III.C. 2. Plastics and Competing Materials by 1985: A Delphi Forecasting Study

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The application of Delphi to the identification and assessment of possible developments in plastics and competing materials [1] posed a severe challenge to the technique. Before launching into a discussion of this project it is worth considering the advantages offered by the technique for this application. Since the study was conducted with questionnaires transmitted through the mails, it permitted many widely separated people to participate without the difficulty of having them travel to be co-located at any specific time. It permitted the group to focus on what they regarded as major developments very quickly and discuss only those prospects in detail. Furthermore, because anonymity was employed, each participant was forced to judge the potential of each possibility on the basis of his knowledge and the supporting arguments presented. In other words, the tendency to judge those developments suggested by the most notable panelists were eliminated by virtue of anonymity.

This study was originally scheduled to be completed in three rounds of interrogation. However, as it evolved, only two rounds appeared necessary. This occurred by virtue of the high degree of specialization which appeared in the first-round responses and became even more evident in the second round.

The ability to tailor-make plastics for various applications, enhanced by growth in understanding of organic chemistry, alloying, reinforcing, etc., plus the responsiveness of the material itself, have led many researchers to believe that the types of plastics produced in the future will be determined more by what is desired (and pursued) than by what is possible. Thus in many ways this study was more an investigation of material needs and resource allocations than of technological possibilities.

The study focused upon possible combinations of material property [2] changes that are likely to affect widespread material usage. A prime difficulty encountered in this study arose from discussing yet unknown (and hence unnamed) materials. In general, it is easier to discuss improvements in the properties of steel, aluminum, concrete, boron, niobium, etc., than to discuss the prospects for development of, and properties of, material X, Y, or Z. Yet in many cases this study had to do exactly that. As a result, it probably tended to focus more on changes in existing materials than it did on totally new materials.

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[1] Selwyn Enzer, *Some Developments in Plastics and Competing Materials by 1985,* Report R-17, Institute for the Future (January 1971).

[2] The term "material property" included not only physical properties such as strength, density, toughness, and others, but also processability and cost.

Since the study focused on material property changes that may be realized in existing materials as well as new materials and their properties, the number of alternatives to be contemplated was vast. To address this challenge a matrixtype categorization of materials and properties was used as the point of departure. For this purpose a breakdown similar to that presented in "The Anatomy of Plastics," *Science and Technology* (F. W. Billmeyer and R. Ford), was used. This matrix of materials and properties was divided into five subcategories:

- Engineering Plastics
- General Purpose and Specialty Plastics
- Glass Fiber Reinforced Plastics
- Foamed Plastics
- Nonplastics

The panel was asked to: (1) review the materials and properties presented, indicating where they thought changes were likely to occur within the next fifteen years which would significantly affect the widespread use of that material; and (2) add and describe the anticipated properties of new materials which they thought were likely to evolve and gain widespread use by 1985. In both of these steps the panel was also asked to describe the new chemical, physical, or other technological developments that they believed would lead to the creation of the new material.

These inputs from the first Delphi round were used to prepare a three-part questionnaire for the final round of interrogation. These parts were: (1) a summary of the assessments of anticipated changes in existing material properties, indicating those selected for more detailed investigation; (2) a listing of both plastic and nonplastic materials with the nature of the anticipated major changes described (those respondents who had anticipated these changes were asked to estimate the new material properties they expected would exist by 1985 and to estimate the 1985 annual consumption by application); and (3) a list of new materials anticipated by 1985 and a description of their properties (those respondents who had anticipated these items were asked to estimate the properties and consumption patterns they expected for these by 1985). All of these parts were open-ended in that any of the respondents could still add additional items or comment on any item.

Anticipated Changes in Properties of Existing Materials

The Delphi panel was presented with descriptions of the major uses, properties, and proprietary qualities of 37 plastics and 16 nonplastics all currently in widespread use. These 37 plastics are presented in Table 1. As indicated earlier, they were asked to: (1) identify likely changes in the properties of these materials which would significantly affect their widespread use by 1985; and (2) identify new materials (in each of the categories shown) which are likely to be developed and would be in widespread use by 1985.

Table 1
Existing Plastics

Engineering Plastics:	Glass Fiber Reinforced Plastics:
ABS	ABS
Acetal	Epoxy
Fluorocarbons	Nylon
Nylon	Polyester
Phenoxy	Phenolics
Polycarbonate	Polycarbonate
Polyimide	Polystyrene
High Density Polyethylene	Polypropylene
Polypropylene	San
Polysulfone	Polyethylene
Urethane	
Poly (Phenylene Oxide)	
General Purpose & Specialty Plastics:	Foamed Plastics:
Acrylics	Polyethylene
Cellulosics	Polystyrene
Cast Epoxy	Polyurethane (low density)
Ionomer	PVC
Melamines & Ureas	Polyurethane (high density)
Phenolics	
Low Density Polyethylene	
Polystyrene	
Vinyls (PVC)	
San	

The format used for this portion of the assessment is shown in Fig. 1. This figure is divided into four columns. Column 1 lists the material and its typical uses. Column 2 describes the properties of that material which are the key to its current widespread use. Column 3 is divided into subcolumns which contain specific material properties and the current performance ratings of each material relative to the others in that category. This rating is indicated with a "1," "2," or "3" in accordance with the code noted at the bottom of the figure. The results of this assessment were presented to the panel in the format presented in Fig. 2. Shown in the subcolumns of Column 3 are the changes anticipated by the panel. "These changes are noted, using the code presented in the upper-right-hand corner of the figure. Column 4 contains the panel's comments. These comments and all other changes suggested by the panel are in italics.

Items noted as being "included in Package No. 2" were reassessed by the panel in the second round in greater detail. The comments received from the panel regarding these materials were presented in greater detail in a subsequent section of the questionnaire.

EXISTING GENERAL PURPOSE & SPECIALTY PLASTICS

1. MATERIAL & Typical uses	2. Proprietary qualities (relative to typical uses): (+) Assets (-) Liabilities	3. Property: Price	Processability	Tensile strength	Stiffness	Impact strength	Hardness	Useful temperature range	Chemical resis.	Weather resistance	Water resistance	Flammability	4. Aspects of changes in material properties:
ACRYLICS Windows; fiber optics; building panels; lighting; tubing	(+) optical clarity; weather resistance (-) abrasion resist.	2	3	2	3	1	2	1	2	3	2	1	
CELLULOSICS Packaging; film; toys; telephones; instrument glass	(+) tough; clear (-) abrasion resist.	2	3	2	2	2	3	2	1	2	1	1	
CAST EPOXY Printed circuits; potting compounds	(+) strong & flexible	2	2	3	2	1	3	3	2	2	1	1	
IONOMER Molded housewares; toys; extruded tubing; sheeting; packaging	(+) transparent, tough & flexible; chemical resistance (-) strength. temp. range	2	3	1	1	3	1	1	2	2	2	1	
MELAMINES & UREAS Dishes; wood laminate; appliance cabinets; electrical devices	(+) appearance (finishability); surface hardness (-) impact strength; temp. range	2	2	2	3	1	3	2	2	2	2	2	
PHENOLICS Appliance cabinets & parts; bonding resins; electrical parts	(+) cost; strong, hard, rigid; abrasion resist. (-) chemical resist.	3	2	2	3	1	3	2	1	2	2	1	
LOW DENSITY POLYETHYLENE Dishes; bottles; pipes; tubing; film packaging	(+) flexible; cost (-) strength; weatherability; flammability	3	3	1	1	3	1	2	3	1	3	1	

3 — Outstanding in property indicated; among the best performers available.	2 — Acceptable performance in this property; still suitable in most cases.	1 — Not acceptable if indicated property is important to intended use.

Fig. 1. Typical questionnaire for eliciting changes in existing plastics.

In the course of this assessment several variations in the original list of existing plastics were made by the panel. As a result, the existing materials that were investigated further in round two are presented in Table 2.

The questionnaire format used for this interrogation and typical results are presented in Fig. 3. As before, the information presented to the panel is in roman type, the additions are in italics.

Table 2
Existing Plastics for More Detailed Consideration

Engineering Plastics:	Glass Fiber Reinforced Plastics:
ABS	ABS
PVF	Epoxy
Nylon	Nylon
Polymides	Polyester (Molding Compounds
High Density Polyethylene	
Polypropylene	
Polysulfone	
General Purpose & Specialty Plastics:	Foam Plastics—Rigid:
Acrylics	Polystyrene Foams
Epoxy	Low Density Polyurethane Foam
Ionomer	Variable (High Overall) Density Integral Skin Urethane Foam
Phenolics	
	Foam Plastics—Flexible:
	PVC Foam
	Variable Density, Integral Skin Urethane Foam

The comments received from the panel are presented in Column 2 of this figure. Because these generally referred to the reasons why the material property changes were anticipated, the panel was asked to indicate whether or not they agreed or disagreed with each statement. The results of this assessment are also shown in Column 2. Those items presented in italics in this column were added in round two and hence were not assessed by the entire panel.

Column 3 presents the current major markets and their annual volume usage. Shown in italics are new markets suggested by the panel and their estimated 1985 usage.

In that portion of the investigation concerned with nonplastics, many new material developments were suggested, but only a few of these were regarded as threats to the growth of plastics. This can be seen in the following general comments received from the panel.

EXISTING GENERAL PURPOSE & SPECIALTY PLASTICS

1. MATERIAL & Typical uses	2. Proprietary qualities (relative to typical uses): (A) Assets (L) Liabilities	3. Property: Price	Processability	Tensile strength	Stiffness	Impact strength	Hardness	Useful temperature range	Chemical resis.	Weather resistance	Water resistance	Flammability	4. Comments
ACRYLICS Windows; fiber optics; building panels; lighting; tubing	(A) optical clarity; weather resistance (L) abrasion resist.	2 +	3	2	3	1 + +	2 +	1 + +	2	3	2	1 + + +	(*Included in package No. 2*).
CELLULOSICS Packaging; film; toys; telephones; instrument glass	(A) tough; clear (L) abrasion resist.	2	3	2	2	2	3	2 (−)	1	2	1	1 +	●*Not competitive with low cost plastics, e.g., vinyls.*
CAST EPOXY Printed circuits; potting compounds	(A) strong & flexible	2 + +	2	3	2	1 + + +	3	3	2 +	2	1 + +	1 + + +	(*Included in package No. 2*).
IONOMER Molded housewares; toys; extruded tubing; sheeting; packaging	(A) transparent, tough & flexible; chemical resistance (L) strength; temp. range	2 + +	3	1 +	1 +	3	1 + +	1 + +	2	2	2	1 + +	(*Included in package No. 2*).
MELAMINES & UREAS Dishes; wood laminates; appliance cabinets; electrical devices	(A) appearance (finishability); surface hardness (L) impact strength; temp. range	2	2	2	3	1 + +	3	2	2	2	2	2	
PHENOLICS Appliance cabinets & parts; bonding resins; electrical parts	(A) cost; strong, hard, rigid; abrasion resist. (L) chemical resist.	3	2 + +	2 +	3	1 + +	3	2 +	1 + + +	2	2	1 + + +	(*Included in package No. 2*).
LOW DENSITY POLYETHYLENE Dishes; bottles; pipes; tubing; film packaging	(A) flexible; cost (L) strength; weatherability; flammability	3	3	1 +	1	3	1	2	3	1 + +	3	1 + + +	●*Compounding can improve weather resistance.*

CODE
Property changes anticipated by the panel, likely to affect the widespread use by 1985, are noted in *italics* as follows:

Direction of expected change \ % of the panel	40 or more	20 to 40	less than 20	None
Improvement	+ + +	+ +	+	
Degradation	− − −	− −	−	

◯ Degradations encircled indicate panel disagreements with the original rating not a forecast.

3	Outstanding in property indicated; among the best performers available.
2	Acceptable performance in this property; still suitable in most cases.
1	Not acceptable if indicated property is important to intended use.

Fig. 2. Typical feedback of results of initial estimates of changes in existing materials.

ENGINEERING PLASTICS

MATERIALS FOR WHICH THE PANEL ANTICIPATES A SIGNIFICANT INCREASE IN USE BY 1985		
KEY PROPERTIES IN WHICH IMPROVEMENTS ARE CONSIDERED LIKELY BY THE PANEL	CURRENT PROPERTY VALUE	ESTIMATE PROPERTY VALUE LIKELY BY 1985
1. ABS		
Price, ($/lb.)	.28-.44	.20-.30
Maximum Service Temperature *(D 648) °F	180-245	250
Flammability, in./min.*(D 265)	1.0-2.0	0.65-2.0
Impact Strength Notched Izod, ft. lb./in. *(D 256) @ 73°F	2.0-10.0	2.5-11.
@ 40°F	.8-3.5	.9- 5.0
Deflection temperature, °F *(D 648) @ 264 psi	214-244	214-280
@ 66 psi	215-250	215-280

COMMENTS BY THE PANEL	AGREE	NO CONSENSUS	DISAGREE
- Reduction in depolymerization will improve flammability.		x	
- Alloying and blending will improve temperature range and flammability	x		
- Improved shaping of disperse particles as well as processing techniques will orient particles.	x		
- Reduction in compound prices; scale and competition lowering prices.	x		
- Availability of composite forms as sheet and ability to fabricate in inexpensive equipment will make this material competitive with glass-polyester.	x		
- Platability makes this material increasingly attractive for automobile parts, this will be especially important if low temperature strength and crack resistance can be improved.	x		
- *Properties will be very dependent upon filler.*			
- *ABS will include chemical and cross-linked materials.*			

APPLICATIONS		
MARKET BREAKDOWN (MAJOR USES)	VOLUME-MILLION LB/YR CURRENT	ESTIMATE 1985
TOTAL VOLUME	508	*1500*
Automotive	80	*250*
Major Appliances	60	*150*
Pipe & Fittings	60	*200*
Bus. Machines, Phones	40	*90*
Recreational Vehicles	45	*150*
Luggage	27	*65*
Other:	196	*350*
Interior panels & sheeting		

*ASTM Test Method

Fig. 3. Typical results of final assessment of important changes in existing plastics.

- The main competition between plastics and aluminum will occur in the construction field, particularly in residential housing and light industrial buildings. New developments in aluminum will hurt plastics in the applications which are primarily structural. On balance, however, these developments will affect the use of other metals more than plastics.
- In general, plastics will continue to replace iron and steel in some applications. This will be significant to the plastics industry; however, it will be a relatively small change to the steel industry. Any development which brings steel closer to "one-step" finishing, with improved environmental resistance, will be important in this regard, since it will blunt some of the basic advantages that plastics have over steel, allowing the use of "conventional" technology and existing capital equipment. Such developments will bring steel and plastics closer to a straight-cost competition. However, these developments must be realized before potential markets have switched from steel to plastics to maintain the continuity of technology and equipment.
- Developments in concrete appear more likely to enhance the demand for plastics than to replace or be replaced by them. Developments in wood and plywood are more likely to be in combination with plastics and hence are apt to increase the demand for such materials. However, unlike the concretes, wood will increasingly be replaced by plastics, particularly in furniture and siding.

Other Materials Suggested by the Panel as Likely to Become Important by 1985

In addition to the changes suggested in the existing materials, other materials (some already in existence) were suggested by the panel as prospects for widespread use by 1985. These are presented in Table 3.

These materials were submitted for consideration by the entire panel in the final round of reestimation. Format and typical results are presented in Fig. 4.

As seen, this is similar to the format presented earlier. One notable difference is in Columns 5 and 6, which contain estimates of the likelihood of these materials being in widespread use by 1985 and the annual production estimated by that time. These estimates should be treated with even greater care than those presented earlier, since they often represent the comments of as few as two or three respondents who were familiar with the development.

As before, the roman type represents information obtained from the panel in round one and hence presented to the entire group in round two. The entries in italics represent the results received in round two.

Table 3
Other Materials Suggested by the Panel as Likely to Become Important by 1985

Engineering Plastics:	Other Fiber Reinforcements and Reinforced Plastics:
Polybutadiene (High 1, 2 Content)	Boron Fibers
Polyethyleneterephthalate	Graphite Fibers
Polyphenylene Oxide Derivatives	Fiber Strengthened Oxides
New Thermoplastic	Aluminum Oxide Fiber & Whisker Composites
New Tougher Plastics	Boron/Epoxy
	Boron/Polymide
	Graphite/Epoxy
	Graphite/Polymide
General Purpose & Specialty Plastics:	Foamed Plastics:
PVC—Polypropylene Copolymers	Phenolic Foams
Ethylene—Polar Copolymer	Vinyl Foam
Acrylic—PVC	Polyolefins (Ethylene, Propylene, etc.)
New Polyolefins	Isocyanurate—Urethane
New Thermosetting Resins	Silicone Foams
Completely Nonburning Organic	Special Hi-Temp Foams
Semiorganic & Inorganic	Structural Foams
	Foamed Thermoplastics
	Injection Molded Urethane Foams
Glass Fiber Reinforced Plastics:	Miscellaneous:
PVC	Silicate Glasses & Polymers
Polyimides (or Amidemides)	Titanium Alloys
Polysulfones	Cermets
Polyurethane	
Vinyl Ether	
Thermoplastic Polyester	
Thermoplastic Sheet	
New Thermoplastic Resin	

OTHER ENGINEERING PLASTICS

1. MATERIAL & Typical uses (suggested by the panel)	2. Proprietary qualities (relative to typical uses): (+) Assets (−) Liabilities	3. Anticipated 1985 Properties: Price	Processability	Tensile Strength	Stiffness	Impact Strength	Hardness	Useful temperature range	Chemical resist.	Weather resist.	Water resistance	Flammability	4. Panel Comments	5. Likelihood of being in widespread use by 1985	6. Potential Volume by 1985 (Million lbs/year)
POLYBUTADIENE (HIGH 1, 2 CONTENT) *Very high performance electrical applications, thermoset molding compound, excellent high performance laminates, Asd laminate*	(+) low density, high rigidity, excellent electrical properties, clarity, high heat distortion (−) processing	2	2	2	3	2	2	2	2-3	2	2-3	2	- These products, which are just developing, will make great progress as availability and costs improve. - *Compared to thermosets these polymers are easily processed and have outstanding high temperature rigidity and low density.*	*80%*	*110*
POLYETHYLENETEREPHTHALATE (saturated polyesters) Large volume in fiber applications	(+) chemical resistance, mechanical properties (−) processing (especially unfilled)	2	2	3	3	2	2	2	2	2	2	2	- Fiber filling will upgrade properties significantly. - *Friction fatigue and bearing props of Nylon without cold flow or creep.*	65%	75
POLYPHENYLENE OXIDE DERIVATIVES		1-2											- Technology exists to make a family of these polymers and polymer blends. *(Yes, but this is true for every family and is not an adequate criterion for expansion.)*	65%	750

[3] Outstanding in property indicated; among the best performers available	[2] Acceptable performance in this property; still suitable in most cases.	[1] Not acceptable if indicated property is important to intended use.

Overall Forecasts of U.S. Plastic Production

Estimates of future plastic production, both in total and in several major subcategories, were also made by the panel. To assist in making these forecasts, graphic data describing the production of (1) all plastics, (2) foamed plastics (total and flexible), and (3) fiber glass reinforced plastics, for the U.S. since 1950 were presented to the panel. Each respondent was asked to extrapolate his estimate of these trends out to 1985. These estimates were collated to display the spread of opinion among the respondents.

Also presented to the panel was the distribution of the current production of major markets. The respondents were asked to estimate the 1985 distribution of production among these markets, and to add others they thought likely to become important by 1985.

In the opinion of the panel, the growth of the plastics industry in the United States will continue at a rate about equal to its current pace. This is seen in the forecast presented in Fig. 5.[3] As seen, the median estimate of the panel suggests that 50 billion pounds of plastic will be produced in the U.S. by 1985, and half of the panel's estimates ranged between 41 and 75 billion pounds for 1985.

Beyond the production estimates themselves, the shape of the trend curves for the median and the upper and lower quartiles appear to suggest a wide divergence of opinion regarding the saturation level of plastic production. The median and lower quartile estimates indicate that the rate of plastic production will peak by around 1980. The upper quartile, on the other hand, suggests that the growth rate in this time period will still be increasing, with no reversal of this trend by 1985.

As can also be seen in Fig. 5, all of the current markets are major growth candidates. The major markets listed currently consume approximately 40% of the plastic production and the 1985 median estimates indicate that these markets will represent about 40% of the 1985 median forecast of plastic production.

Figure 6 presents comparable estimates for foamed plastics production. These estimates were made for both total foamed plastic production and the subcategory of flexible foamed plastics. The difference between these estimates represents, of course, rigid foamed plastics. Foamed plastics, which are presently produced at the rate of approximately 1 billion expected to reach a production rate of between 2.7 and 3.8 billion pounds per year by 1985. The bulk of this growth is anticipated to result from the construction, furniture, packaging, and transportation markets.

Here again the shapes of the forecasts are quite revealing. These indicate ,that the largest portion of the growth of foamed plastics in the 1970-80 time period is expected to occur in the flexible foams. However, the panel estimates a leveling off of this growth after 1,980, despite an increased rate of growth for foams in general. This indicates that the growth of rigid foams is likely to be slow until 1980 but is expected to increase more rapidly thereafter.

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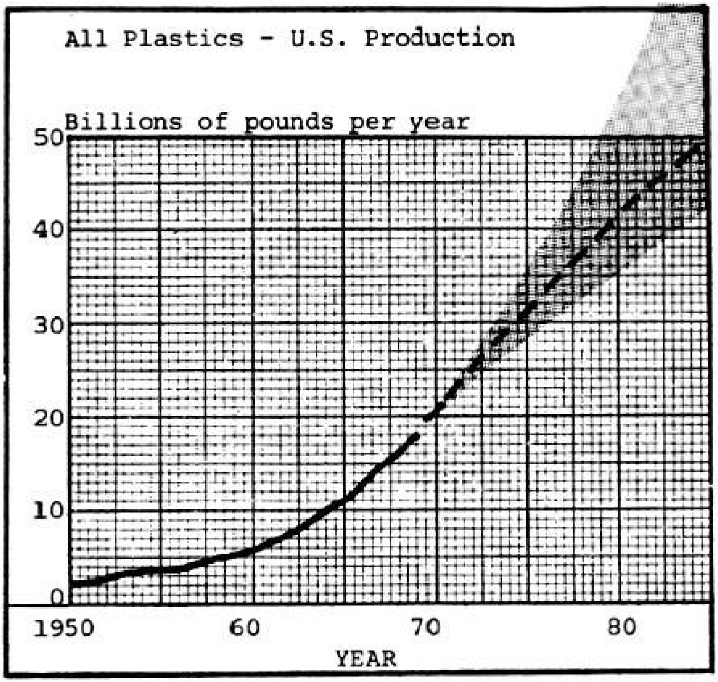
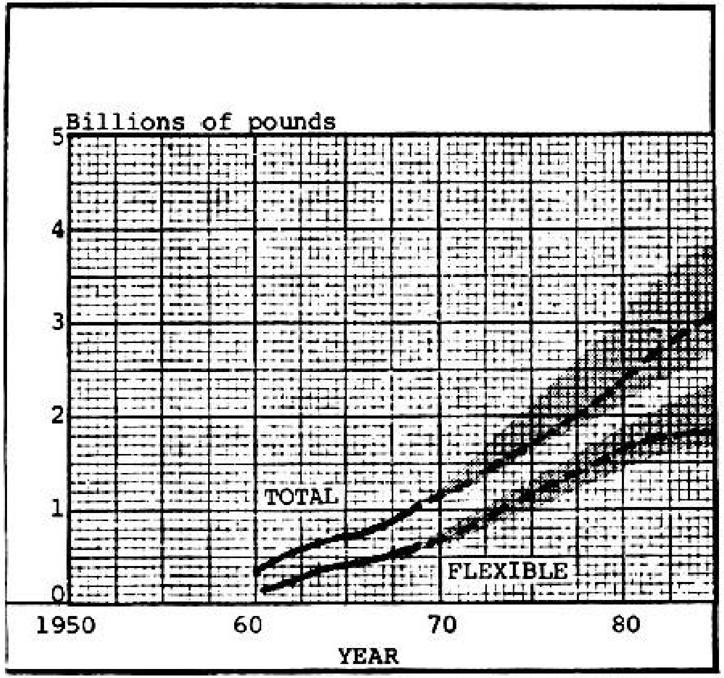
[3] In this and all similar figures illustrating the panelists' forecasts, solid lines represent statistics, dashed lines the median forecast, and shaded areas the interquartile range.



MARKETS	U.S. PRODUCTION (MILLIONS OF LB./YR.)	
	CURRENT	BY 1985
Appliances	476	1,000
Construction	2,359	6,000
Consumer Products	1,245	3,500
Furniture	567	1,600
Packaging	2,892	5,500
Transportation	835	2,500

Fig. 5. Total U.S. plastic production.



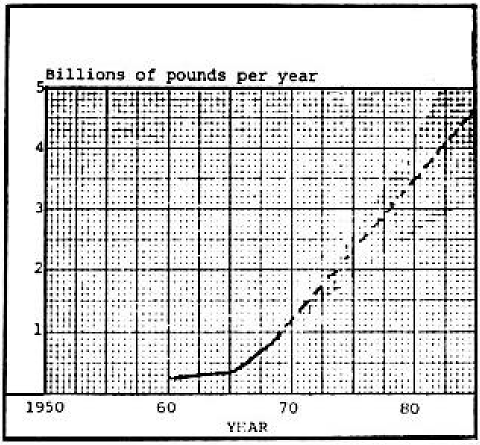
MARKETS	U.S. PRODUCTION (MILLIONS OF LB/YR.)	
	CURRENT	BY 1985
Appliances	58	130
Construction	206	1,050
Furniture	270	825
Packaging	170	475
Transportation	200	575
Other	90	440

Fig. 6. Total U.S. production—foamed plastics.

Figure 7 presents the panel's estimates for the growth of fiber glass reinforced plastics. As seen, the spread of opinion here is quite large, but even the conservative group, as indicated by the lower quartile curve, suggests a tripling of this production by 1985. Fiber glass reinforced plastics, which are presently produced at a rate slightly in excess of 1 billion pounds per year, are expected to reach a production rate of between 3.2 and 6.1 billion pounds per year. The major growth markets for this material are expected to be construction; marine products; transportation; and pipes, ducts, and tanks. Additionally, a significant growth in the use of fiber glass reinforced thermoplastics is anticipated. Presently only 6% of all fiber glass reinforced plastics are thermoplastics; by 1985 this figure is expected to reach 35%.

Interestingly, the median values for the numerical estimates of the market distribution for fiber glass reinforced plastics are considerably less than the median of the graphic estimate. However, since several of the respondents estimated only selected markets, consistency among these forecasts need not occur.

Along with these forecasts, comments were also elicited from the panelists. These comments are presented in Fig. 8. In general, these comments suggest that the growth of plastic production is related more to the nature of the products likely to be in demand and the natural environment (resources and pollution) than it is to technological progress per se.



MARKETS	U.S. PRODUCTION (MILLIONS OF LB./YR.)	
	CURRENT	BY 1985
Appliances	30	120
Construction	108	600
Consumer Products	60	200
Marine Products	270	600
Transportation	200	975
Agriculture	34	100
Aerospace, aircraft	42	140
Electrical	82	225
Pipes, ducts & tanks	105	500
Miscellaneous	12	65
FGRP market distribution by plastic		
Type:		
Thermoplastics	6%	35%
Thermosets	94%	65%

Fig. 7. Total U.S. production—fiber glass reinforced plastics.

- PLASTICS, ESPECIALLY REINFORCED PLASTICS, WILL REPLACE WOOD AND METALS IN MANY APPLICATIONS.
- AS NATURAL RESOURCES CONTINUE TO BE DEPLETED, PLASTICS OF ALL KINDS BECOME MORE IMPORTANT.
- IMPROVEMENTS IN PROCESSABILITY MAKE PLASTICS INCREASINGLY MORE ECONOMICAL THAN TRADITIONAL ENGINEERING MATERIALS.
- PLASTIC USE WILL INCREASE BEYOND ITS NORMAL GROWTH BECAUSE OF ITS INCREASED USE IN: 1) ALL PLASTIC APPLIANCES, 2) MODULAR HOME CONSTRUCTION, AND 3) TRANSPORTATION EQUIPMENT.
- AIR POLLUTION WILL FORCE THE AUTO INDUSTRY TO ELECTRIC CARS AND HENCE ALL-PLASTIC BODIES.
- CONSUMERS WILL DEMAND, AND GET LONGER LIFE IN APPLIANCES, HENCE FUTURE PRODUCTION WILL NOT KEEP UP WITH GNP INCREASES, AND PLASTIC GROWTH RATE WILL DECREASE.

Fig. 8. Panel comments concerning future plastic consumption.