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PROCESS FOR CONDITIONING PLANT FIBERS FOR SPINNING

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The present invention relates to a novel process for conditioning plant fibers, particularly for the preparation of yarns therefrom, and more particularly for a process for the partial removal and softening of the lignin and/or gums between the fibrils of natural plant bast fibers or hard fibers, preparatory to the spinning of yarns therefrom. The processes of the present invention utilize alkaline solutions of an alkaline metal hydrosulfite.

This application is a continuation-in-part of copending application Serial No. 197,485, filed November 24, 1950, for "Delignification Process," now abandoned which is incorporated herein by reference.

Various processes are known for the treatment of hard and bast fibers preparatory to spinning of yarns therefrom. It is a characteristic of plant fibers of this type that they are made up of tiny fibrils that are cemented together by natural cementitious materials, including gums, lignin, pentosans, etc. As the plant grows these materials are deposited between the fibrils and in the mature plant they serve as cements which hold the fibrils together forming the fibers of the plant. The fibers are denoted "hard fibers" or "bast fibers," depending upon the part of the plant or type of plant in which they originate. According to the present invention such plant fiber material is treated for the partial removal of cementitious material between the fibrils. It is believed that the ligneous material is more completely and readily removed than the gum-like material and that ligneous material may be completely removed, while the gums are merely partially removed and softened, the cellulose fibers being affected very little, if at all. According to this invention the treatment effects a softening and only a partial removal of the cementitious material between the fibrils, and while the cementitious material is in a softened and plastic condition, it serves to bind the fibrils together while at the same time is sufficiently plastic to permit them to slip relative to each other, thereby enabling extension of the fiber proper during drafting (drawing) and spinning. This enables the preparation of fine yarns.

Various processes for delignification are known. Frequently such processes include the use of alkaline materials, such as sodium hydroxide, sulfur-containing compounds, such as sodium bisulfite or sulfide. In addition, combinations of these reagents have been used. These various processes have left much to be desired. In general the prior art processes require high concentrations of reactants, long time periods and elevated temperatures, and as a result thereof the cellulose fibers are pulped and the cellulose itself suffers oxidative degradation. So far as is known, prior to the filing of the aforesaid application Serial No. 197,485, no one ever previously used alkali metal hydrosulfite, such as sodium hydrosulfite $Na_2S_2O_4$, for cellulose delignification processes or for the partial removal of the cementitious material (ligneous, gum or otherwise) occurring in natural plant material. There is mentioned the use of hydrosulfite as

a bleaching agent for cellulosic materials in their natural state. Typical of these bleaching processes is that disclosed in Wickham Patent No. 1,027,953 in which straw is bleached in an alkaline bath containing sodium hydrosulfite. Low concentrations and low temperature are used, and consequently the only result obtained is bleaching. No delignification takes place and the straw retains its original physical structure after the bleaching operation.

In accordance with the present invention it has been discovered that alkali metal hydrosulfites are excellent agents for the partial removal of the cementing materials (lignin, gums, etc.) between the fibrils of bast fibers and also hard fibers of plant origin, when such alkali metal hydrosulfites are used in alkaline solution at elevated temperatures. As will be seen hereinafter, it has been discovered in accordance with the present invention that low concentrations of alkali metal hydrosulfite may be used in combination with alkali at elevated temperatures to effect the rapid and efficient and partial or complete removal or softening of the cementitious matter of bast or hard fibers on a wide variety of cellulosic plant fibers.

It is an object of the present invention to provide a novel process for conditioning hard fibers or bast fibers of plant origin for wet spinning, for preparation of yarns therefrom.

It is a further object of the present invention to provide a novel process involving the use of alkaline solution of alkali metal hydrosulfite at elevated temperatures for conditioning plant fibers for spinning.

The invention is applicable to hard fibers or bast fibers of plant origin. Common among such materials there may be mentioned the bast fibers obtained from the flax plant. Flax of many varieties is known, some of it being bred and grown to partial maturity for the production of fibers, as for the making of linen, whereas other flax is bred and grown to maturity for the production of flax seed, for the oil content thereof. Heretofore large quantities of flax straw from flax seed (linseed) culture have been allowed to go to waste or used for processes of less commercial value because the fibers are hard, exceedingly tough, and resistant. Such fibers of plants of the flax family may be treated with great facility and economically according to the present invention. Other plant fiber material which may be mentioned as exemplary include ramie, Manila hemp, American hemp, jute, yucca or the like.

In general the process for the complete removal of the ligneous component and the partial or complete removal of gum-like cementitious material in the hard or bast fibers of vegetable origin proceeds similarly in all of these materials, but the reaction conditions vary somewhat according to the particular material being treated, the conditions under which it was cultured, the weather conditions under which the plant was grown, the age and type of plant and many other factors. Extremely low concentrations of hydrosulfite have been found to be effective, as will be shown more fully hereinafter. For example, a solution containing 0.1% by weight of sodium hydrosulfite and 0.5% by weight of sodium hydroxide is effective for a sufficient delignification and softening of the cementitious materials of flax for spinning of yarns, where the flax was the dried flax straw left over from the culture of flax for linseed and where such flax straw was preliminarily broken and combed mechanically for the partial removal of shives. Higher concentrations may also be used, such as for example 5% to 10%, and there does not appear to be any upper limit of the concentration of hydrosulfite. It is preferable to employ the lowest concentration which will effect the removal and softening of the ligneous or gum materials sufficiently to permit

the particular fiber being treated to be drafted and spun. Thus the alkali hydrosulfite concentration is 0.1% or more by weight of the solution with 10% by weight of the solution as the upper commercial limit.

The alkali metal hydrosulfite, such as potassium or sodium hydrosulfite, is used along with an alkali such as the sodium hydroxide. As the alkali there may also be used the alkali phosphates and the alkali carbonates. Thus, sodium or potassium hydroxide may be employed, or the corresponding phosphates or carbonates. Sodium hydroxide is preferred because it is relatively economical and efficient. In general, it is not desirable to employ alkali solutions less concentrated than 0.5% by weight. Alkali solutions up to 10% or even more may be employed, but preferably the alkaline solution is less concentrated, so as to reduce the expense of the process. The range of alkali is therefore from 0.5% to 10% by weight of the solution.

The alkali metal hydrosulfite and the alkali are in the same solution and hence act on the fiber simultaneously. They are ineffective if used singly.

A sufficient quantity of alkaline hydrosulfite solution should be employed to permit the solution intimately to contact all portions of the plant fiber material being treated. In this connection it has been found desirable to employ some circulatory system by means of which the solution is carried into intimate contact with the fiber materials. An excess of solution is desirable, particularly where the operation is carried out on a large scale. This permits the maintenance of a more uniform concentration of treating solution at all points throughout a reacting vessel, and insures a uniform treatment of the fibrous material throughout the batch.

In carrying out the invention the fibrous material being treated (straw or stalks) is preliminarily worked mechanically so as to remove most of the shivey components of the plant, although some of the shives always remain adherent to the fibers. Such preliminary working usually involves the breaking and scutching of the fiber, and in certain cases combing may be used. The fibers, which may be hard fibers or bast fibers of plant material (however denominated) are then preferably worked into a loose roving which may be kept in suitable containers or given a very low twist (such as 1 to 15 turns per inch) so as to enable ready handling thereof. It is preferable to wind the roving loosely on bobbins before it is treated with the chemical reagents. The treatment according to the present process is usually facilitated by using hollow cored perforated bobbins, so as to permit the treating liquid to flow from the inside as well as the outside of the fibrous plant material wound thereon, the reaction is facilitated by pumping the solution through the bobbins. The foregoing should not be understood as limiting the treatment only to material in roving form on bobbins, because loose or combed fibrous material may also be treated. However, before being spun the fibrous material has then to be brought into a roving form suitable for handling on the spinning machinery and it is usually more convenient to do this before the process treatment. The treated fibrous material, after treatment, may be maintained in the wet condition until spinning, or it may be dried and then combed and hence drafted before spinning in a dry or rewetted state.

For convenience in handling, however, it is preferred to preliminarily work the straw or fiber mechanically for producing the roving which can then be treated chemically and spun expeditiously.

The fibers or plant material are treated according to the present invention at elevated temperatures in the range of 100° to 150° C. At temperatures below 100° C. the reaction time required is sharply extended, and accordingly it is preferable not to operate at temperatures below 100° C. The reaction proceeds rapidly in the range of 120°–150° C. Higher temperatures do not provide economical gains and increase the risk of weakening the resultant yarns.

In general, it may be stated that at temperatures materially below 100° C. the processes of delignification, partial removal and/or softening of the gum cementitious materials of the fibers do not proceed at an appreciable rate. The particular temperature in the range of 100° C. to 150° C. is selected according to the particular material being treated; the concentration of alkali metal hydrosulfite and alkali that is used, and the time of treatment. At temperatures above 120° C. the time period of treatment is shortened at some sacrifice of fiber quality but the quality remains good up to and slightly beyond 150° C. According to the present invention the fibrous material most easily treated consists of the bast fibers of the linen flax plant since the quantity of lignin to be removed in such fibers is relatively small. For this material, temperatures in the lower portion of the range of 100°–150° C. are preferred. At 100° C. the time period is lengthened as compared with that required at 120° C.

Another fibrous material easily treated by the present process is the whole straw of the flax plant cultured for linseed production. Straw of such character may be dry as left from the threshing and combining operations. It is slightly more difficult to treat the whole straw because of its higher content of lignin and gums present in the shivey material. Therefore, the preliminary treatment for breaking of the straw and removal of the shives will appreciably reduce the time and ease of treatment. For example, a thoroughly combed roving made from a broken and scutched dry straw of the linseed flax plant may be treated according to the present invention at low reagent concentrations at temperatures in the neighborhood of 120° C., whereas with a coarser roving, it is preferable to operate at somewhat higher temperatures in the range of 120–150° C.

It may be stated that various straws will take more or less time of treatment, depending upon many cultural and climatic conditions. Thus, the fibers from young straw of an immature plant which is somewhat green may be treated more readily than a hard, dry or mature straw. The fibers from a greenish straw may be treated more readily than a dry straw. Likewise, plant material grown in hot dry climates, or during a hot, dry year usually require a greater concentration and/or longer time of treatment at higher temperatures than materials produced under cool climate or during a cool, wet condition. The species of plant likewise has an influence upon the time and ease of treatment. Another factor influencing the time of treatment, concentration of reactants and the temperature of treatment is the time during which the straw is exposed to the weather before it is mechanically handled and the kind of weather it is exposed to.

Nature does not produce uniform materials, and each material is therefore tested in order to determine the time of treatment, temperature, the concentration of ingredients for successful treatment. The test used can easily be made in conjunction with spinning as follows:

For treating the fibrous plant material in preparation for wet spinning, we have found that the presence or the absence of shives at the end of the chemical treatment in solution of alkaline alkali metal hydrosulfite may be used as a reliable indicator of the degree of treatment. This is not to say that the presence of some shivey residue in the treated fibers is detrimental to spinning or that yarns containing some shive marks or shive residues are unmerchantable. Thus, coarser yarns containing some shive marks or residues may be used for the preparation of coarser materials, such as rug backing, monk's cloth, rough cloth for rough clothing, and the like, or for the preparation of rope and cordage. Indeed, some coarser decorative cloths have an enhanced appearance and decorative character because of such shive residues and

marks. The finer yarns, which are free from evidence of shives, are suitable for the finer uses, such as softer clothing, table linens, toweling, suiting, shirting, handkerchief material and the like. But for testing completion of the process, utilizing the concentrations and temperatures as herein stated, the material is, as previously stated, preferably first mechanically worked by breaking, scutching and combing for the production of the roving. In this stage the fibers, which are the bast or hard fibers of the original plant material, will have some shives adhering to them at various places. During the treatment the shive material undergoes a delignification and/or softening, however denominated, and may be tested readily by picking out a little bit of the shives and rubbing the same between the fingers. When the shives readily break up with slight pressure or mechanical action, the process has proceeded sufficiently so as to enable the production of the finer qualities of yarns of higher lea numbers, substantially free of evidence of shives. Where the shive does not break up so readily, slight residues from the shive will be present in the yarn ultimately produced, and though it is still mechantable, such yarns are best suited for the coarser rougher or decorative uses. Thus, the time of disintegration of the shive may be regarded as a means of timing of the chemical treatment process. When the shives in the roving disintegrates very readily or have disintegrated by themselves without mechanical treatment, the process is completed. It is undesirable to carry the process much beyond this point, otherwise too much of the cementitious material will be removed from the bast or hard fibers (whichever is being treated) thereby unduly liberating the fibrils with resultant weakening of the yarn ultimately produced. Thus, by carrying the process substantially beyond the point where the shives disintegrate by themselves in the treating solution, the fibrils begin to be liberated and pulp formation results. Yarns made from such over-treated material are weak and of little value.

The time of treatment may therefore be determined as not substantially beyond the time when shives adhering to the fibers of the plant material disintegrate of their own accord in the treating solution. When this occurs yarns free from shive residue will result. It may be noted that the guiding and drafting of the roving of fibers applies sufficient mechanical working to eliminate many of the softened shive residues, even though the shives may still be quite apparent and adherent to the fibers. Accordingly, many fine yarns of quality and free from all but occasional shive residues are capable of being produced even with shorter treating time than that indicated by the spontaneous disappearance of the shive in the treating solution. The slight working of the fibers as they are pulled by draft rollers and over guides, etc. during drafting and spinning rubs off the softened shivey material, which is at this stage quite loose, soft and even mushy, and such mechanical working eliminates some of the shives. The time periods of treatment (determined by tests herein defined) will also soften the cementitious material between the fibrils and the drafting and drawing out of the fibers during spinning and consequent production of fine yarns is thereby facilitated.

It may be stated in general that the treatment for substantial removal of the shive material and softening of the fibers preparatory to drafting and spinning is accomplished in about one-half hour to three hours, usually in about two hours. In many instances this may be shortened by preliminarily treating the fiber roving or fibrous material, in whatever form the fiber may be treated, with hot water, or previously used treating solution, or by treatment with a mild alkaline solution.

The concentration of reagents and time and temperature of the treatment is adjusted, within the stated limits, in accordance with the material being treated. In general higher concentrations of reagents and the longer time periods of reaction are preferred for the fibrous plant materials of the more resistant type. Aqueous solutions containing not substantially less than 0.1% of alkali metal hydrosulfite and not substantially less than 0.5% alkali, both by weight, appear to constitute a practical minimum for commercial treatment of fibers for preparing them for drafting and spinning. On the other hand, concentrations may go as high as 5% for each of these reagents when treating resistant fibers. In order to reduce the costs of processing, it is preferred to use the minimum concentrations capable of effecting the treatment for delignification and/or softening and partial removal of the cementitious complex. Therefore, the range of alkali metal hydrosulfites may be stated as from 0.1% to about 5% and the range of alkali as from 0.5% to 5.0%. Higher concentrations than 5% of each of the reacting ingredients may be used, but they are uneconomical.

It is possible to apply the above described treatment directly to the native cellulosic material, such as the straw or stalky material in its native state without pretreatment of the cellulosic fibers. It is preferred, however, to pretreat the fibrous material mechanically for the production of the rovings as previously stated, and in many instances economies may be effected by preliminarily treating the fibers with a pretreating solution which may be either recovered reagents from a previous batch, water or a weak alkali solution. Thus, according to the present invention the reagent of a previous batch is removed and used for pretreating the next batch. In the process of this invention, the principal treating liquor, viz. an alkaline, alkali metal hydrosulfite solution, even after fully treating a batch, is still in a relatively clear and clean condition. Unlike the treating reagent in the paper industry, where the "black liquor" from digestion is really black, turgid and heavy loaded with coloring material, the treating reagent in accordance with this invention, when drained from the fibrous material undergoing treatment, is still clear and light colored, and looks much like the color of clear cider vinegar. Such clear light-colored treating liquor from a previous batch may therefore, without ill effects to the fibers, be used for the preliminary wetting and soaking of fibers of a succeeding batch, thereby effecting economies in preparation of the pretreating liquor, heat economies and otherwise. Plain hot water may likewise be used for the pretreatment, such as a one-half to one hour soaking in hot water at 100° C., or a soaking in a dilute aqueous alkali hydroxide solution for one-half to one hour, for example a 2% aqueous sodium hydroxide solution.

By such preliminary treatment with used treating liquor from a previous batch, or alkali hydroxide solution, as much as 40% by weight of the original starting material may be removed, thus appreciably lessening the amount of material remaining in the fibers for removal or softening during the subsequent final treating process. The use of water alone in the pretreatment will remove a lesser percentage.

If the straw or stalky material from which the plant fibers are derived is permitted to remain in the field where produced, and exposed to sun, rain, wind and dew, for a period of several days to several weeks, depending upon the weather, humidity, temperature and other factors, a certain amount of ligneous and/or gum material of the plant will be removed by natural processes denoted as "dew retting". "Water retting" may also be used, where the material in the field is sprinkled or is bundled and soaked. Such processes are an advantage in that the drafting and spinning of the fibers, after treatment in accordance with this invention, is facilitated.

In carrying out the processes of the present invention the hard or bast fibers of the plant material, preferably in the form of a roving or low twist roving, is placed loose or loosely wound on bobbins in a suitable treating vessel which is capable of standing the action of the reagents and of withstanding generation of pressures to permit the attainment of temperatures of 100°–150° C. The

fibrous material is cooked in the pressure vessel in the presence of the delignification reagents for a time period as previously stated, correlated with temperature and concentrations to effect the desired delignification and/or gum softening and removal. Thus, the vessel is preferably provided with some means of stirring the treating liquor which should be present in sufficient quantity completely to cover and surround the fibers. If desired, the liquid may be pumped through the bobbins on which the fibers are wound, or circulated by pumping through the treating vessel.

After completion of the cooking the thus treated fibrous material is removed or the cooking liquor is drained from the treating vessel and the resultant treated fibers are thoroughly washed with water and finally given a slight acid rinse in order to remove last traces of alkali and hydrosulfite. This acid rinse may be accomplished by means of the use of dilute solutions of organic or mineral acids, such as acetic acid, hydrochloric acid, sulfuric acid, phosphoric acid or the like. The liquor recovered from the cooking of the cellulosic material may be saved and, as previously explained, utilized for treating a subsequent batch or for the preliminary pre-cooking of the material of another batch.

It may be pointed out that the cooking reagents produce delignification in a reducing action and thus the entire treatment is free from any tendency to oxidize the cellulose fibers. This is an advantage.

The following table will illustrate a series of exemplary runs of plant fibers which were conducted according to the above described procedure showing the variation of concentration, time, temperature and the result of these variables on the condition of the treated fibrous material. In all of these runs the straw was broken and scutched and the separated bast fibers combed into a roving. Some shives, occasionally in considerable amounts, adhered to the fibers. The flax used for the preparation of such rovings was dry Minnesota seed flax straw.

Run Number	Treating Reagents	Temperature (°C.)	Time (Hours)	Condition of Shives	Condition of Fibers
1	3% NaOH, 5% $Na_2S_2O_4$	150	2	Pulped	Was drafted and spun.
2*	3% NaOH, 1% $Na_2S_2O_4$	150	2	do	Do.
3*	2% NaOH, 1% $Na_2S_2O_4$	150	2	do	Do.
4	2% NaOH, 1% Na_2SO_3	150	2	do	Do.
5	2% NaOH, 1% $Na_2S_2O_4$	150	1	do	Do.
6	1% $Na_2S_2O_4$ alone, followed by washing, then 2% NaOH alone.	150	2	Considerable shives.	
7	2% NaOH alone, followed by washing, then 1% $Na_2S_2O_4$ alone.	150	2	do	

*Samples given pretreating of 2% aqueous NaOH solution for 30 minutes at 100° C.

It will be apparent from Runs 1–5, inclusive, that extremely low concentration of alkali metal hydrosulfite results in pulping of the shives, even where a considerable amount of such shives are present, and that the treatment conditioned the fibers by softening and/or partially removing the cementitious material with the result that the fibers could be drawn out and spun. The time periods indicated may therefore be considered as exemplary time of treatment for the particular materials indicated. When the shives have been "pulped" any further treatment of the fibrous material proceeds beyond the stage of delignification required for partial or complete removal of gum cementitious materials and a decrease in the strength of the fibers is brought about, and as a result material so treated is inferior for drafting and spinning into yarn. Runs 1–5, as compared with Runs 6 and 7 show the necessity for simultaneous treatment with caustic alkali and hydrosulfite. Thus, in Runs 6 and 7 the sequential separate treatment of the flax fibers with the two reagents did not result in pulping of the shives, nor in producing the conditioning of the fibers needed for spinning, while the simultaneous use of the reagents in Runs 1–5 for corresponding periods and temperatures was effective for such purpose.

The yarns resulting from the foregoing experiments had lea numbers in the range of 40 to 60, the yarns were light colored and did not require bleaching. It may be stated in this connection that yarns produced in utilizing the processes of the present invention are usually sufficiently light colored so as not to require added bleaching.

Where the flax is subjected to mechanical combing for the thorough removal of shives prior to chemical treatment, it is possible to operate under even milder conditions than are set forth in the above runs. Thus, in the following runs the flax roving had been thoroughly combed for the removal of shives.

Run Number	Treating Reagents	Temperature (° C.)	Time (Hours)	Condition of Shives	Condition of Fibers
8	.15% $Na_2S_2O_4$, .5% NaOH.	120	2	Pulped	Was drafted and spun.
9	.2% $Na_2S_2O_4$, .5% NaOH.	120	2	do	Do.
10	.25% $Na_2S_2O_4$, .5% NaOH.	120	2	do	Do.

Runs were made similar to numbers 8, 9 and 10 wherein the flax roving was pretreated with a 1% sodium hydroxide solution for one hour at 100° C. prior to the hydrosulfite-alkali treatment. It was found that such pretreatment facilitated the delignification, partial and/or complete gum removal required for spinning and the production of good yarns.

When using the lower concentrations of reagents, previously described, the shivey material is softened but may not always be completely pulped and eliminated when the yarn is drafted and spun. It may be stated that during the wet drafting and spinning operation the roving, being drawn and spun, is passed through guides and rollers in the spinning equipment, and the shivey residues still adhering to the fibers, which are reasonably softened by the treatment, are usually eliminated even though they may be visible at the end of the treating process. In some instances hard specks of shives may remain adherent to the yarn, but this does not render the yarn unmerchantable for it may still be used for the coarser uses. Thus a dew retted flax fiber from flax grown in the province of Ontario, Canada, treated at 150° C. for 2 hours, in a solution of 0.2% sodium hydrosulfite and 0.5% sodium hydroxide, yielded a bleached fiber capable of drafting and spinning, but the shivey material was not completely softened and parts thereof remained adhering to the resultant yarn. The time of disappearance and elimination of the shives during the treating process may therefore be considered as an indication of the approximate maximum length of treatment, and lesser time periods of treatment are satisfactory for many yarns. Lengthening the treating period brings about a reduction in strength of the yarns ultimately produced, without compensatory advantages.

When alkali phosphate, such as trisodium phosphate, or alkali carbonate, such as sodium or potassium phosphate, are used as the alkali, a greater percentage is generally necessary than where sodium hydroxide is used, or the treating time shall be extended or higher temperatures used than where sodium hydroxide is employed. Thus, a treatment of Ontario grown flax fibers in roving form in a bath containing 5% each by weight of trisodium phosphate and sodium hydrosulfite for 2 hours at 36# gauge adequately softened and simultaneously bleached the fibrous material which was capable of being drafted and spun, although some shives were still present, and a substitution of sodium carbonate in place of sodium phosphate produced corresponding results. Sodium hydroxide is in general preferred to the other alkaline materials because of its favorable reaction characteristics at low concentrations, and its low cost.

It will be apparent from the foregoing description that the present invention provides a simple and efficient process for the removal of lignin and partial or complete softening of the cementitious materials in hard or bast fibers of plant material, preparatory to the drafting and spinning of such fibrous material into yarn. The resultant yarns are of excellent quality and are very light in color and usually require no bleaching. Where bleaching is desired this can readily be effected by the use of sodium hypochlorite, or other commercial bleaches.

In place of the sodium hydroxide and sodium hydrosulfite, sodium carbonate and trisodium phosphate, there may be used the corresponding potassium salts.

All percentages are by weight unless otherwise stated.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that we do not limit ourselves to the specific embodiments herein.

What we claim is:

1. In the process of preparing linen yarns from the hard dry straw of seed flax which comprises mechanically breaking and scutching the straw for separating the fibers and removing at least most of the shives therefrom, working the thus separated fibers into a loose roving, submerging the roving in an aqueous treating bath, removing the roving from the treating bath and rinsing and neutralizing the same, and then drafting and spinning the roving, the improvement which consists in subjecting the loose roving to an aqueous treating bath containing sodium hydrosulfite in an amount from 0.1 percent to 10.0 percent and an alkali in an amount ranging from 0.5 percent to 10.0 percent, said treating bath having a temperature in the range from 100° C. to about 150° C. for a time period not substantially in excess of that in which shives present in the roving are pulped.

2. The process of preparing linen yarn from flax straw which comprises preliminarily mechanically working the straw to remove most of the shive components of the straw, working the fibers of the straw from which most of the shives have been removed into a loose roving, exposing said fibers to contact with a chemical treating bath consisting essentially of an aqueous solution of alkali metal hydrosulfite and an alkali, the hydrosulfite being present in an amount ranging from about 0.1% to 10.0% and the alkali being present in an amount ranging from about 0.5% to 10.0%, said bath having a temperature in the range of 100° C. to about 150° C., exposing said fibers to said bath for a time period not substantially in excess of that at which the shives present with the fibers are pulped in order to pulp those shives and at the same time soften the cementing materials betwen the fibrils of the fibers, at least partially removing the pulped shives from the fibers, neutralizing the fibers, and then, while the fibers are wet and the cementing materials are soft, drafting and spinning the treated fibers into yarn.

3. The process of claim 2 further characterized in that the flax straw is the hard dry straw of seed flax plants.

4. The process of claim 2 further characterized in that the hydrosulfite is sodium hydrosulfite and the alkali is sodium hydroxide.

5. The process of claim 2 further characterized in that the bast flax fibers are preliminarily soaked in a solution having a temperature of about 100° C., said solution being selected from the class consisting of water, water containing a small percentage of alkali, and the treating liquor of a previous batch containing alkali metal hydrosulfite and alkali.

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