

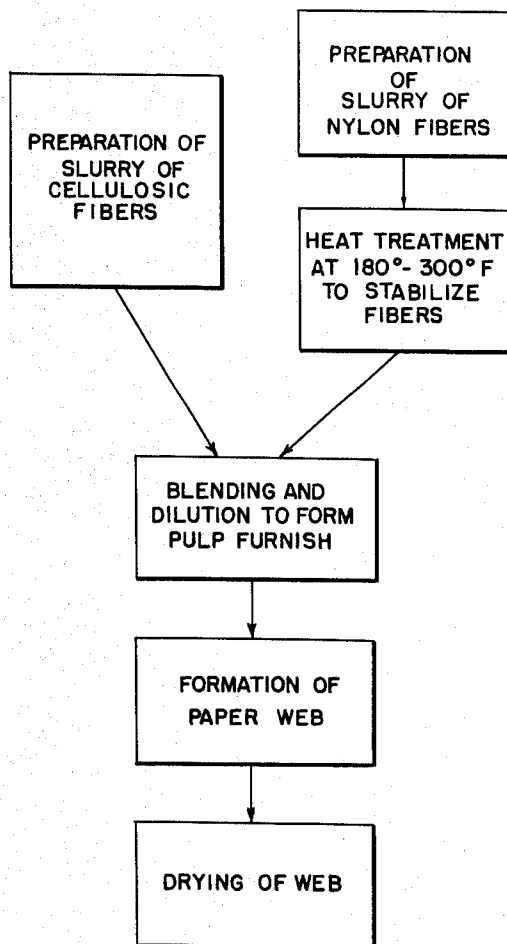
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PROCESS FOR MANUFACTURING PAPER FROM SYNTHETIC FIBERS

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1

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PROCESS FOR MANUFACTURING PAPER FROM SYNTHETIC FIBERS

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The present application is a continuation-in-part of our copending application Serial No. 770,010, filed October 28, 1958, which, in turn, was a continuation-in-part of our then copending application Serial Number 601,375, filed August 1, 1956. Both of said applications are now abandoned.

This invention relates to the manufacture of paper from synthetic fibers and, more particularly, to the manufacture of synthetic fiber paper on a paper making machine, where the synthetic fiber is subject to shrinkage in the presence of heat. The invention is particularly suited to the manufacture of nylon, Vinyon and Orlon papers, for example, but we shall discuss it principally, hereinafter, as applied to the manufacture of nylon paper.

During the development of paper possessing increased physical endurance and resistance to degradation, some attention has been directed towards the feasibility of manufacturing paper from the newer synthetic fibers in an attempt to impart the unique functional properties of these fibers to paper. Paper manufactured from nylon, for example, thus should be expected to possess the very features, such as fold and flex endurance, abrasion resistance, electrical properties and resistance to chemicals and microorganisms, which characterize the nylon fiber.

Although nylon and other synthetic fibers have been incorporated into several laboratory handsheets, the manufacture of such papers on paper making machinery has created a number of difficulties. Inasmuch as standard paper making machinery is designed for use with cellulosic pulp, these difficulties may be ascribed to the chemical and physical nature of fiber.

Several of these difficulties occur in the preparation of a pulp furnish. Due to the hydrophobic nature of the synthetic fiber, the formation of an aqueous slurry of such fibers requires either copious quantities of water or the use of a dispersing agent. Beating of nylon fibers, for example, is ineffective in controlling the fiber length, for there is a tendency for the nylon to rope and intertwine in the rolls of the beater; continued beating for extended periods of time renders the fiber too short to be serviceable in paper making. Hence, the pulp furnish insofar as fiber length is concerned must be prepared by other methods than beating, a beater being employed as a convenient means only for wetting out the fibers.

Upon forming a wet web from a furnish of nylon fibers, for example, it was observed that the sheets had virtually no wet hang, and could not be processed through a paper making machine. Only upon the addition of a quantity of a cellulosic fiber blended into the nylon furnish was it found that sufficient wet hang could be attained. The most persistent difficulty encountered in the manufacture of nylon and like papers occurs during drying of the wet web. Even though the furnish contains a suitable quantity of cellulosic fiber to give the satisfactory minimum wet hang to the wet web, passing the damp sheet over the steam dryers persistently tears the sheet apart.

2

These various difficulties, encompassing effective control of the fiber length, preparation of a furnish capable of giving suitable wet hang to the web, and drying of the sheet without ripping or tearing the resultant paper, thus combine to present an impasse to the manufacture of paper using nylon and similar synthetic fibers, such as Vinyon and Orlon, on conventional paper making machinery.

Resolution of this impasse has been accomplished in the present invention, for we have now developed a process for the manufacture of nylon and other synthetic fiber papers on a conventional paper making machine. In an advantageous form of this process a furnish is prepared from an aqueous slurry of nylon fibers previously shrunk and dimensionally stabilized. A sufficient quantity of cellulosic fibers, advantageously highly beaten manila hemp, is blended into the aqueous slurry to give a web formed therefrom an adequate wet hang. The pulp furnish is deposited onto a continuously moving screen or cylinder of a paper making machine and formed into a wet web, the water being removed by suction, drainage and pressing if necessary. Upon leaving the couch rolls, a suitable bonding agent for nylon may advantageously be added to the damp sheet prior to passing the paper through the dryer section. Entering the dryer section, the paper is rapidly dried without substantial shrinkage, since the nylon fibers have previously undergone stress relaxation or pre-shrinkage.

The stress relaxation of nylon, Vinyon and Orlon is accompanied by shrinking, and renders the fiber dimensionally stable and impervious to further substantial changes upon the application of temperatures which are not appreciably greater than the temperature at which the fiber has been dimensionally stabilized. We have found that when the aqueous slurry of heat shrinkable fibers, such as nylon, Vinyon and Orlon, is heated to a temperature sufficiently high to effect stress relaxation of the fiber, the resultant heat-treated slurry may be used in the preparation of a furnish and processed on a paper making machine without substantial shrinkage of the wet web in the dryer section. Alternatively, the fiber may be annealed, or preshrunk, prior to the preparation of the aqueous slurry thereof, thus precluding shrinkage or slippage of the wet web in the dryer section as the nylon paper is dried.

Nylon paper, for example, produced by the process of our invention contains substantially only nylon fibers intimately interlaced and co-mingled with a small quantity of cellulosic fibers, advantageously highly beaten hemp or cotton fibers, particularly highly beaten manila hemp as previously suggested. The addition of a nylon bonding agent to the wet web gives the resultant paper increased strength and fold endurance. Although the fiber length of the nylon in the paper may be varied, we have found that an exceptionally strong sheet may be prepared from nylon fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch.

A simplified flow diagram of the process is shown in the drawing.

In accordance with the process of the invention, synthetic fiber is cut to a predetermined length. Although the preparing of an aqueous slurry of the fiber is facilitated by short fibers, we have found that a fiber length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch is particularly advantageous in forming a furnish for processing in a paper making machine. Care must be taken during the cutting of the

synthetic fibers to avoid fusing of the cut strands as the cutting knives dull and become heated, for these fused strands may not be broken apart and thus result in poor paper machine formation. Neither beating nor use of a Jordan machine is capable of separating the fused fibers resulting from over-heating of the cutting knives.

Dispersion of the cleanly cut fibers to form a uniform aqueous slurry requires copious quantities of water, due to the hydrophobic nature of synthetic fibers such as nylon. However, the addition of 2 to 4 percent, based on the weight of the total fiber content, of a guar gum, such as OPM-C Lycoid sizing, manufactured by the Stein-Hall Company, advantageously facilitates the dispersion of nylon fibers in water. In this manner, slurries containing from 3 to 4 percent by weight of nylon fibers may be readily prepared.

To preshrink the nylon or other heat-shrinkable fibers at this state, the aqueous slurry is heated to a temperature sufficiently high to dimensionally stabilize the fibers. Thus, heating the aqueous slurry to a temperature of about 250° to 300° F. causes nylon fibers to become stress relaxed. Although stress relaxation of the fiber is accompanied by shrinkage, there is no appreciable change in the tensile strength of the dimensionally stabilized fiber. After undergoing stress relaxation, the nylon fibers retain their shape at all temperatures under the temperature at which preshrinkage occurred. Alternatively, the synthetic fiber may be dimensionally stabilized prior to forming an aqueous slurry, and annealing nylon fiber, for example, soon after melt-spinning is sufficient to preshrink and dimensionally stabilize the annealed fiber. In both cases, however, the furnish deposited onto a continuously moving wire of a paper making machine must contain dimensionally stabilized synthetic fibers to avoid excessive shrinkage and tearing of the wet web in the dryer section.

Where a nylon fiber slurry is heated to 250°-300° F., prior to forming a web on conventional paper making machinery, substantially no shrinkage of the web occurs, since the temperature to which the web is subjected in the dryer section does not exceed the stabilization temperature. However, while it is usually more convenient to pre-treat or stabilize nylon fibers after forming the slurry, certain practical problems may be occasioned by the fact that a pressure vessel is required to raise the temperature of an aqueous slurry to 250° or 300° F. Accordingly, for most industrial operations the advantages of the invention are realized by heating the aqueous slurry, including nylon fibers, to a temperature of not substantially less than 180° F., and advantageously between 180° and 190° F. Such treatment can be carried out in any open pulping vessel and affords sufficient dimensional stabilization of the fibers to permit of the successful manufacture of nylon paper on conventional paper making machines. Thus, although the temperatures to which the web is subjected in the dryer section may be somewhat higher than the stabilization temperatures, the differential is not of a magnitude such as to result in excessive shrinkage of the web.

Because of its chemical and physical composition, nylon and certain other synthetic fibers will not bond similarly to cellulose, and consequently do not possess the wet hang of natural fibers. Complete absence of wet hang renders it impossible to process a 100 percent nylon sheet, for example, over a paper making machine; hence a previously prepared cellulosic fiber must be blended into the furnish to give the wet web sufficient wet hang. After extensively testing a variety of blends, we have found that a blend of 5 percent of highly beaten manila hemp and 95 percent of nylon fiber gives a most advantageous balance of properties for the manufacture of nylon paper. Other hemp fibers as well as cotton fibers may also be used in preparing the furnish, but the aforementioned nylon highly beaten manila hemp blend results in a superior wet hang. The following table illustrates the

differences in wet hang of various nylon-rope and nylon-rag blends:

TABLE I

Wet Hang of Nylon-Rope and Nylon-Rag Sheets

Percent Floc	Nylon-Hemp 1— Wet Tensile (Lbs./Inch of Width)	Nylon-Cotton 1— Wet Tensile (Lbs.)
2.....	1	0
5.....	1	0
10.....	2	3
15.....	5	5

¹ Basic weight—70 pounds per 3000 ft.²

In the preparation of the furnish, an aqueous slurry of nylon fibers is mixed and blended with the cellulosic fiber previously beaten to a false freeness, and the resultant mixture diluted to a proper consistency. We have found that a consistency of 0.5 percent by weight of the furnish will result in an easily controllable furnish which deposits readily onto the continuously moving wire of a paper making machine to form the wet web. The damp or wet sheet may advantageously be saturated as by being passed through a solution or dispersion of a bonding agent to strengthen the sheet and bond the fibers prior to drying. Many bonding agents may be applied to the damp sheet, and include phenolic resins, polyamide resins, inorganic salts (CaBr₂ and ZnBr₂, for example), latex and other compounds. A bonding agent may alternatively be applied following drying of the web and presently we believe this may give the most advantageous results. A satisfactory bonding agent for dry web saturation is a nylon resin solution such as, for example, a solution of Zytel No. 61 in alcohol e.g., a 10 percent solution in ethanol, Zytel No. 61 being a nylon resin manufactured by E. I. du Pont de Nemours and Company, it being understood, of course, that reference is made to Zytel No. 61 as manufactured on the date of filing of this application. The following table indicates the difference in tensile strength of a treated and untreated sheet, both containing varying amounts of highly beaten manila hemp as a binder:

TABLE II

Tensile Strength of Nylon Paper¹

Percent Manila Hemp	Untreated Nylon Sheet—Tensile Strength (Lbs./ Inch of Width)	Treated Nylon Sheet—Tensile Strength (Lbs./ Inch of Width)
2.....	0	22.4
5.....	1.3	22.4
10.....	2.3	13.4
15.....	2.4	13.5
25.....	4.3	11.4
35.....	4.9	13.1
50.....	6.5	16.4

¹ Steam dried.

² Treatment—saturation of 70 pound/3000 ft.² nylon sheet with a 10 percent solution of Zytel No. 61 in ethanol.

Drying of both the saturated and the untreated sheet occurs without excessive shrinkage, primarily due to the fact that the nylon fibers have previously been stress relaxed before preparation of the pulp furnish. Prior to the use of preshrunk fibers in the furnish, the wet web persistently tore apart in the dryer section due to excessive shrinkage of the fibers. In some instances, even the use of infrared dryers, specially mounted between the saturating bath couch roll and the dryer section, failed to avert this tearing when the paper was under tension. The use of preshrunk nylon, however, precludes further substantial shrinkage in the dryer section, and results in a nylon paper having exceptionally high fold endurance and tear strength.

As an alternative, however, the preshrinking of the nylon fibers may be delayed until drying of the damp nylon sheet. By using a festoon dryer, so that no tension

5

is exerted on the damp sheet, the damp sheet of nylon paper may be concurrently dried and shrunk in the festoon dryer. Since this alternative process causes the paper to undergo as high as 15 percent shrinkage in length, it is obvious that only a festoon dryer or drying tunnel may be used when preshrinkage of the nylon fibers is delayed until after the sheet has been formed.

The characteristics of the nylon paper produced by the process of the invention are summarized in the following table, in which sample A is the untreated nylon paper, while sample B has been saturated with a 10 percent solution of Zytel No. 61 in ethanol:

TABLE III
Characteristics of Nylon Paper

	Sample A	Sample B
Weight in pounds per 3,000 ft. ² -----	25.5	40.5
Gauge in inches $\times 10^{-3}$ -----	7.5	8.0
Apparent Density (Lbs./3,000 ft. one mil in thickness)-----	3.4	6.1
Porous paper porosity (Seconds to pass 100 cc. of air through 0.25 sq. in. of paper area under influence of 5 oz. cylinder in Gurley densometer)-----	0.3	0.3
Mullen in pounds/in. ² -----	7	120
Tear Strength (gm.)-----	20	200
Tensile Strength (pounds per inch of sample width):		
Lengthwise-----	2.5	26.5
Transverse-----	2.0	23.2

It should be understood that the invention is not necessarily limited to the making of papers incorporating nylon as the heat-shrinkable synthetic fiber. By way of further example, the principles of the invention are applicable equally well to the manufacture of papers in which Vinyon forms a high-percentage constituent, as the heat-shrinkable synthetic fiber. Vinyon, like nylon, shrinks when passed over the paper machine dryer, following conventional procedures. However, by first heating the Vinyon fiber to a temperature beyond its shrinkage temperature and then forming the paper web therefrom, the residual shrinkage, if any, of the treated fibers is sufficiently small to obviate the problem, otherwise encountered, of the web breakage in passage through the dryer section.

In the making of papers, in accordance with the invention, in which Vinyon fibers are a high-percentage constituent, the Vinyon fibers are subjected to annealing at a temperature of at least about 140° F., but advantageously not above about 30° F. At the lower temperature limit of about 140° F., substantial shrinkage of the Vinyon fibers will take place, such that any further shrinkage in the dryer will not be troublesome.

The foregoing is intended to be illustrative of the invention, the full scope of which is defined by the appended claims.

We claim:

1. A substantially continuous process for manufacturing paper from heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures above 180° F. and below 300° F. which comprises annealing the heat-shrinkable synthetic fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed synthetic fiber to a predetermined length, forming an aqueous slurry of the synthetic fibers, preparing a furnish from the aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, and including at least 2% by dry weight of cellulose fiber, forming a wet web from the furnish wherein the synthetic fibers become intimately interlaced, removing water from the wet web to form a damp sheet of synthetic fiber paper, and drying the synthetic fiber paper by applying heat thereto.

2. A substantially continuous process for manufacturing paper from heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures above 180° F. and below 300° F. which comprises annealing the heat-

6

shrinkable synthetic fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed synthetic fiber to a predetermined length, forming an aqueous slurry of the synthetic fibers, preparing a furnish from the aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the pulp furnish wherein the synthetic fibers become intimately interlaced, removing water from the wet web to form a damp sheet of synthetic fiber paper, saturating the damp sheet of synthetic fiber paper with a solution or dispersion of a bonding agent of a character to bond the interlaced synthetic fibers, and drying the resultant synthetic fiber paper by applying heat thereto.

3. A substantially continuous process for manufacturing synthetic fiber paper which comprises forming an aqueous slurry of heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures above 180° F. and below 300° F.; said fibers having a predetermined length, heating the aqueous slurry to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize the synthetic fibers, preparing a furnish from the heat-treated aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the pulp furnish wherein the fibers become intimately interlaced, removing water from the wet web to form a damp sheet of synthetic fiber paper, and drying the paper by applying heat thereto.

4. A substantially continuous process for manufacturing nylon paper which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a predetermined length, heating the aqueous slurry to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize the nylon fibers, preparing a pulp furnish from the heat-treated aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the pulp furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a sheet of nylon paper, saturating the sheet of nylon paper with a solution or dispersion of a bonding agent of a character to bond the interlaced nylon fibers, and drying the paper by applying heat thereto.

5. A substantially continuous process for manufacturing nylon paper which comprises annealing heat-shrinkable nylon fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed nylon fiber to a predetermined length, forming an aqueous slurry of the nylon fibers, preparing a furnish from the aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, and drying the nylon paper by applying heat thereto.

6. A substantially continuous process for manufacturing nylon paper which comprises annealing heat-shrinkable nylon fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed nylon fiber to a predetermined length, forming an aqueous slurry of the nylon fibers, preparing a furnish from the aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the furnish

wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, saturating the sheet of nylon paper with a solution or dispersion of a bonding agent of a character to bond the interlaced nylon fibers, and drying the paper by applying heat thereto.

7. A substantially continuous process for manufacturing synthetic fiber paper which comprises forming an aqueous slurry of heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures of about 180° F. to 190° F.; said fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to a temperature of about 180° F. to 190° F., thereby shrinking and dimensionally stabilizing the fibers, preparing a furnish from the heat-treated aqueous slurry, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber, forming a wet web from the furnish wherein the fibers become intimately interlaced, removing water from the wet web to form a damp sheet of synthetic paper, and drying the paper by applying heat thereto.

8. A substantially continuous process for manufacturing nylon paper which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to a temperature of about 180° to 190° F., thereby shrinking and dimensionally stabilizing the nylon fibers, preparing a furnish from the heat-treated aqueous slurry by blending a sufficient quantity of highly beaten manila hemp with the aqueous slurry so that it comprises at least about 2 percent by weight of the total fiber content thereof, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a wet web from the furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, and drying the nylon paper by applying heat thereto.

9. A substantially continuous process for manufacturing nylon paper which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to a temperature of about 180° to 190° F., thereby shrinking and dimensionally stabilizing the nylon fibers, preparing a furnish from the heat-treated aqueous slurry by blending a sufficient quantity of highly beaten cellulosic fiber with the aqueous slurry so that it comprises at least about 2 percent by weight of the total fiber content thereof, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a wet web from the furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, saturating the damp sheet of nylon paper with a bonding agent to bond the interlaced nylon fibers, and drying the resultant nylon paper by applying heat thereto.

10. A substantially continuous process for manufacturing synthetic fiber paper which comprises annealing a heat-shrinkable synthetic fiber of a type which is subject to shrinkage when exposed to temperatures above 180° F. and below 300° F. by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed fiber to a length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch, forming an aqueous slurry of the fibers, preparing a furnish from the aqueous slurry by blending a sufficient quantity of highly beaten cellulosic fiber with the aqueous slurry so that the cellulosic fiber comprises at least about 2 percent by weight of the total fiber content, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a wet web from the furnish wherein the synthetic and cellulosic fibers become intimately interlaced, removing water from the wet web to form a sheet of paper, saturating the sheet of paper with a solution or dispersion of a bonding agent

for the synthetic fiber to bond the interlaced fibers, and drying the paper by applying heat thereto.

11. In a process for the manufacture of nylon paper, the method of preparing the furnish which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a predetermined length, heating the aqueous slurry to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize the nylon fibers, and blending a sufficient quantity of cellulosic fibers with the aqueous slurry to form a furnish, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber.

12. In a process for the manufacture of nylon paper, the method of preparing the furnish which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to a temperature of about 180° to 190° F., thereby shrinking and dimensionally stabilizing the nylon fibers, and blending a sufficient quantity of cellulosic fibers into the aqueous slurry so that the cellulosic fiber comprises at least 2 percent by weight of the total fiber content, the blended slurry having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof.

13. In a process for the manufacture of synthetic fiber paper, the method of preparing the furnish which comprises forming an aqueous slurry of heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures above 180° F. and below 300° F. said fibers having a length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize the synthetic fibers, and blending a sufficient quantity of cellulosic fiber into the aqueous slurry so that the cellulosic fiber comprises at least 2 percent by weight of the total fiber content, the blended slurry having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof.

14. In a process for the manufacture of synthetic fiber paper using heat-shrinkable synthetic fibers subject to shrinkage when exposed to temperatures above 180° F. and below 300° F., the method of preparing the furnish which comprises annealing the heat-shrinkable synthetic fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed fiber to a length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch, forming an aqueous slurry of the synthetic fibers, and blending a sufficient quantity of highly beaten cellulosic fibers into the aqueous slurry so that the last mentioned fibers comprise at least 2 percent by weight of the total fiber content, the blended slurry having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof.

15. In a process for the manufacture of nylon paper, the method of preparing the furnish which comprises annealing heat-shrinkable nylon fiber by heating it to a temperature of not less than 180° F. nor substantially more than 300° F. to shrink and dimensionally stabilize it, cutting the annealed fiber to a predetermined length, forming an aqueous slurry of the nylon fibers, and blending a sufficient quantity of highly beaten manila hemp with the aqueous slurry to form a furnish, said furnish having a predominant proportion of the nylon fibers in relation to the total fiber content thereof and including at least 2% by dry weight of cellulosic fiber.

16. A substantially continuous process for manufacturing nylon paper which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to about 250° to 300° F., thereby shrinking and dimensionally stabilizing the nylon fibers, preparing a furnish from the heat-treated aqueous slurry by blending a sufficient quantity of highly beaten manila hemp with the aqueous slurry so that it

comprises at least about 2 percent by weight of the total fiber content thereof, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a wet web from the furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, and drying the nylon paper by applying heat thereto.

17. A substantially continuous process for manufacturing nylon paper which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to about 250° to 300° F., thereby shrinking and dimensionally stabilizing the nylon fibers, preparing a furnish from the heat-treated aqueous slurry by blending a sufficient quantity of highly beaten cellulosic fiber with the aqueous slurry so that it comprises at least about 2 percent by weight of the total fiber content thereof, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a wet web from the furnish wherein the nylon fibers become intimately interlaced, removing water from the wet web to form a damp sheet of nylon paper, saturating the damp sheet of nylon paper with a bonding agent to bond the interlaced nylon fibers, and drying the resultant nylon paper by applying heat thereto.

18. In a process for the manufacture of nylon paper, the method of preparing the furnish which comprises forming an aqueous slurry of heat-shrinkable nylon fibers having a length of about $\frac{1}{8}$ to $\frac{3}{8}$ inch, heating the aqueous slurry to about 250° to 300° F., thereby shrinking and dimensionally stabilizing the nylon fibers, and blending a sufficient quantity of cellulosic fibers into the aqueous slurry so that the cellulosic fiber comprises at least 2 percent by weight of the total fiber content, the blended slurry having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof.

19. A substantially continuous process for the manufacture of paper using heat-shrinkable, synthetic fiber subject to shrinkage when heated to a predetermined temperature and wherein the paper is formed into a continuous web and dried continuously by the application thereto of heat at a temperature above said predetermined temperature, which comprises forming an aqueous slurry of the synthetic fibers, heating the slurry to a temperature above said predetermined temperature to effect stress relaxation and to cause at least partial shrinkage of the synthetic fibers in said slurry, preparing a furnish from the heat-treated slurry by blending a sufficient quantity of highly beaten cellulosic fiber with the slurry so that it comprises at least about 2% by dry weight of the total fiber content thereof, said furnish having a predominant proportion of the synthetic fibers in relation to the total fiber content thereof, forming a web of synthetic fiber paper, and drying the resultant sheet by applying heat thereto at a temperature above the predetermined temperature but not substantially above the temperature to which said slurry is heated.

20. The method of claim 19, in which said heat-shrinkable fiber is Orlon.

21. The method of claim 19, in which said heat-shrinkable fiber is Vinyon.

22. The method of claim 21, in which the aqueous slurry of Vinyon fibers is heated to a temperature of at least about 140° F. but not substantially above 300° F.

References Cited in the file of this patent

UNITED STATES PATENTS

2,336,797	Maxwell	Dec. 14, 1943
2,357,392	Francis	Sept. 5, 1944
2,496,665	Hermanson	Feb. 7, 1950
2,526,125	Francis	Oct. 17, 1950