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PROCESS FOR TREATMENT OF VEGETABLE FIBERS

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This invention relates to the treatment of vegetable fibers, and more particularly to those fibers which require treatment with liquors before usable for textile purposes, such as the commercial product known as Chinagrass, being the dried, gum-coated fibers of the ramie plant (*Boehmeria nivea*), although this invention is not confined or limited thereto. To those familiar with the subject, it is well known that ramie (*Boehmeria nivea*) has been grown and utilized for centuries in the Orient, particularly in China, but has a wide range of growth in other warm countries also, including the southern States of the United States.

To enable one to more fully comprehend the present invention it may be stated that ramie is a perennial shrub or plant, the stalks of which frequently reach a height of five and one-half feet, or higher. The center of the stalk is a woody cylinder containing pith. The commercial fiber grows from the roots to the tops immersed in gum outside the woody cylinder and enclosed in the outer bark of the stalk.

Dependent upon the climate, the stalks are harvested by hand or by standard or special harvesting machinery, from one to four or five times a year, by cutting the stalks above the roots. To utilize the fiber, the parts of the stalk other than the commercial fiber, must be separated therefrom. This is done by two operations, roughly divided into decorticating and washing, also called degumming, cleaning and processing. The utilization thereof is by spinning or twisting into threads, yarns, lines and cordage. Briefly, decorticating is the removal of the commercial fiber from the stalk, by hand or by machinery, and the separation therefrom of the wood, pith, leaves and bark, leaving the fiber in stalk-length, flat strips which, when oxidized and dried, resemble straw and are called Chinagrass. Washing includes the preparation of the Chinagrass for spinning. In practice, harvesting may include separation of leaves and tops. Decorticating may include the elimination of part of the gum as well as the wood, pith, tops, leaves and bark.

In actual practice, Chinagrass when received in this country has a part of the gum eliminated, but certain particles of bark, extremely difficult to separate from the tenacious gum, still adhere to the bark. Washing may start with the fiber in the stalk, and may also be prolonged, and part thereof may take place during the pre-spinning operations.

Washing generally contemplates taking the dry, flat strips of Chinagrass, releasing the fiber for the prespinning and spinning operations. Other workers frequently refer to this process significantly as "degumming" and "cleaning." The preparation of the raw fiber or Chinagrass for spinning contemplates the use of heated or unheated liquors, with or without mechanical steps. Other processes, when the object is successfully performed according to intention, produce a beautiful, lustrous, silky fiber, with each fiber separate and apart from the other fibers, with the surfaces clean, smooth, shiny and glistening, but with a texture fragile to tortion, brittle to machinery, and so hard and stiff that the fibers do not readily cling or adhere together in spinning and twisting. The fibers with processes other than this, are processed primarily for the pre-spinning operation known as "combing," whereby the fibers are put through a "comb" which segregates the fibers of suitable lengths for "long fiber" spinning machines, and separates therefrom the fibers not of suitable length, which fibers, so separated, are called "combings," "tow," "noils" and "short fiber." That the product of the comb in "long fiber" is seldom as much as twenty-five percent of the staple combed, and most frequently the fibers separated as "combings," "tow," "noils" and "short fiber" exceed seventy-five percent of the product admitted to the comb. That notwithstanding said combed long fiber from other processes is smooth and does not readily cling or adhere together in spinning, said "long fiber" of said processes other than this, is frequently spun into 100% ramie yarn, often by wetting and other aids, and frequently said "long fiber" ramie of processes other than this is mixed with other fibers to facilitate the spinning thereof. That the combings, tow, noils, and short fiber of processes other than this are usually valueless for any textile purpose and commercially impractical for textiles due to the difficulty and extreme cost of spinning thereof, even when mixed with easier spinning fibers. That in no process other than this, are the fibers cut to short lengths and spun into 100% ramie yarn.

It should be borne in mind that, as it is highly desirable, and practically essential in order to get the desired finish to the fibers, that it be treated in such a manner in the various stages as not to impart harsh treatment to the fibers. That in the preparing of the fibers for spinning and twisting, it is necessary to introduce the fibers into a kier, vat, tank, or container holding liquors, and with or without agitation. The ob-

ject of other workers appears to be the total elimination of all gums from the fibers, and to accomplish this object, the fibers are frequently subjected to super-heating in strong caustic solutions in covered kiers, in super-atmospheric pressure, or when less harsh treatment is given, to prolong treatment until the fibers are thoroughly degummed or cleaned.

The present process has for one object the treatment of ramie to enable one to obtain a resultant fiber having some gum on its exterior surface, thus preserving its natural strength, elasticity, softness, natural spinning tendencies, and other qualities, leaving it with greater tortion strength, twisting qualities, softness and elasticity than obtained by other processes, and while the fibers from this process are disposed in a mat, when the fibers in the mat from this process are separated from each other, the residue gum remains with the fibers, thereby aiding the fibers to adhere and cling together in the subsequent spinning operations, thus assuring the spinning of a 100% ramie product when the fiber is, without cutting, spun on spinning machines adapted to spinning at the same time long and short fibers, intermingled together; contributing to the spinning of a 100% ramie product when the fiber is combed and the fibers are separated into long fibers for long-fiber spinning machinery, leaving combings, tow, noils, or short fibers; which residue may readily be spun on short-fiber spinning machines, as well as contributing an easily spinnable product for mixing or blending with other fibers for mixture spinning; and contributing to a 100% ramie product for intermediate-length spinning on intermediate-length spinning machines, such as French worsted spinning machines; also, for 100% ramie in short fiber yarns, threads, lines and cordage, and 100% ramie in intermingled long and short fiber ramie lines and cordage.

A further object is to produce 100% pure ramie short fiber thread or yarns, lines and cordage, free from other fibers, as desired.

A further object is to produce a mat of processed fibers which may be economically utilized thereafter in the spinning of thread or yarn, or in the making of lines or cordage, without appreciable waste.

A further object is to treat ramie fibers by a washing process that will leave sufficient natural gum with the fibers to insure spinning operations.

A further object is to produce ramie fibers sufficiently free from gums, minerals and bark, and having a desirable outer surface of a character adapted to subsequent spinning.

A further object is to provide a simple and practical process which may be inexpensively practiced.

Other objects will be in part obvious and, in part, hereafter pointed out. The invention accordingly consists of the several steps and the relation and order of one or more of such steps with reference to each of the others thereof, as will be exemplified in the hereafter disclosed process, the scope of the application of which will be indicated in the claims that follow.

As heretofore stated, the commercial Chinagrass or decorticated ramie fiber contains more or less particles of bark adhering to the gums. The sufficient elimination of this bark by such a method as will not injure the fiber, is essential. The bark has separate non-commercial fibers, held together by cementing matter and impregnated with tannic acid which must be removed. The ordinary washings, alkalis in the quantities used, together with the agitation and rinsing, get rid of part thereof. To get rid of sufficient of the bark, in this process a separate bath, directly after the first alkaline bath, is found effective, not instantly, but by the time of the last rinse, when the bark and its fibers are sufficiently removed. For example the ammonia used, being a strong alkali, begins to act on the tannic acid at once, and the additional alkaline bath and bleach are sufficient to neutralize the tannic acid. The bark fibers are too small and light to affect the commercial fiber, and are subsequently rinsed off and sufficiently eliminated in subsequent machine operations.

The fiber produced by this process is soft, and naturally spinnable, without a pronounced artificial curl imparted thereto. It is desirable to produce a decided artificial curl when certain counts of wool-like yarn are desired, and when certain other fibers are mixed with this ramie and spun together. The curl is induced by the shrinking of the fiber, which can be done by a strong solution of caustic soda. The treatment of the fiber by weak solutions renders immaterial the nature of the container in which the process is performed—whether wood, iron or other material. It is also unnecessary that the container be covered. Heat may be applied from the outside or internally, by way of a steam pipe or coil. Agitation may be applied by a mechanical paddling, tumbling, arms or plunger working automatically, by live steam, through a perforated steam pipe or coil, by compressed air, through a pipe or coil, or may be effected by hand.

In this process, fiber alone may be processed, or the stalks, either whole or cut to length, containing the fiber, may be processed and the separation of the wood, bark and pith from the fiber accomplished at later periods of the processing. Also, the fiber may be processed full length or cut to length at the outset or at any time during the process, or at the end thereof.

Ramie fiber, as is well known, differs in many respects, not only as to lengths and fineness of the fibers, but in gum content. Thus, there are established grades of Chinagrass, to-wit; Poochi, Wuchand, Yuenkiang, and others. There are differences due to the point of origin, and in the seasonable crops. Hence, other workers have had great difficulties on this account. It is my experience that the formula herein presented may be worked without difficulty on all grades of Chinagrass, imported or domestic, as the differences are not so great that this process will not be effective.

An exception, however, exists in freshly harvested and freshly decorticated ramie, when put in the process within a short time after harvesting. It is a temptation in decorticating to remove a great deal of gum by instantly washing such fiber in water, removing much of the gums by that method. When, however, the fiber is freshly decorticated and the gums are not washed off by water, the proportions of chemicals may be reduced from forty to sixty percent, dependent upon the wet or dry condition of the gums. Where the fibers have been washed in water directly after decorticating, the reduction of the chemical proportions must be greater.

The following formula, therefore, is for commercial dried fiber or Chinagrass. The proportions and ingredients used in the following steps have been tried repeatedly and give satisfactory results. But obviously, variations in amounts

may be practiced within reasonable limits and chemical equivalents substituted, and accordingly, I do not wish to be limited to the exact amounts stated or to the chemicals used.

As heretofore stated, the process is not required to be performed in any particular kind of kier, tank, vat or container, but may be performed in any conveniently disposed container. The heating is not required to conform to any set plan, but any adaptable method is effective. The agitation is not required to be one method alone, but may be one of the several heretofore specified. The fiber may be introduced directly into the container or may be introduced in a removable cage. Or, said process may be performed on a continuous belt or conveyor plan in which the fibers are either introduced by said conveyor into tanks or vats of liquors, or whereby said liquors are forced into or onto the fibers by sprays, and in which the fibers may be appropriately beaten or spread by hand or appropriate machine, with or without the removal from the continuous belt or conveyor.

Preferably, to process twenty five pounds of dry ramie fiber, I utilize a metal tank of oblong formation, holding about 130 gallons. The liquor heating element is steam, introduced through the side of the tank, and coiled on the bottom or sides thereof, with the exhaust outside. The liquor heating steam unit should be able to maintain a minimum of sixty pounds, and a maximum of one hundred pounds, of steam at all times. The agitating means is preferably a coil of perforated pipe on the bottom of the tank, through which compressed air is introduced, as and when required. For efficient surface drainage, a controlled opening is placed in the tank at sufficient height to drain the surface scums, and a bottom-controlled drain is provided of sufficient size to drain the tank with reasonable speed. Water is introduced at the bottom of the tank, also at the top with perforated pipes, to aid in rinsing. A removable cage, so constructed as to hold the fiber from close contact with the steam pipes, and suitably perforated bottom and sides. All this is well known equipment and needs no detail illustration or description.

Let us consider, for illustration, a small batch is to be treated, that is, approximately 25 lbs. of dry, raw ramie, or commercial Chinagrass. This is either cut to length or treated full length. It may be cut at the outset or at any time during the process thereafter, or after the process is performed. It may be placed in a removable cage, and the cage lowered into the tank, filled with clear, fresh water to approximately 120 gallons. The water is heated to approximately the boiling point, or for a period of one hour.

Then, an acid solution is added, to-wit: 6 oz. dissolved citric acid, 4 oz. acetone and 4 oz. castor oil. The acetone acts as a solvent of the hardened gums and permits a more effective action of the acid upon the minerals and ash, as heretofore described. Without the early introduction and use thereafter of castor oil, the chemicals have a tendency to attack the gums too vigorously, but the oil forms a coating or slime, protecting the coating of the fiber and softening the intercementing gums. After fifteen minutes, the action of the acid may be checked by the introduction of any well known alkali such as 1 lb. of sodium of bicarbonate, but as the formula requires immediate and thorough rinsing, the application of the soda may be safely omitted.

It is obvious that other acids, either extremely diluted mineral acids, or weak organic acids, such as succinic, tartaric, etc., acids, may be used in the place of citric acid. It is also obvious that other well-known organic solvents may be used instead of acetone, i. e., ethyl acetate, butyl acetate, etc. Likewise, Turkey red oil, olive oil, and other vegetable oils, such as corn oil, cotton seed oil, etc., may be substituted for the castor oil.

After the fiber and the container are thoroughly rinsed from the former operation, 120 gallons of clear water is again placed in the container, to which is added 2 lb. of caustic soda, 1 lb. of borax, 1½ lb. of tri-sodium phosphate, 25 oz. good hard soap, preferably Lux soap flakes, and 6 oz. unboiled linseed oil. After emulsification and heating to nearly boiling point, more or less, the fiber is put in the liquor and the heat continued for one hour with the fiber under agitation.

Caustic soda is a detergent, effective on ramie gums, frequently used by other workers in a strong solution, virtually completing the degumming operation in one bath. I do not avoid this valuable product, but have found that its quick action, when strongly used, exposes the fiber from its film of gum, thereafter rendering it hard and brittle. Hence I use it sparingly. The same thing is true of tri-sodium phosphate, which has likewise been strongly employed by other workers, also early destroying the gummy film on the fiber with like results. When using these strong detergents, even in limited quantities, I likewise may use unboiled linseed oil as a stronger agent than castor oil in preserving the gummy film. Borax is a water softener and purifier, and causes more effective action of the soap here used for the cleaning purposes.

It is obvious that in the place of caustic soda, caustic potash may be used, and even sal soda in quantities proportionate to the strength of the caustic, and that in the soap part of the process, commercial soaps, bar, flake or powder, or soft soaps, may be used also, and many special soaps. Other detergents than tri-sodium phosphate, even alum, may be used in proper proportions. Likewise, it is obvious that in the place of unboiled linseed oil, boiled linseed oil or any other oxidizing vegetable oil may be used.

After the fiber has been in the emulsion for one hour, under heat and agitation, the further action of the detergents may be checked by adding 4 oz. acetic acid or other acid in the same proportion as to strength. This is cautionary only and is not essential. Immediately after the cooking of one hour is completed, whether or not the acid be applied, the fiber should be thoroughly rinsed, and the container rinsed after eliminating the cooking liquor.

While the fiber is wet, after rinsing, it should be divided or separated by hand, and beaten or spread, preferably, however being beaten with a wooden mallet while lying on sidewise edges of several boards fastened or held together, each part of the fiber being thus successively beaten firmly until the "ropes" or coils are flattened, the fibers separated, and the "cores" are exposed for further treatment. This treatment prevents the interior of the "ropes" and coils from remaining untreated. It also effectively tends to break down the natural intercementing of the fibers in the masses beaten.

The tank, after rinsing from the last treatment, is filled with clear, fresh water to the ex-

tent of approximately 120 gallons, and heated to close to, or above, boiling point. The fiber is placed in the removable cage, and the cage is lowered into the water. There is then added to the water 32 oz. of full strength aqueous ammonia. The fiber and liquor are agitated for fifteen minutes.

Ammonia in gaseous form may be used in this process or aqueous form of less than full strength, provided approximately the same strength is imparted to the water. As heretofore described, the action of the ammonia on the bark has a tendency to hasten the dissolving of the tannic acid in the bark, and to cause the bark gradually to be removed in this and subsequent processes due to the alkaline action.

The liquor, after the fifteen minutes' cooking, may be eliminated from the tank, without rinsing either the tank or the fiber, and 120 gallons of fresh, clear water is taken therein. To this water, while the grass is in, add 40 oz. sodium silicate solution, 25 oz. soap, 16 oz. castor oil and 4 oz. caustic soda. The liquor is brought to near to, or just above, boiling point, and cooked one hour.

This bath is almost solely a soap bath. In addition to the soap which, as before, may be any kind, preferably Lux flakes, the caustic soda acts on the castor oil and forms soap in solution. After the prior alkaline bath being mostly of detergents, a washing with soap removes the unsettled gums, and with the addition in this bath of the sodium silicate solution, a mild detergent, completes the unsettling of such unnecessary gums as are only partly disintegrated by the first alkaline bath. The abundance of castor oil only in part turned into soap by the caustic soda, covers the fiber with a film or slime, protecting the gum remaining on the fiber. In the place of sodium silicate solution, tri-sodium phosphate or other detergent may be used in quantities properly proportionate as to strength of the detergent here used.

No acid to check the alkaline is here required, as the bath was mostly cleansing and ingredients mostly soaps and oils. A thorough rinsing is required both of the fiber and of the tank, and the fiber, while wet, receives a second beating process as heretofore described.

The next step may be described as a partial bleaching process. To 120 gallons of clear, fresh water in the tank, without the fiber and while at near, or slightly above, boiling point add 25 oz. soap, preferably Lux flakes, and 24 oz. caustic soda. When ready to put the cage with the fiber therein in the tank, add to the liquor 8 oz. chloride of lime, preferably Babbitt's, and 5 oz. full strength hydrochloric acid. This should be thoroughly agitated for fifteen minutes only, after which 1½ lb. sodium bisulphate should be added, and the fiber and the tank should be thoroughly rinsed.

This form of bleach is dangerous to ramie fiber, if applied to thoroughly cleaned fiber with no gum thereon, because it has a harsh effect, particularly when used in the quantities of the ordinary commercial bleach. It will be noted, however, that the bleach here used is far weaker in quantity than the ordinary commercial bleach. It will also be noted that the bleach is further neutralized by the soap and caustic introduced therein. The action of the free chlorine on the persistent cementing gums holding the fibers together is beneficial in aiding in their later separation. The bleach is also effective in changing the neutral color of the fiber to a grayish shade of white, resembling fine wool when carded or spun. The soap is beneficial in keeping the stronger liquor from entirely absorbing and destroying the gummy film on the fiber. As to the caustic, further mention may be made.

It is obvious that other soda or alkalis, such as bicarbonate of soda, may be used to neutralize the bleach instead of sodium bisulphate. It is also obvious that other bleaches may be used, such as peroxide, etc.

The sparing use of caustic soda performs an additional function without harming the fiber in the manner it is here used. Instead of hardening the fiber by use of quantities, the sparing use in addition to the other functions perceptible, shrinks the fiber, causing a curl, aiding in spinning. This curl is not pronounced, except in the carded material.

In order to provide a more pronounced curl, valuable in tightly twisted yarns and in spinning this ramie with other fibers less easily spun, a further step in the process is to soak the fiber one hour in a strong solution of 1 gallon water to 1 lb. caustic soda, then the fibers when separated are more tightly curled. After this process, care should be taken to fully rinse the fiber. This step is not essential to spin the fiber, and unless handled expertly, may destroy the gummy film and may weaken the texture of the fiber.

The bleaching step and the added curling step may be omitted. A dyeing of the fiber may take place before or after the bleaching step.

After each of the several steps above described as the second beating step, the bleaching step, the dyeing step, and the curling step, in each instance the fibers will be found to be in an intermingled matted massed condition, and it is this production of this finally dried mat or mass that is one of the main objects of this invention.

A further step in the complete process is the application of an emulsion to the fibers at some point before spinning, preferably before the carding preparatory to the making of the roving. The making of this emulsion includes two steps: the preparation of a fondant and later the preparation of the emulsion from the fondant to be applied by spraying or sprinkling on the fiber to dampen them. To prepare the fondant, take 20 lbs. of water, 4 lbs. of stearic acid and 1 lb. of caustic soda. To the 20 lbs. of water while boiling add slowly, while stirring, a little of the stearic acid at a time until thoroughly mixed and then, while stirring the hot solution very slowly, add a little caustic soda at a time, continuing the stirring until it begins to thicken. When cool, this fondant is a solid paste. At the appropriate time to apply to the fiber, prepare the emulsion by mixing thoroughly one pound of the fondant with two gallons of hot water. Spray, sprinkle or dampen the fiber with the emulsion in proportion of one pound of emulsion to three pounds of fiber. Thoroughly "work" the emulsion into the fiber and pack in a covered container so the emulsion will be absorbed by all of the fiber or as stated in another way, by each individual fiber.

There are many possible and obvious equivalents of the ingredients used, and this process is not precisely confined to the ingredients in the emulsion as stated. The application of the emulsion before or during the machining processes—preferably before carding of the fibers to form the roving—has a peculiar effect, tending to soften

the gum left on the fiber, thereby permitting the fibers the more easily to cling together and to adhere one to the other after spinning; to allow the fiber more easily to assume a parallel and spinnable position in the carding operation, to form a more even roving, and to allow the machining, possibly, without undue static electricity being formed on the fibers.

After the step thus described to the point of the formation of the soft mat of fibers, the same may be introduced to any pre-spinning machinery for the purpose of separating the fibers, preferably to the bale breaker down-stroke cleaner to open the mass, thence to the rag picker to shred the mass, and preferably after applying the emulsion as aforesaid, to introduce the fibers to the carding machine, roving machine, and spinning machine, successively.

It is obvious that heat merely hastens the effect of the chemicals in the various steps, and that greater heat would merely mean quicker results and conversely, that less heat means slower results. It is not only theoretically, but actually, possible to omit heat. In fact, in certain primitive processes no heating elements are employed. Hence, I do not confine myself to degrees of heat, but state the degree of heat only as that preferably used.

The fibers in the mat or mass as heretofore described are easily separable one from another by hand or by appropriate machinery, just as the fibers of asbestos may be separated one from the other, and it is believed that by this separation of one fiber from another a slight "fuzz" or projection is caused to exist on the outer surface, being adhesions of the residue gums and the walls of the fiber, thereby the better permitting the adherence of the fibers one to the other during the spinning operation. And it is believed the preservation of gum on the surface of the fibers greatly aids in preserving the strength, the natural spinning qualities, softness, tortion strength, elasticity, and preserves the unexposed fibers from hardness or brittleness. In other words, heretofore the treatments have been so rough and the solutions so strong that the final product was, as aforesaid, slimy, smooth and brittle; and when it was attempted to spin such fibers, there was no adherence one to the other except by the "kong fiber" process, and a decided tendency to fracture and break into short lengths during all machining processes, particularly during combing, thus preventing the spinning of any but a small percentage thereof on "long fiber" machinery, resulting in a high percentage of waste.

Ramie has a natural spinning quality of which I take advantage by my process. As shown, I wash the fibers down to a point where by reason of the chemical and mechanical action, the pectine, cutose and vasculose, generally described as "gum," which embed the fibers, are removed to the extent that the fibers may be machined, that is, picked, moistened, carded and spun, as hereindescribed. The ramie fiber embedded in its natural gums is held under tension, which may be illustrated by cleaning a single fiber from a lot of Chinagrass. When freshly cleaned and separated, the fiber held at its end by hand, it will be observed, that it will twist and keep on twisting its full length and resemble a single fiber of fine wool, because of the kinks. It will also be observed that by wetting or moistening, even a long carded and flattened fiber twists—though feebly, as compared with a freshly cleaned fiber.

By my process, slight tension is released in washing and cleaning the individual strips forming ropes, and at the end of the process the tension is further released, so the fibers are intermingled in a mass or mat, and when dried, the remaining tension is suspended, held by the gums holding the fibers one to another.

As part of my invention, the dried mass or mat is torn apart, but as the fibers and gums are dried, the gums still hold tension in the fibers, although the fibers are picked apart. This picking is done mechanically, by appropriate machinery, as herein elsewhere specified. The release of tension by picking the fibers apart is fairly offset by the intermingling of the picked fibers.

As a further and important part of my invention, I put on the fibers theretofore shredded and picked apart an emulsion as described herein, and work the emulsion into the fibers, thoroughly dampening and moistening them. Ramie fibers, dampened, always twist, but in the freshly picked fibers the released tension is greater.

I now put the picked and dampened fibers in appropriate machinery to even the volume and to parallel the fibers, preferably a combined card and roving machine. The tension released and being released causes the fibers to mingle closely and twist together into a firm card blanket, to separate in firm strips at the tapes, and to form into firm roving. The roving is slightly twisted and easily causes the tension in the fibers—staggered as to length and evened as to volume in the card—to resolve itself into a filament, and when twisted into a single filament or yarn, the tension first released in part by washing, and released in part by the successive steps, is finally released in the form of yarn by my invention.

The above outlines a process which has been successfully performed repeatedly and has produced large quantities of the threads and yarns as heretofore claimed. While the process has been described with relation to its application to ramie, it is believed that it is equally applicable to other kinds of vegetable fibers, such as bast fibers, and also hemp, and flax straw. Also, while several steps have been described in detail, a single alkali bath and treatment without acid bath to attack the minerals and ash, will treat the fibers in a way, but not to the desirable extent as would be obtained by following the above procedure.

An analysis of Chinagrass, gums and fiber, shows that the same contains lime, silica, iron and other minerals to the proportion of three to four percent, of the product by weight. This mineral acts as cementing matter, and if not attacked in the process, will cause entanglement of the fibers to such an extent as to engender breakage of the delicate parts of the pre-spinning machinery, and cause "slubs" and breaks in the yarn. In other processes this is usually attacked, if at all, by acids, after the fibers are cleaned of gum, causing deterioration of the fibers. In this process, the acid is applied while the gum is still on the fibers, preferably prior to the first alkaline bath. Said acid bath sufficiently removes said minerals and ash.

It is, therefore, a further object to eliminate in a manner not injurious to the fiber the particles of bark and the minerals which cause thickened places in the sliver and the roving, and prevent the making of yarns of finer counts.

The proportions, ingredients and steps have been found to be satisfactory. These could probably be varied. The two alkaline baths and the

bleach may be combined. They could be varied within reasonable limits and substitution made of equivalents as stated above. As those familiar with the subject well know, ramie is an extremely difficult fiber to treat and is subject to adverse change very easily, promoting breakage and waste. It is believed that this objection is the result of the cleaning processes heretofore carried out, as the finished fiber had a hard, lustrous, silk-like appearance, somewhat resembling spun glass in texture and brittleness, but of course, to a less degree. At any rate, ramie yarns and ramie cloths now on the market are weaker in tortion than the products made by this process.

The term "ramie" as herein used in the claims is to be interpreted as that type of bast fiber usually known as "ramie" but designated throughout the world by other names such, for example, as Boehmeria nivea, nivea tenacissima, rhea, Chinagrass, tchou-ma, cho-ma-mao, Karimushi, etc.

I claim as my invention:

1. The process of treating ramie, which includes the steps of subjecting ramie fiber to successive acid and alkali treatment baths to remove the major part of the gum and produce a mat or mass of intermingled and closely adhering fibers held together by the small amount of unremoved gum, substantially drying and mechanically separating the fibers and dampening the separated fibers with an emulsion approximately during the subjection of the mat to a fiber-separating action, and subsequently spinning the fibers.

2. The process of treating ramie, which includes the steps of subjecting the ramie fiber to a weak acid solution, rinsing the fibers and subjecting them to an alkali treatment including an oil for softening the fibers, rinsing and drying the fibers to form a mat, then mechanically separating the fibers while still retaining some of their natural gums, and subsequently dampening the fibers prior to the carding, rove making and spinning operation.

3. The process of treating ramie with a weak organic acid bath, rinsing said fibers and subjecting them to a weak alkali bath containing also a vegetable oil and mild detergent, rinsing and drying the fibers to form an intermingled mat of closely adhering fibers held together by the small amount of unremoved gum, and subjecting the fibers while damp to mechanical separation and spinning.

4. The process of treating ramie with a weak organic acid bath, rinsing said fibers and subjecting them to a weak alkali bath containing also a vegetable oil and a mild detergent, rinsing and drying the fibers to form an intermingled mat of closely adhering fibers held together by the small amount of unremoved gum, picking and separating the fibers, and spraying the separated fibers with an emulsion, and subsequently spinning the separated fibers.

5. The process of treating ramie fibers cut to sizes for short fiber spinning; including the steps of forming the same into a partially degummed mat; the separation of the fibers from the mat, the moistening of the fibers and carding the moist fibers into rovings and the subsequent spinning thereof.

6. The product consisting of a mass or mat of ramie fibers from which the gums have been partly dissolved to expose the fibers, but in which the fibers have on and between them, and are united by the natural gum, thereby to hold a part of the natural tension of the fibers or filaments in suspension.

7. The process of making yarn, thread, or line from ramie, which consists in dissolving the gums, thereby to control gradually the release of the natural tension in the individual filaments or fibers to expose the fibers, but leave gum on and between the fibers in a mass or mat still united by some of the natural gums; drying the mass or mat, picking the dry mass or mat part by suitable picking machine; dampening or moistening the mass or mat with an emulsion, placing the moistened and picked separated fibers in a suitable machine to control, even and parallel the volume of the fibers, to form roving, doubling and slubbing from the last product in a suitable machine, and thereafter to spin the roving in a suitable spinning machine, producing yarn or the like by successive releases of the natural tension of the partially degummed filaments.

8. The product consisting of yarn, thread or line made from dry gum-coated strips of ramie by dissolving the gums in greater part to expose the fibers, but leave the fibers united in a mass or mat with a portion of the natural gum, drying the mass or mat, separating the dry mass or mat with the natural gum thereon in a suitable picking machine into individual fibers as by a suitable picker or fiber separator, moistening the fibers with an emulsion, controlling, paralleling, staggerging and leveling the fibers in a suitable machine, dividing the mass into rove, doubling or slubbing, and spinning the same into yarn, thread or line on a suitable spinning machine.

9. The process of converting pieces of ramie into spinnable fiber and spinning the same, the pieces having been cut to the size of the spinning machine's requirements, by first dissolving the greater part of the gum therefrom to leave the fibers exposed but held together by some of the natural gums, and drying the same in the form of a mass or mat to hold the natural tension of the fibers, in part, in the fibers, thereafter separating the fibers from the mat by suitable machine, partly releasing some of the remaining tension, by thereafter moistening the picked or separated fibers with an emulsion, thus reviving and increasing the tension in the fibers, and thereafter paralleling the fibers in an even lap, and working the fibers to form doubling, roving or slubbing prior to spinning the same into yarn, thread or line.

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