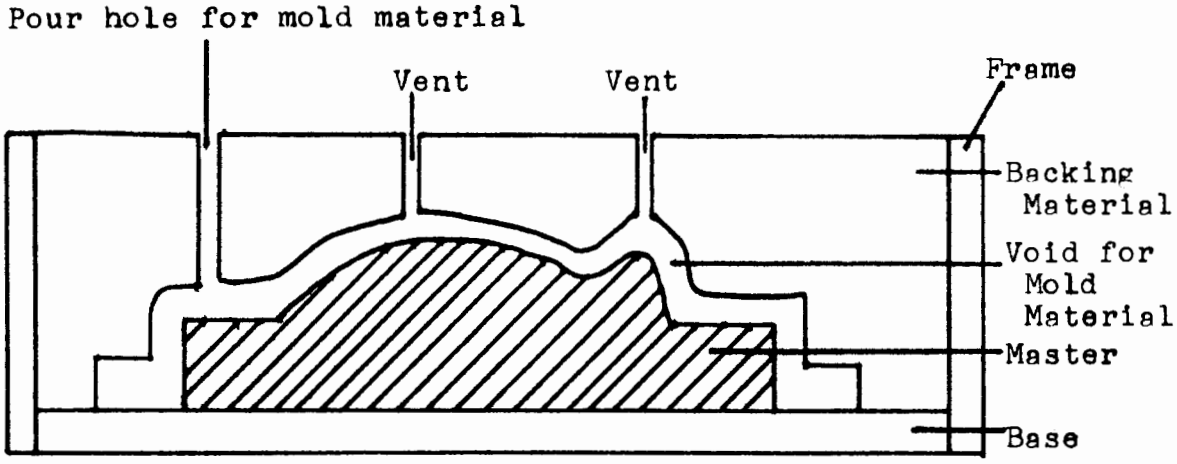

Figure 5

Cavity Stage

The final step is the same for both methods. After the molds have cured, they are removed from the master and are ready for use.

Cast mold. The one piece cast mold is by far the easiest of all molds to make. The master is positioned or fastened to a bottoming board with a frame made around the mold, leaving 3/16 inch along the sides and top of the master. A mold release should be applied to the frame, bottom board and the master pattern. The molding material is then poured slowly over the master and allowed to cure before removal from the master mold.

Some suggestions to keep in mind when making molds might be (1) allow for undercuts for the backing block on

a skin mold; (2) read directions carefully before mixing and pouring any material; (3) remove parts as soon as possible from the molds to help insure a longer mold life; (4) make certain all molds are allowed to cure properly, usually twenty-four hours; and (5) mold design is limited only to the creativity of the designer.

Types of Plastic Materials

All plastic materials used will fall into either the thermosetting or the thermoplastics classification. Thermosetting plastics are those materials that take a permanent shape when heat and pressure are applied during the formation period. Once these materials are cured, reheating will not soften them. Thermoplastic materials are those that can change their shape when heated and retain it when cooled. This process can be repeated many times without changing the properties of the material being used.

There are many different types of materials used throughout the plastics industry. Only those materials that are used most frequently in the manufacture of furniture parts will be discussed here.

Polyester. This thermosetting material has two main uses. One is for casting small articles, and the other is the impregnation of fibrous materials used in reinforcement. One quality this method has over other materials is that it is adaptable to large parts because it can be formed with little or no pressure and at normal

room temperatures. Due to the surface hardness of this material, it is highly resistant to many substances. A wide range of colors and pastels can be added to give the surface a pleasing appearance. Most polyesters are liquid, dry powders, or molding compounds, which are formed by casting, impregnating, and reinforcing. (S. P. I., February, 1970, p. 24).

Polystyrene or styrene. This thermoplastic is one of the most widely used of all plastic materials. It is used in many plastic furniture parts manufactured because of the optical qualities contained in its variety of colors and texture. Polystyrene is used primarily for household goods. It does not withstand extreme heat or cold, but is chemically resistant to liquids such as alcohol, most oils, and common household acids; it can be damaged by cleaning fluids, oil from citrus rinds, or nail polish and remover. Polystyrene is usually available in molding powder, granules, sheets, rods and various other shapes. Most finished products are done by injection or compression molding; but some laminating, extrusion, and machining are also used (S. P. I., February, 1970, p. 28).

Polyurethane or urethane. The interest in this thermosetting material has grown considerably in recent years. This growth is due to the great versatility of these substances.

Foamed urethane can be either flexible or rigid, with the rigid now being used rather extensively in the

formation of furniture parts. The accuracy in grain reproduction is unmatched by any other plastic process. The foamed type is made from polyols, polyisocyanates, water and a catalyst mixture. These materials are then mixed and usually injected into some type of molded form.

In its solid state, urethane is tough and resists common chemicals. The solid type is formed by combining two reactants which could be either solid or liquid. The final article can be extruded, molded, or cast into the desired shape (S. P. I., February, 1970, p. 29).

Polyurethane structural foam. The molding of cellular urethane plastics has developed tremendously in the past few years. New raw materials along with new molding techniques make it possible to produce finished parts with solid outer skins and microcellular interiors in a single operation. This foam is rather rigid, yet relatively light weight. A major difference in this substance is that the surface skin and the core are made from the same materials. Polyurethane foams have many physical properties superior to those of rigid urethane foams. With the high strength and good dimensional stability, these materials are well suited to the construction of furniture and furniture parts.

Polyurethane foam holds up well under many kinds of testing. It is resistant to most chemicals that it might contact in use. After undue exposure tests to various forms of light and weather, a yellow cast forms on the surface, but this does not decrease the strength. Certain water

tests cause a dulling of the surface, which can be removed with some polishing. Nail and screw holding characteristics are similar to those of plywood.

The bases for the production of urethane foam are polyisocyanates and polyols, which are easy-pouring liquids at room temperature. There are many combinations of chemicals that can be used; but factors such as density, temperature stability, finished costs and cycle times determine the selection of chemicals.

Urethane foam is used a great deal in load bearing structural components by the furniture industry because of its sandwich-like construction. Many case goods are made with this material due to its large one piece construction and the fact that it can be hammered, sawed, nailed and glued. This foam also reproduces all wood characteristics well (S. P. I., Structural Foam, pp. 11-14).

Plastic Processes

Plastic can be shaped or formed using many different processes. These processes range from the simple one piece molds to the very complex machines that are necessary to meet industrial standards. The plastic furniture parts industry chooses the machine that will best fit the needs of its operation.

Casting. This method can be used for either a thermosetting or thermoplastic material. It consists of pouring either a hot or cold liquid resin into a suitable mold and

allowing it to cure. Some of the common casting resins are acrylics, polyesters, silicones, phenolics, and polyurethanes. The materials come in any color and vary from clear to opaque. The molds used for this process are generally made from wood, metal plaster or possibly other plastics. A couple of differences between casting and molding are that molding uses some pressure and casting takes more time than molding.

In production casting a resin and a catalyst are mixed automatically in a large dispenser unit. When the mold is filled, the machine operator presses a lever or button. The mixed resin flows directly into the mold and is stopped when the operator releases the lever or button. This method is frequently used by industries trying to simulate wood grain or decorations (Baird, 1971, pp. 175-177).

High pressure laminating. This process of laminating plastic closely resembles that of making plywood. It is the bonding together of two or more layers of plastic to form a single sheet. The laminate is bonded by a synthetic adhesive or by the fusion of the layers. If the pressure used is less than 1000 psi, the process is called a low pressure laminate, and when the pressure is greater than 1000 psi, it is a high pressure laminate.

The laminating is done in a heated platen hydraulic press. Layers of materials are impregnated with some type of thermosetting resin, allowed to dry, and then placed together until the desired thickness is attained. This

material is placed on the polished plates of the press and pressure is applied. Heating coils are found in these plates; and when the pressure is applied, heat is also applied. Since both of these factors can be controlled, the material is cured in the press at the correct temperature and pressure. Temperatures will vary from 300 F to 350 F, and the pressure will normally vary between 1000-2000 psi. When the proper curing time is reached, the material may be removed from the press, even though it might still be hot (Baird, 1971, pp. 191-192).

Most of the products produced by this method are in sheet form. They are used for cabinet tops, table tops or where some flat surface is desired. Occasionally a design will be stamped on these sheets so they can be used for decorative furniture parts, ceiling panels or some other decorative purpose.

Injection molding. This is the principle method of forming thermoplastic materials. Some modifications are necessary for thermosetting substances. The basic processes involved in a molding cycle are filling the hopper with plastic granules, pushing the granules into a heating chamber where the plastic turns to a molten state, and exerting pressure to force the molten material through a nozzle into the mold. When the plastic returns to a solid state, the mold opens and ejects the plastic piece (S. P. I., February, 1970, pp. 37-38).

The basic injection molding machine has two different types of devices which can be used to convey the plastic from the hopper to the nozzle. One is a plunger, and the other is a screw ram. The reciprocating-screw type is used most because of the faster cycles, lower melting temperatures, and better mixing quality.

Molds used in injection molding are formed in two halves--one stationary and one movable. The stationary part is fastened to the fixed platen of the press and to the nozzle. The movable half is attached to the movable platen and contains the injection pins which remove the plastic part from the cavity of the mold.

Almost any thermoplastic resin can be injection molded with a few modifications. The controlling of temperatures, which change various resins from a solid to a liquid, present the greatest concern. In general, the injection molding process is very efficient (Baird, 1970, pp. 87-93).

CHAPTER V

INSTRUCTIONAL INFORMATION

One of the objectives for industrial arts is to try to acquaint the students with new innovations in industry. The manufacture of plastic furniture parts is such an innovation. A unit on this topic could be incorporated into either a plastics or a woodworking course. It would allow the students to use some new materials and to express their ideas creatively.

Study Unit

I. Basic course objectives
   - A. To develop an understanding of plastic furniture parts
   - B. To develop an awareness of some of the problems in design
   - C. To develop an insight into how plastic parts are produced
   - D. To provide an opportunity for some creative exploration by the student
   - E. To develop an appreciation for plastic furniture parts

II. Introduction
   - A. Historical information
   - B. Geographical location
   - C. Occupational information

III. Types of molds

A. Flexible

1. Materials

a. RTV silicone rubber

b. Latex

2. Molds

a. Skin molds

b. One piece molds

B. Rigid

C. Mold release

IV. Materials

A. Thermoplastic - polystyrene

B. Thermosetting

1. Polyester

2. Polyurethane

a. Solid type

b. Foam type

V. Industrial processes

A. Casting

B. Injection molding

VI. Job opportunities

VII. Behavioral objectives

At the conclusion of this unit each student will be able to:

A. List two types of molds used for plastic furniture parts.

B. Define the term mold release either orally or in writing.

C. Name two types of materials used in the making of a flexible mold.

D. Make a mold and a casting from that mold.

The activity for this unit would be carried out most effectively on an individual basis; but with limited time and facilities, small group (three or four students) work is more realistic.

Instructional Aids

The following is a step-by-step procedure to make a one piece RTV mold:

1. Obtain the pattern.
2. Fasten the pattern securely to a board.
3. Make sure the pattern has been sealed properly if it is a porous material.
4. Apply mold release to the pattern.
5. Build a small frame around the pattern and the sides and extending the sides at least one-half inch above the highest point of the pattern.
6. Apply mold release to the frame.
7. Mix RTV silicone rubber according to the manufacturer's specifications.
8. Pour the RTV silicone rubber slowly over the mold until the material fills the cavity within the frame.
9. Allow the mold to set up four to five hours before removing the frame.

10. Allow twenty-four hours of curing time for the mold before applying any plastic molding material.

Mass Production

This topic is not an ideal mass production unit for the school shop. It could, however, be used as part of a mass production run. The part or parts could be made in advance and stockpiled for use during the unit or actual run. The factors dictating this type of situation are curing time needed for molds, availability of more than one mold of the same type, cost, and the limited number of people needed.

A simulation of mass production in industry might include breaking down the steps in the construction of a mold and making a casting of it. The emphasis on this subject will be more classroom oriented rather than shop oriented.

Pupil Evaluation

The evaluation for this unit would be measured best by a written examination and the laboratory work which would consist of designing and making a mold and a casting from the molds.

Sample Test

1. The two types of molds are _____ and _____.
2. Define mold release.

3. What is the difference between thermoplastic and thermosetting?
4. Where are most of the plastic parts plants located?
5. What is the meaning of RTV?
6. List two types of thermosetting materials.
7. Name two advantages of a flexible mold.

Safety Precautions

1. The ABC of safety (Always Be Careful).
2. Wear approved eye protection.
3. Wear proper clothing or clothing protection.
4. Check to see if adequate ventilation is available.

Textbooks

Baird, Ronald. Industrial Plastics. South Holland, Illinois: The Goodheart-Willcox Co., Inc., 1971. $5.97

Cope, Dwight W. Cope's Plastic Book. South Holland, Illinois: The Goodheart-Willcox Co., Inc., 1973. $4.80

Edwards, Lauton. Industrial Arts Plastics. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1974. $6.51

Visual Aids

Film - "Plastics"
Number 50963 - UNI Media Center
26 min., color, sound

This film shows through illustrations and photography what plastics are and how they are manufactured. It explains the two types of plastics--thermoplastics and thermoset plastics--and tells how they are produced and the various uses of them.

The Society of Plastics Industry, Inc., has a list of motion picture films, filmstrips and slides available from various organizations. The information did not indicate whether or not they are free loan visual aids. The address is:

The Society of the Plastics Industry, Inc.
Public Relations Department
355 Lexington Avenue
New York, New York 10017

Tool and Supply Purchase Information

Most tools necessary for this activity would be found in the normal school shop.

Current costs of some of the molding and casting items necessary are as follows:

Silastic A - RTV silicone rubber	$7.95/lb.
Kwikmold - molding latex	4.50/qt.
Water-Extended Polyester - resin	2.95/qt.
Co-cast - casting resin/hardener	3.25/qt.
Castomold - molding material	3.00/pt.
Liquid Rubber	4.25/pt.

Two companies that deal with material related to this field are:

Industrial Arts Supply Company (IASCO)
5724 West 36th Street
Minneapolis, Minnesota 55416

Cope Plastics, Inc. (Main Office)
4441 Industrial Drive
Godfrey, Illinois 62035

Cope Plastics, Inc. (Warehouse)
714 66th Avenue S. W.
Cedar Rapids, Iowa 52401

CHAPTER VI

SUMMARY

Plastics are being used more extensively in the manufacture of decorative furniture parts. With the exact reproductions of wood grain and wood characteristics, in many cases it is very difficult for the general public to distinguish between actual wood and its plastic counterpart. Through the advancement of science and technology, new chemicals with properties similar to wood and more complex machinery are being developed. Also, because of the high cost of labor and the scarcity of wood, expansion of this industry appears definite.

On the basis of the investigation completed, this writer believes that the making of plastic parts for furniture should be considered by those seeking to enrich an industrial arts course in woodworking. It would offer some challenge to the students' creative ability. While the job opportunities for skilled workers in this area may be limited, the unit should make the student a more knowledgeable consumer when purchasing furniture.

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DuBois, J. Harry and Frederick W. John. Plastics, Fifth Edition. New York: Van Nostrand Reinhold Company, 1974.

Good Housekeeping, "Plastics: The Now and Future Furniture Material," Vol. 175 (November, 1972), pp. 136-41.

LaRue, James P. "An Occupational Analysis of Job Titles and Related Competencies Required for Entry into the Skilled and Technical Occupational Levels of the Plastics Industry of Iowa." Department of Public Instruction, Des Moines, Iowa, April, 1973.

Smith, H. A. "Here's a Guide to Making Flexible Molds For Foam Furniture," Plastics Technology, (September, 1968), pp. 38-41.

Society of Plastics Engineers, Inc. and The Society of the Plastics Industry Inc. "The Need for Plastics Education," September, 1968.

The Society of Plastic Industry, Inc., "Structural Foam," Worcester, Massachusetts: David Press, Inc.

The Society of Plastic Industry, Inc., "The Story of the Plastics Industry," Twelfth Edition, Printed by The John B. Watkins Company, February, 1970.

Weiss, Allen. "Manufacturing Plastic Furniture Parts," Industrial Education, Vol. 60 (January, 1971), pp. 48-50.

APPENDIX

APPENDIX A

University of Northern Iowa
Cedar Falls, Iowa 50613
June 23, 1975

Monsanto Polymers & Petrochemicals
Department 804
800 North Lindbergh Boulevard
St. Louis, Missouri 63166

Dear Sir:

I am a graduate student at the University of Northern Iowa majoring in industrial education. I am enrolled in a projects research course which requires correspondence with industrial firms associated with the project area selected. My research is being done on the manufacture of plastic parts in furniture construction.

I am seeking information on how the parts are molded, what type of plastic is used, and how designs are made. Also, if you have any information on audio-visual aids, it would be greatly appreciated.

Because this is a summer session, I would appreciate any material you could supply as soon as possible. Please send it to: Bradley Anderson, University of Northern Iowa, Cedar Falls, Iowa 50613.

Thank you for any help you might be able to give me.

Sincerely,

Bradley Anderson

University of Northern Iowa
Cedar Falls, Iowa 50613
July 11, 1975

Mr. Larry A. Denning, Sales Engineer
National Automatic Tool Company, Inc.
Plastics Machinery Division
Richmond, Indiana 47374

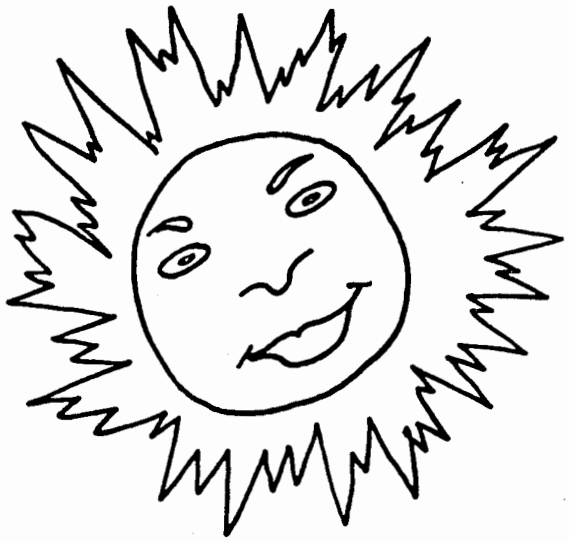
Dear Mr. Denning:

Thank you for the prompt reply and information that you sent me. It will be of great assistance in both the oral presentation and the research paper.

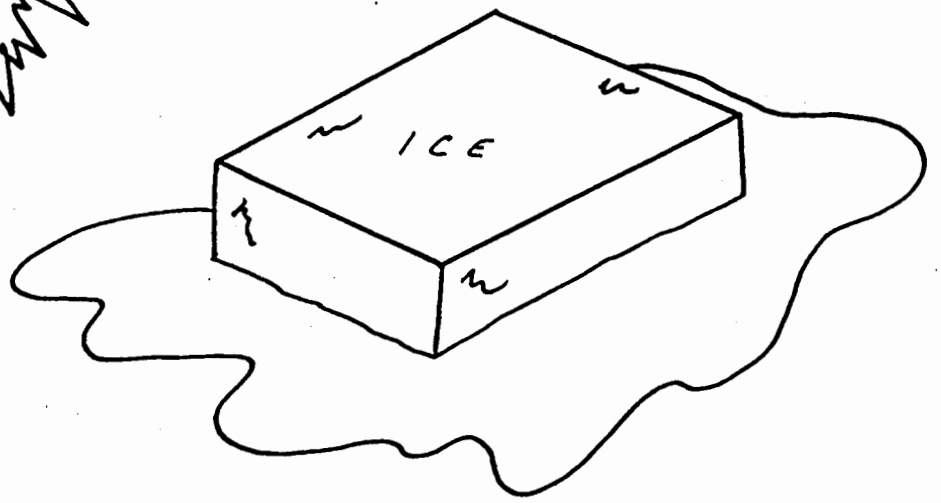
Sincerely,

Bradley Anderson

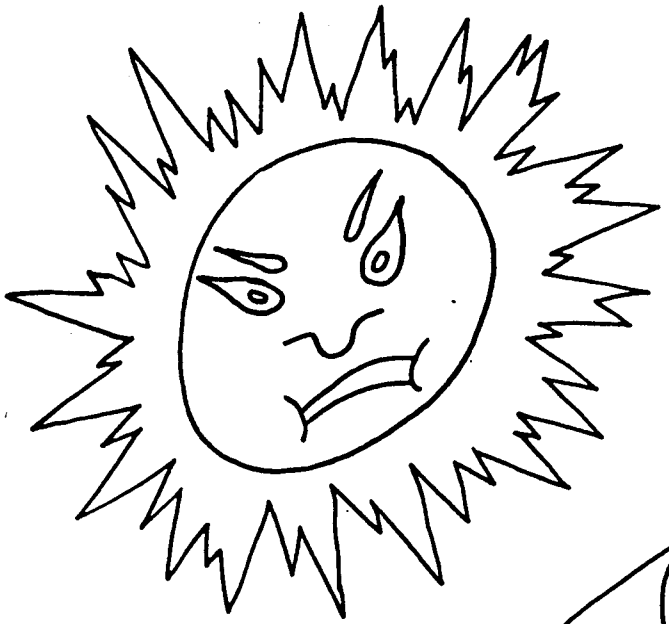
THERMOPLASTIC



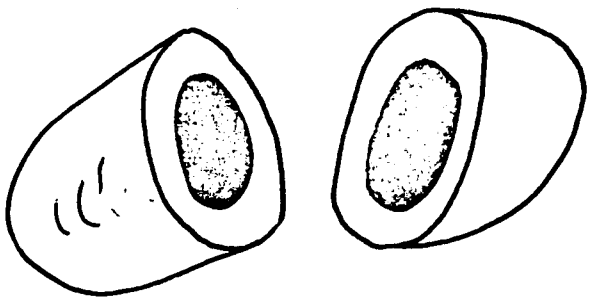
THESE PLASTICS BECOME SOFT WHEN EXPOSED TO SUFFICIENT HEAT AND HARDEN WHEN COOLED, NO MATTER HOW OFTEN THE PROCESS IS REPEATED.



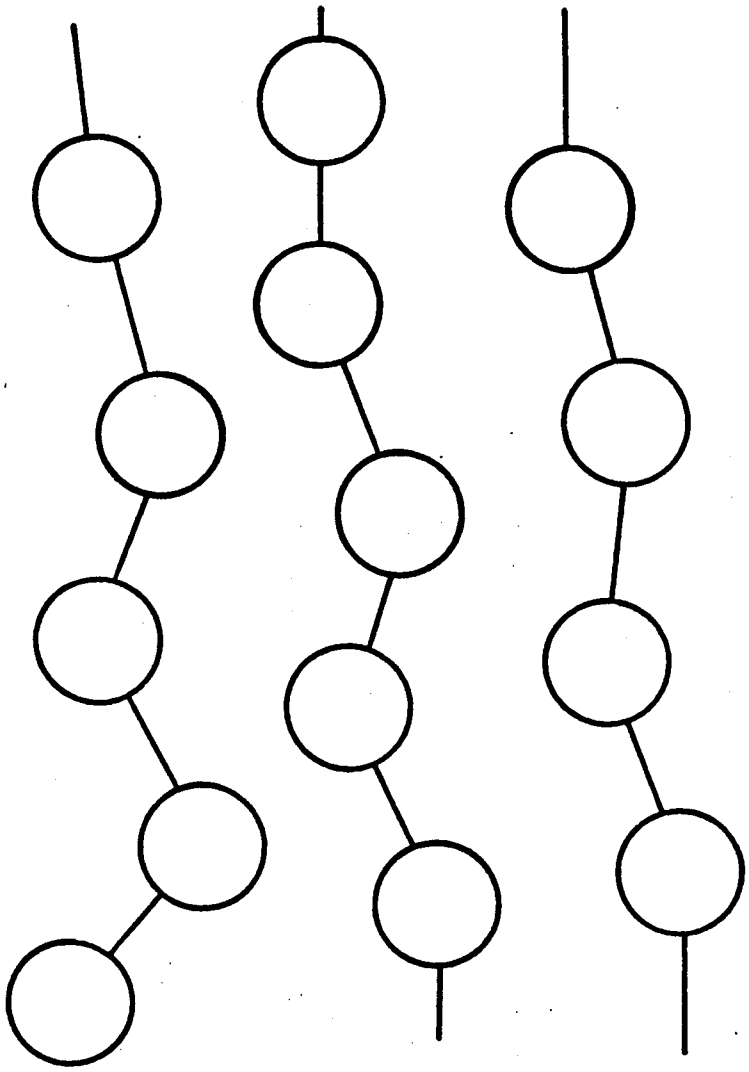
THERMOSETTING



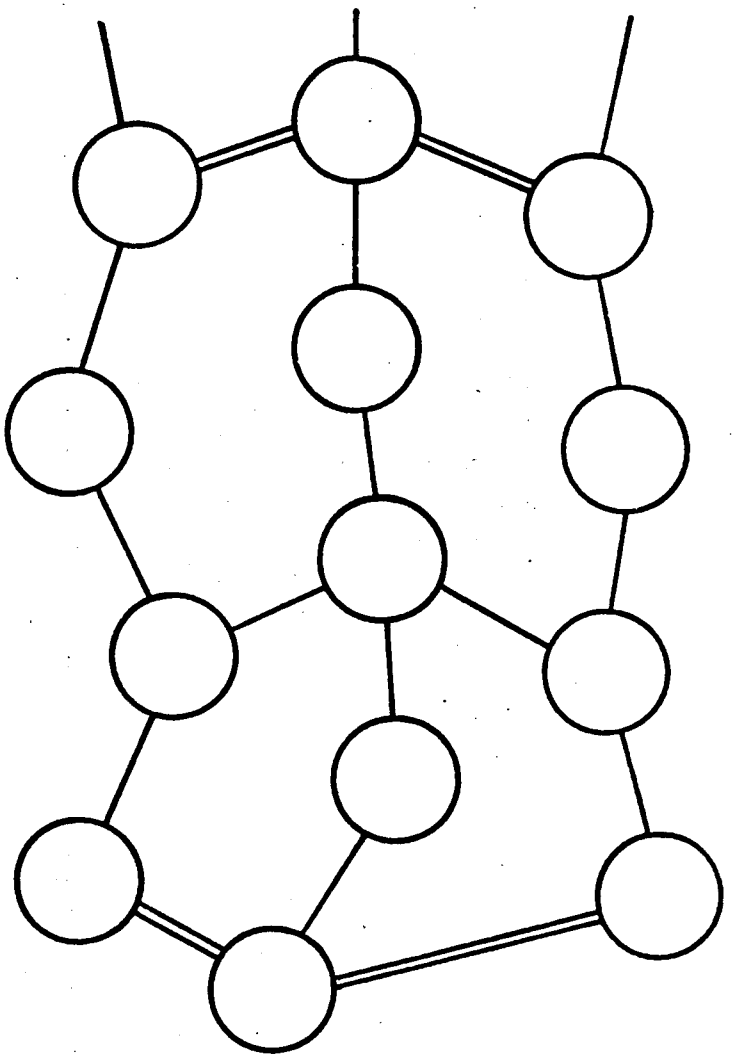
THE PLASTICS MATERIAL BELONGING TO THIS GROUP ARE SET INTO PERMANENT (USUALLY RIGID) SHAPE WHEN HEAT AND PRESSURE ARE APPLIED TO THEM DURING FORMING.



PLASTIC STRUCTURE

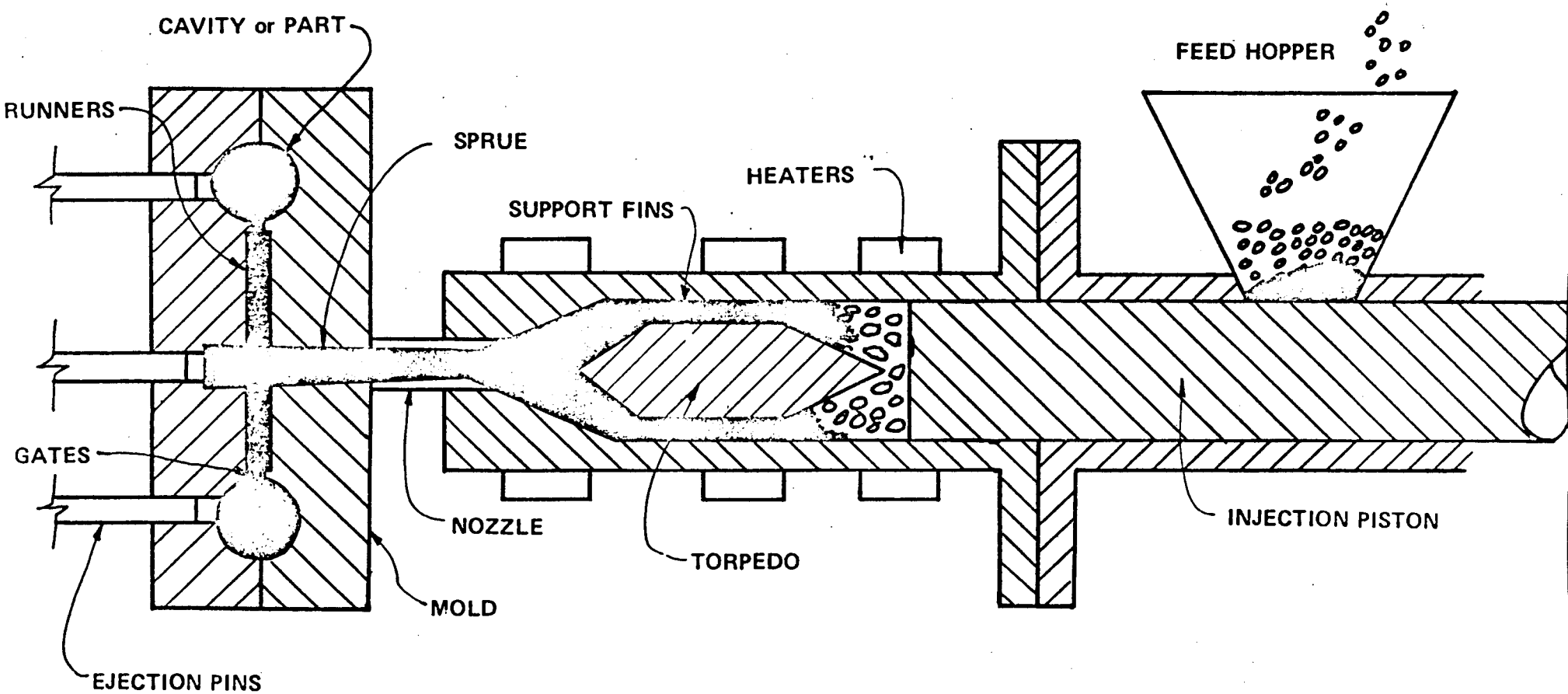


THERMOPLASTIC



THERMOSETS

INJECTION MOLDING



VITA

Name	Bradley Anderson
Date of Birth	
Place of Birth	
Wife	Carol
Children	Kelly,
	Mark,
Education	High School, Parkersburg Parkersburg, Iowa Graduated 1953
	Luther College Decorah, Iowa 1953-1954
	University of Northern Iowa Cedar Falls, Iowa 1954-1957 BA 1957
	University of Northern Iowa Cedar Falls, Iowa MA 1976
Past Positions	Grand Mound Cons. School Grand Mound, Iowa 1957-1961
	Roosevelt Military Academy Aledo, Illinois 1961-1962
	Central Community Junior High DeWitt, Iowa 1962-1965
Present Position	Central Community High School DeWitt, Iowa 1965-