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Synthetics and the Cotton Textile Industry

TECHNOLOGICAL progress in the development of synthetic fibers is proceeding at such a pace as to foreshadow a radical change in the cotton textile industry, the largest integral part of the Southeast's industrial structure. To rayon, which is the oldest synthetic fiber of importance and which has itself recently experienced tremendous technological improvements, have now been added several different types of nylon as well as a dozen or more other synthetic fibers. Some of these have definite revolutionary qualities. Indeed, now looming on the horizon are several new synthetic fabrics which require no spinning or weaving but are manufactured by extrusion in sheets. If these new fibers and fabrics are developed to their full potentialities, the effect upon existing textile manufacturing capacity will be very far-reaching.

Up to the present time production of no other synthetic fiber has approached rayon output, although nylon manufacture has been expanded at a tremendous rate since its commercial introduction in 1938. American plants in 1944 produced 724 million pounds of rayon filament and staple. This amount represents an increase of 9 per cent over the 1943 production and contrasts with an output of 128 million pounds as recent as 1930. Consumption of rayon exceeded that of wool during 1944 and in recent years has averaged around 10 per cent of total textile fiber consumption.

Rayon is derived from cellulose. Two chief sources of cellulose have been used by the rayon industry—cotton linters and wood pulp. From 1900 to about 1925 viscose rayon was manufactured from wood pulp exclusively. After 1925 there was a period during which the viscose rayon manufacturers used varying mixtures of cotton linters and wood pulp, but in the last few years no linters have been used in the common grades of viscose rayon because qualitative improvements in wood pulp and rising prices of cotton linters have made it uneconomic to use linters in the process. More cotton linters, however, have been used in the manufacture of high-tenacity viscose rayon since 1937. Prior to 1940 the acetate and cuprammonium rayon producers used linters exclusively. In the last few years these producers also have tended to use larger and larger amounts of wood pulp of special highly purified grades. Of the 367,000 tons of cellulose pulp consumed by the industry in 1944, 78 per cent was wood pulp and 22 per cent linter pulp.

The first method of manufacture used by the rayon industry on a commercial scale was the nitrocellulose process. But this method now has been virtually abandoned in favor of three newer processes—viscose, acetate, and cuprammonium. Because the cuprammonium process accounts for only a small part of American rayon output, statistics for this method as well as those for the nitrocellulose process are commonly lumped with figures for the dominant viscose process.

Of the filament yarn produced in 1944, 69 per cent was made by these processes and 31 per cent by the acetate process. Prior to about 1930 rayon was produced principally as a continuous filament. Since that year a rapidly increasing proportion of rayon production has consisted of staple fiber, and in 1944, 555 million pounds of filament yarn and 169 million pounds of staple fiber were produced. An estimate is that about one fourth of the staple fiber produced in the United States is acetate rayon and the remainder is viscose. Staple fiber rayon is composed of fibers of equal length, usually from one to eight inches, depending upon the spinning system on which it is to be made into yarn.

A new form of rayon, distinct from both filament yarn and staple fiber, is now attracting considerable attention. Called rayon tow, it is, basically, uncut staple fiber stock. Tow, which looks something like untwisted rope and which is made up of a large number of parallel continuous filaments, is now used in the manufacture of spun yarns. Spun rayon yarn can probably be reduced in cost and improved in quality with the development of tow, which eliminates carding and combing operations. New processes cut or break the filaments into the length desired and manipulate them into spun yarn, while maintaining the parallelism of the filaments.

The number of filaments composing a rayon yarn of a given size determines, in part, its strength, its pliancy, and certain fabric characteristics. The trend over the last two decades has been to increase the number of filaments. Different types of rayon vary greatly in elasticity, but apparently little improvement has taken place in the low elasticity of rayon in general.

The successful commercial production of nylon, rayon's closest competitor among the synthetics, was first announced in 1938, and since then its growth has been remarkably rapid. Nylon is the generic name applied to a wide range of polyamides developed by the E. I. DuPont de Nemours Company. Ten different types of nylon have been placed in commercial production, but the first type developed, fiber 66, is still the

most widely used for textile purposes. In counterdistinction to rayon, nylon is a completely synthetic material. Whereas rayon is derived from natural cellulose, nylon is chemically synthesized. The basic materials used are simple ones—coal, air, and water—but a series of complex chemical processes is involved in the manufacture. Nylon is found to be particularly suitable where high elasticity is desired, such as in hosiery, parachute fabrics, and glider tow ropes. It has also a potentially wide range of industrial uses.

New Synthetic Fibers

Within the last few years a number of other synthetic fibers have reached the stage of commercial production, but none of them have yet acquired a large market. These include Vinyon and Vinyon E, which are derived from a vinyl resin, a copolymer of vinyl chloride and vinyl acetate. Vinyon's most important use so far has been in industrial filter cloths because of its unusually high resistance to acids, alkalies, and other liquids and gases. Vinyon E, with its high elasticity, has been used chiefly as a substitute for rubber in such products as suspension cords for jungle hammocks. These two fibers are manufactured by the American Viscose Corporation.

A similar synthetic fiber derived from petroleum and salt is manufactured by the Dow Chemical Corporation, the Firestone Industrial Products Company, and Pierce Plastics, Inc., under the names of Saran, Velon, and Permalon, respectively. This fiber has been found to be particularly useful where low water absorbency, high resistance to chemicals and abrasions, great strength, and elongation are required.

Still another fiber is Aralac, manufactured from casein, a precipitate of skim milk, and introduced by Aralac, Inc., some years ago. It has been found useful for blending with other fibers in fabrics where its low wet strength would not be a handicap. The Owens-Corning Fiberglas Corporation has produced Fiberglas both as a continuous filament and as a staple fiber. Each of these is derived from glass marbles remelted in small electric furnaces. Various other fibers have been produced on an experimental basis from peanuts and corn meal, and for a time soybean fiber was manufactured on a semicommercial scale by the Ford Motor Company, which has relinquished the process to the Drackett Company of Cincinnati.

Several different synthetic rubber yarns have been produced on an experimental basis, and the U. S. Rubber Company and the B. F. Goodrich Company, which manufactures Ameripol, have such yarns on a commercial production basis at present. Under the trade name of Plexon, various plastic-coated yarns are manufactured by Freyberg Brothers & Strauss, Inc. These are cotton, rayon, and other yarns coated with such plastics as cellulose acetate and cellulose acetate butyrate.

So far the manufacturers' plans in the development of synthetic textile materials have been formulated with the established textile industry in mind. An attempt has been made, in other words, to sell rayon and nylon to firms already processing cotton, wool, and silk. With minor adjustments to the machines already installed in their mills, cotton textile manufacturers have for years been successfully processing rayon into fabric. With one exception, the producers of rayon have carefully avoided competition with their own customers—the established cotton-spinning mills — although several of the producers make woven or knitted goods from their own filament yarn. Moreover, by the development of rayon staple fiber since the early 1930's, they have provided the established cotton manufacturers with a synthetic fiber material that must be spun as well as woven and that thus fits almost precisely into the established cotton-processing pattern.

Beginning about 1920, but more apparently since 1930, fluctuating cotton prices in conjunction with falling rayon prices; the increasing technological advance that has given rayon more quality and style advantages than it formerly had; and the increasing importance of rayon staple have caused cotton processors to turn, in part, to the fabrication of rayon. This trend has been accelerated since 1940. It has, nevertheless, been obscured by the large wartime cotton consumption and an over-all textile shortage so great that on July 1, 1944, all spindles in the cotton industry, both Northern and Southern, were reported in use.

A postwar possibility, however, is that technological advances in synthetic fibers, rayon, nylon, Vinyon, and other materials will progressively displace cotton in textile manufacture. Moreover, this trend is likely to go a considerable distance before a new equilibrium between the different fibers is reached. Now, so long as staple rayon took the place of cotton in the processing plants of the cotton textile industry, cotton mill operators had no cause for real alarm except insofar as the development of new spinning and weaving machinery, adapted primarily to rayon utilization, meant more rapid obsolescence of the existing plant and earlier expenditures on new machinery. Rayon filament, of course, does not need to be spun, and its use thus short-circuits the spinning process essential in cotton manufacture, although weaving is still necessary.

Declining Rayon Prices

One of the most remarkable occurrences in the history of rayon development has been the rapid price reduction. In 1920, 150-denier filament yarn was at its all-time peak of $6.00 a pound. The price fell to $2.80 in 1922, to $1.25 in 1929, to 60 cents in 1932, and to 55 cents in 1934. It fluctuated around the last figure until November 1941 when 55 cents was made the ceiling price. Viscose staple fiber, which was 60 cents a pound as late as 1931, is now only 25 cents a pound. Because much less waste is involved, rayon staple fiber is cheaper than cotton at present prices. Staple fiber is less costly to manufacture than is continuous filament yarn, because it can be manufactured in larger units and because it involves less cost for inspection and packaging.

Though with many textile applications price is not the determining factor in the selection of the fiber to be used, quite clearly declining rayon prices, coincident with rising cotton prices, have contributed in recent years to the increased use of rayon. Furthermore, much progress has been made in improving the uniformity of its tensile strength, diameter, and denier. The tensile strength has been greatly increased, and although, generally speaking, standard grades of rayon are weaker than cotton, nylon, or the better grades of silk, their dry tensile strength is greater than that of wool. The saponified acetate rayon, however, is as strong as any other textile fiber now in commercial use, or stronger. It is still true that rayon suffers a greater loss of strength when wet than do any of the other fibers except those derived from casein and soybeans.

Different types of rayon vary greatly in elasticity, but apparently little improvement has taken place in the low elasticity of rayon as a whole. A further handicap for a long while was that rayon's glossiness was undesirable in some uses, although in others its silk-like appearance was an asset.

Recently, processes of manufacturing dull and semidull rayons have been greatly improved, thus extending the area in which rayon is competitive with other fibers. Its dyeing properties and color fastness have been improved. Moreover, rayon can now be made water repellent. Better handling techniques in manufacturing rayon fabrics have also been developed. All these factors make the use of rayon less costly and more advantageous to the textile manufacturer than it was formerly.

It seems certain that in the immediate postwar years there will be little real danger that the cotton textile industry will be by-passed on any large scale in the manufacture of fabrics from synthetic materials. In the first place, cotton still supplies 67 per cent of all textile needs in the United States, and not for many years, if ever, will the bulk of this market be lost by the cotton textile industry. It is well within the realm of possibility, however, that 10 years or so after the war sheet plastics will begin to make real inroads in markets now supplied by fabrics spun and woven from natural fibers, such as cotton and wool, as well as those made from regenerated cellulose fibers, such as rayon.

Sheet Plastics

Just as the possibilities of improvement in the natural fibers through research are limited by the nature of the fiber, so the possibilities of improvement in regenerated cellulose fibers are limited by the chemical nature of cellulose. Only within the realm of completely new synthetic materials, of which nylon, Vinyon, and sheet plastics are merely the first examples, is the textile chemist almost entirely free to build a material that will fit the particular end use in mind. Already sheet plastics are competing with woven textiles in the manufacture of such products as raincoats and shower curtains, and it is at least reasonable to assume that research will widen their field of usefulness rather rapidly in the coming years.

Spinning, knitting, and weaving processes are age old, and the latest spindle, loom, and knitting machines merely represent modifications in these processes and the application of mechanical power to them. Many persons argue that the production of sheet textiles will never be a serious threat to the cotton textile industry for health requires air vents in fabrics and that such vents can be economically secured only by spinning, knitting, and weaving. The argument loses a good deal of its cogency with the realization that air vents are hardly necessary in some industrial and household fabrics and that, furthermore, the solving of this problem economically for clothing fabrics would not appear to be nearly so difficult as many of the solutions achieved in a short time under the spur of wartime necessity.

In the cotton textile industry, capacity is commonly measured by the number of spindles in place. On July 1, 1944, there were 26 million spindles in the cotton mills of the United States. Of this number, 74 per cent were in the six Southeastern states of Alabama, Georgia, North Carolina, South Carolina, Tennessee, and Virginia. Sixty-one per cent of all spindles in place in American cotton mills are located in the three states of North Carolina, South Carolina, and Georgia, chiefly in their western areas. The cotton textile industry is the largest employer of industrial labor in those states during peacetime.

Developments that would tend to make obsolete a large part of the spinning and weaving capacity of Southern cotton textile mills would also intensify the problem of providing employment for displaced war workers and returning servicemen in the area. In Alabama, Georgia, North Carolina, South Carolina, Tennessee, and Virginia, 1,046,200 persons were employed in manufacturing establishments in 1939. Of these, one third were engaged in the spinning of cotton yarn and the weaving of cotton cloth. In that same year 30,900 persons were employed in the manufacture of rayon broadwoven goods and 1,500 in the manufacture of rayon yarn and thread. In Virginia and Tennessee during 1939 plants engaged in the manufacture of rayon itself employed 23,200 persons, more than were engaged in spinning and weaving cotton in those two states.

Cotton Textile Costs

Unit labor costs in Southern cotton mills have probably risen as much as 50 per cent during the war. Obviously, the more costly the production of fabrics by established methods becomes, the greater is the incentive for manufacturers of clothing and producers of household goods to turn to the use of sheet plastics, which short-circuit the spinning and weaving processes. The design of more efficient spinning and weaving machinery would tend to retard a trend toward the use of sheet plastic instead of spun and woven fabrics. The cotton textile industry, as well as some manufacturers of rayon filament and staple, is now designing better machinery, which will probably reduce unit labor costs appreciably.

A large cost item in many mills is materials handling. The installation of mechanical handling devices, conveyor belts, and similar equipment will be carried forward in many of the larger mills in an attempt to cut production costs. But the possibilities of cost reduction in the cotton textile industry by these methods are limited because, for example, a conveyor system reaches its top efficiency only when it is installed at the time the plant is built. Proper plant design now gives greater attention to materials flow, but for mills built some years ago the possibilities of cost saving through the mechanization of materials handling are definitely limited.

Since the cost of cotton to the mill can be reduced by improvements in marketing practices, attention is being given to this problem. The elimination of excessive marketing costs, however, will always be simpler with synthetics because they are manufactured by a few large companies whereas cotton is produced by thousands of individual growers.

A great deal of effort is currently being expended in attempts to improve the quality of cotton textiles, and this effort will no doubt serve to retard the advance of the synthetic fibers relative to cotton. That the advance can be halted entirely, however, seems quite unlikely. The Department of Agriculture's ginning laboratory at Stoneville, Mississippi, is carrying forward a series of experiments directed toward improving the handling of cotton. At Stoneville attempts are being made to develop machinery to remove the dirt picked up by the mechanical harvesters. Work is also being carried forward on methods of removing the seed with less damage to the lint. Better baling developments include new ginning processes in which the cotton is compressed to 22 pounds per cubic foot without the necessity of sending the ginned cotton to special compressing centers.

This list of technical and mechanical improvements in cotton is by no means exhaustive. Many agencies are giving a great deal of thought to the problem of making further improvements, but the fact remains that the characteristics of a natural fiber will always be limited by the nature of the fiber,

Sixth District Statistics

DEPARTMENT STORE SALES AND STOCKS

Place	SALES			INVENTORIES		
	No. of Stores Reporting	Per Cent Change Mar. 1945 from		No. of Stores Reporting	Per Cent Change Mar. 1945 from	
		Feb. 1945	Mar. 1944		Feb. 1945	Mar. 1944
ALABAMA						
Birmingham	5	+ 29	+ 17	4	+ 2	— 2
Mobile	4	+ 31	+ 10	..	....	.....
Montgomery	4	+ 42	+ 38	3	+ 1	— 2
FLORIDA						
Jacksonville	4	+ 36	+ 32	..	....	.....
Miami	3	+ 16	+ 11	..	....	.....
Tampa	5	+ 30	+ 19	..	....	.....
GEORGIA						
Atlanta	6	+ 29	+ 33	5	+ 9	+ 13
Augusta	3	+ 49	+ 60	..	....	.....
Macon**	3	+ 95	+ 62	3	+ 7	— 9
LOUISIANA						
Baton Rouge	3	+ 30	+ 33	..	....	.....
New Orleans	4	+ 36	+ 23	3	— 5	— 27
MISSISSIPPI						
Jackson	4	+ 35	+ 27	..	....	.....
TENNESSEE						
Chattanooga	3	+ 42	+ 31	..	....	.....
Knoxville	3	+ 30	+ 31	..	....	.....
Nashville	6	+ 42	+ 28	4	— 2	— 3
OTHER CITIES*	24	+ 35	+ 27	24	+ 4	— 1
DISTRICT	85	+ 33	+ 27	46	+ 3	— 2

*When less than 3 stores report in a given city, the sales are grouped together under "other cities."
**One firm included last three days of February in March sales report.

DEBITS TO INDIVIDUAL BANK ACCOUNTS
(In Thousands of Dollars)

Place	No. of Banks Reporting	Mar. 1945	Feb. 1945	Mar. 1944	Per Cent Change Mar. 1945 from	
					Feb. 1945	Mar. 1944
ALABAMA						
Anniston	3	19,891	16,704	18,466	+ 19	+ 8
Birmingham	3	204,624	185,165	192,664	+ 11	+ 6
Dothan	2	8,010	7,320	7,260	+ 9	+ 10
Gadsden	3	11,010	10,730	10,104	+ 3	+ 9
Mobile	4	124,035	108,285	113,118	+ 15	+ 10
Montgomery	3	40,280	35,892	37,408	+ 12	+ 8
FLORIDA						
Jacksonville	3	191,739	170,664	174,300	+ 12	+ 10
Miami	6	159,908	129,662	148,905	+ 23	+ 7
Greater Miami*	10	219,872	176,340	199,450	+ 25	+ 10
Orlando	2	39,562	29,453	31,005	+ 34	+ 28
Pensacola	3	25,580	24,893	25,026	+ 3	+ 2
St. Petersburg	3	32,394	28,185	26,900	+ 15	+ 20
Tampa	3	89,846	79,659	83,166	+ 13	+ 8
GEORGIA						
Albany	2	10,041	8,729	9,568	+ 15	+ 5
Atlanta	4	514,895	448,263	471,140	+ 15	+ 9
Augusta	3	40,231	29,461	37,583	+ 37	+ 7
Brunswick	2	15,366	13,931	13,262	+ 10	+ 16
Columbus	4	36,242	37,495	33,174	— 3	+ 9
Elberton	2	2,040	1,802	1,855	+ 13	+ 10
Macon	3	44,010	36,764	39,542	+ 20	+ 11
Newnan	2	5,759	3,666	4,799	+ 57	+ 20
Savannah	4	87,330	74,221	81,410	+ 18	+ 7
Valdosta	2	7,097	5,918	5,571	+ 20	+ 27
LOUISIANA						
Baton Rouge	3	42,926	46,649	39,580	— 8	+ 8
Lake Charles	3	17,547	15,274	24,263	+ 15	— 28
New Orleans	7	446,086	397,138	433,753	+ 12	+ 3
MISSISSIPPI						
Hattiesburg	2	13,136	11,991	12,900	+ 10	+ 2
Jackson	4	70,873	56,792	57,571	+ 25	+ 23
Meridian	3	18,472	15,598	15,643	+ 18	+ 18
Vicksburg	2	18,807	16,966r	20,523	+ 11	— 8
TENNESSEE						
Chattanooga	4	91,274	78,168	83,556	+ 17	+ 9
Knoxville	4	135,291	121,854	100,000	+ 11	+ 35
Nashville	6	177,771	162,128	168,027	+ 10	+ 6
SIXTH DISTRICT 32 Cities	114	2,742,073	2,409,420r	2,522,042	+ 14	+ 9
UNITED STATES 334 Cities		81,068,000	70,250,000	76,090,000	+ 15	+ 7

*Not included in Sixth District total
r = Revised

whereas synthetics can be given virtually any characteristic desired.

Though cotton still has certain advantages over the synthetic fibers, in spinnability and strength-retaining absorptivity for instance, these advantages will probably be met in large part by technical research in the synthetics industry. Synthetics, on the other hand, have the advantage of dependability of supply, uniformity of production, and stability of price that can probably never be met by any natural fiber whose production is conditioned by vagaries of the weather and other natural hazards.

At the present time, the American synthetics industry, including producers of nylon and Vinyon, consists of 16 companies that operate 29 plants. Of these, 21 plants manufacture rayon by the viscose process, 6 plants manufacture it by the acetate process, and 2 plants use the cuprammonium process. Of the 29 plants, 7 are located in Virginia, 4 in Tennessee, 1 in North Carolina, and 1 in Georgia.

To be sure, a partial offset to the potential loss in cotton textile employment in the South is the increasing employment in plants manufacturing rayon and other synthetic fibers and the continued employment in those cotton mills now spinning and weaving synthetics. Compared with the cotton textile industry, rayon is a high-wage industry because of its higher skilled labor requirements. In December 1944, the latest month for which such figures are available, average hourly earnings in plants manufacturing rayon and allied products were 92 cents whereas average hourly earnings in cotton textile manufactures, except smallwares, were 65 cents. During the same month there were 54,200 persons employed in manufacturing rayon and allied products in the United States and 433,700 wage earners in cotton manufacturing, smallwares excepted.

Rayon Production Capacity

At the present time the projected capacity of the rayon industry is 810 million pounds annually. More than one fourth of this, 240 million pounds, is tire yarn capacity. The outlook for rayon tire cord is not entirely clear. Authoritative sources have estimated that the amount of rayon tire-yarn capacity in operation after the war will be from 160 million to 200 million pounds. That there are less than a half dozen large tire companies and that they are extremely price conscious, plus the fact that some of these rubber companies own cotton tire-cord plants, cast some doubt on the future of rayon tire-cord production.

Perhaps the over-all conclusion to be drawn from an analysis of the present and potential threat to the cotton industry from synthetics is simply that change, rapid and in some respects unpredictable, will be the order of the day. It follows from this conclusion that alert, forward-looking management will be more essential in the cotton textile industry than ever before. Postwar years will be years of great opportunity for those firms in the industry best able to gauge accurately the type of product that will most readily satisfy consumers' desires and at the same time lend itself to profitable manufacture within the existing competitive structure. Many cotton textile firms failed during the years when routinized operations were possible in the industry. A routinized approach to textile manufacturing from here on out will be almost certainly suicidal for the firms practicing it. Depreciation policy, machinery replacement policy, integration possibilities, and inventory policy—all must be carefully examined in the light of the changing situation.

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