

Rayon Staple Fiber and Manufacture of Spun Rayon Yarns

By D. L. PELLATT, BOLTON, ENG.

(All rights reserved by the author)

The material which is variously termed rayon staple fiber, rayon fiber, or staple rayon, consists of synthetic fibers formed by one of the well known commercial processes by which rayon is produced. Instead of being in the form of continuous filaments, as in the case of rayon yarns, staple fiber consists of filaments of staple

length equivalent to cotton, wool, or linen, in which condition it forms a raw material from which a thread is formed by twisting together the filaments in the usual manner employed in those industries.

Requirements for Clothing and Furnishing Rayon Fabrics

The position occupied by staple fiber and the subsequent spun rayon yarns and cloths, as compared with continuous filament rayon and the older textiles, requires consideration.

Rayon fabrics, generally, possess the merits of pleasing appearance combined with relatively low cost. As such, they are attractive for certain clothing purposes and especially for furnishing fabrics. In the latter instance they possess the added advantage of not easily holding dirt, on account of their smooth surface. By reason of this fact, curtains, as an instance, made from rayon will remain clean for a longer period than a similar material produced from cotton.

The utility of rayon for all classes of furnishing fabrics is, therefore, pronounced, and this field is likely to be supplied in increasing degree by rayon. The high luster of rayon is also of great importance for furnishing fabrics, permitting as it does the production of bright and striking effects with a high light reflection value.

For clothing purposes the advantage of high luster is much less marked, and may in fact be absent. This is exemplified by the considerable attention which has been directed to the production of dull or reduced luster yarns.

The effects produced by spinning staple fiber into spun rayon possess a much reduced luster of a pleasant silky appearance. By far, however, the greatest influence lies in the question of warmth which, after all, is the essential requisite of materials for clothing purposes. The older textiles, particularly cotton and wool, depend almost entirely for their warmth or heat insulation properties upon their capability of entrapping air within the fabric. This fea-

ture is notably reduced in rayon fabrics, although in other respects, including the transmission of ultra violet rays, they are in every way healthful.

The attempt to combine the pleasing "feel" or "handle" of rayon and its attractive appearance with the warmth of the older textiles is, therefore, appreciable and natural. This has, in fact, taken place by producing rayon in continuous filaments, cutting these to desired length, and subsequently spinning into thread in a manner similar to that of cotton or wool. In so doing, a new textile has emerged from which may be produced garments possessing many of the advantages of rayon, together with the warmth associated with the older textiles.

Processes by Which Staple Fiber May Be Produced

Rayon staple fiber may be produced in a similar general way to rayon yarns, after which the material is guillotined to suitable staple length. Alternatively it may be produced in staple lengths which do not require guillotining.

The methods of production are described later in detail, but it may be mentioned that patents have been taken out for the production of yarn of staple length, of which British Patent No. 308645, and German Patents Nos. 400931 and 401988 are typical.

The processes by which staple fiber may be produced are as indicated by the nitro-cellulose, cellulose-acetate, cuprammonium, and viscose processes. Very small quantities are available by the nitro-cellulose process, however, and this is consequently hardly of commercial importance. By far the greater proportion of staple fiber is produced by the viscose process, chiefly on account of the lower cost of production afforded by this process as compared with the acetate and cuprammonium processes. A further reason for this lies in the fact that whereas both acetate and cuprammonium yarns possess advantages which are not present in viscose yarns, these are less apparent

when the staple fiber is spun into a thread on the lines of cotton or wool.

Both acetate and cuprammonium continuous filament yarns, generally speaking, are employed for the finest deniers, while acetate yarns have the added advantage of dyeing reactions quite different from the other forms of rayon.

For staple fiber the viscose process may be used to produce low filament deniers equal to those of the finest grades of cotton, for which the plant available for the later processing of staple fiber is designed. Further, a large proportion of staple fiber is used, mixed with a proportion of cotton or wool as the case may be, wherein the cross-dyeing effects possible with acetate yarns are definitely lost.

From this it will be seen that the tendency to produce staple fiber by the viscose process is likely to increase rather than to decrease.

Raw Materials—Cellulose

Viscose rayon, in common with the other commercial processes by which rayon is produced, uses as its raw material cellulose; the final yarn consisting also of cellulose.

As the composition of cotton is similar—cotton being the purest form of cellulose existing in nature—there is a definite link between cotton and rayon, so far as composition is concerned. This fact is of importance in considering the relations of the various textiles. Cellulose, in greater or lesser purity, exists throughout organic vegetable life, and it is, therefore, theoretically possible to produce rayon from any form of plant growth.

Cotton, which as already stated forms the purest source of supply, is relatively expensive, and its use is consequently restricted. Only those processes of rayon manufacture where cellulose in a form as little degraded as possible is imperative make extended use of cotton as a raw material. This is not generally the case in the viscose process, and consequently the use of cotton in the form of linters pulp sheets is only found to a limited extent. It may be as-

sumed that for staple fiber the use of cotton as a source of cellulose is unnecessary and unusual. The source of cellulose usually employed is wood pulp.

Before the rise of the rayon industry, the production of wood cellulose for paper manufacture was already developed. As was only natural, therefore, the growing rayon industry made use of the source of cellulose ready at hand and available in a suitable form of high purity and uniformity and in ample quality.

Much has been said regarding the use of various alternative sources of cellulose, such as esparto grass, pineapple fiber, waste sugar cane fiber, etc., and some limited use has been made of some of these.

The rayon industry will always be able to demand the best and most regular form of cellulose, and consequently it would appear that any alternative must first become commercialized as a paper pulp before it can command a market in the rayon industry. The influence of these factors is of great importance in respect of staple fiber because it would appear that we are now at the very commencement of developments of far reaching importance.

Importance of Uniformity

The advance of civilization has always been marked by the replacement of uncertain methods by those of greater dependability, and the development of textiles of a synthetic character is natural.

The period of growth of wood ensures an average rate of growth of exact regularity, in addition to which the possible ultimate sources of cellulose from tropical and sub-tropical growths are unlimited.

It does not seem merely fanciful, therefore, to suggest that in a true appreciation of staple fiber rayon, these factors must be taken into account. They would appear to suggest that, as already stated, we are at the beginning of a development which may result in the use of continuous filament rayon for furnishing fabrics, and in the use of staple fiber rayon for clothing fabrics. This development must, of course, be ac-

accompanied by the very gradual displacement of the older textiles though for a very long time to come their development is likely to be interdependent.

Development of Staple Fiber Along the Lines of Older Textiles

As the growing rayon industry made use of the existing wood cellulose industry, so is staple fiber being used in conjunction with the cotton and wool industries. These industries are highly organized and developed, and machinery is available which has resulted from the experiments and researches of generations. It is only natural, therefore, that in its present development, staple fiber should be produced and spun of staple length which is equivalent to that of either cotton or wool.

It is far too early to say whether this represents a permanent development or whether ultimately a new technique will be developed to meet the needs of the new textile.

At the present time cotton spinning machinery, with certain minor alterations, seems most suitable for the production of spun rayon yarns, and apparently developments are most likely to follow the lines of cotton spinning equipment.

To summarize the position, therefore, as it exists at present, staple fiber rayon consists of rayon produced or cut to suitable staple length, which then forms a raw material analogous to cotton or wool and which may be processed in similar manner to these textiles. We may, therefore, be seeing the early development of a universal class of raw material for textile fabrics. We are certainly seeing in staple fiber rayon the development of what is essentially a new textile.

EDITOR'S NOTE: American mills have lagged behind European manufacturers in the utilization of rayon staple fiber. Possibly this has been due in part to the lack of information on this material and methods of processing it. Mr. Pellatt is preparing a series of five articles discussing the field for staple rayon, its properties and production, and the processes of yarn manufacturing. Through this series American manufacturers will be made more familiar with what is essentially a new textile raw material. This first article is in the nature of an introduction to rayon staple fiber and its field. Later articles will take up fiber production and yarn manufacturing.