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WOOD SEASONING PROCESS

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This invention relates to the chemical seasoning of wood, and particularly to the chemical seasoning of moisture-containing wood by treatment thereof with urea.

In the lumber industry, one of the most serious problems has been that of checking and cracking of moisture-containing wood during its storage and drying after cutting. This checking and cracking of wood is due, primarily, to the shrinkage resulting from drying of the outer area or portions of moisture-containing wood at a more rapid rate than the interior portion. As a consequence of this uneven shrinkage, surface strains and stresses are set up which cause extensive cracking, checking or splitting of the moisture-contaning wood, being most apparent at the ends and along the surface of the moisture-containing wood in the central portions of the flat grain cut.

It has heretofore been proposed, in order to overcome the above described cracking and checking during seasoning, to apply various hygroscopic salts to the moisture-containing wood undergoing seasoning. This tends to prevent the outermost portions of the wood from drying and cracking while the innermost portions are still laden with moisture. The most successful chemical proposed for wood seasoning is urea, which provides a stable, hygroscopic, non-corrosive substance, ideally suited for the purpose. The general procedure for employing urea in the treatment of lumber is described by J. F. T. Berliner in the publication "Mechanical Engineering" for March 1942 at page 181. The bibliography there appended further describes the state of the art.

The principal difficulty in the use of urea for chemical wood seasoning has been the difficulty in securing a simple, low cost method for applying a sufficiently high concentration of urea to the surface of the wood undergoing seasoning. One method in common use has been to apply the solid urea crystals by hand or with a scoop or a trowel to the uppermost surfaces of the moisture-containing wood undergoing seasoning. It is obvious that this represents a tedious and laborious method of applying the urea.

Another method has been to make up a concentrated aqueous solution of urea in water and thereafter to soak the moisture-containing wood to be seasoned in this treatment bath until the wood has taken up a sufficient quantity of urea for proper chemical seasoning. When, however, the moisture-containing wood is placed to soak in the urea solution, an enormous investment of money is tied up in the very large tanks necessary to treat any considerable capacity of moisture-containing wood. One lumber mill has employed tanks of 88' x 10' x 9', requiring from 20 to 30 tons of urea in the initial make-up solution. Aside from the high cost of the tanks, the handling charges likewise become excessive when extended soaking treatments are employed.

A third method which has been attempted for applying the urea to the moisture-containing wood to be seasoned is that of dipping the moisture-containing wood into a comparatively small tank of urea solution, thereafter withdrawing and stacking up the wood so dipped. However, urea solutions in all concentrations up to that saturated in water at 35° C., (containing 146 grams urea dissolved in 100 grams water) have a lower viscosity than a 50–50 ethyl alcohol-water solution, and the very low viscosity of the urea solution results in a rapid and nearly complete drainage of the urea solution applied to the moisture-containing wood, allowing only a very small amount of urea to be retained on that surface. As the thickness of the wood being seasoned is increased, it is apparent that the difficulties inherent in a dipping process or a spraying process for applying the urea solution are multiplied, since thick wood requires a greater amount of urea for proper chemical seasoning and presents proportionately less surface on which to apply the urea. Thus, prior to the present invention, the chemical seasoning of moisture-containing wood, especially in the larger sizes, required that the urea be spread on dry by hand, or that the wood be soaked for long periods of time in a concentrated urea solution, in order to secure a sufficiently heavy application or absorption of urea.

Accordingly, it is an object of the present invention to provide a method and means for increasing the quantity of urea retained upon moisture-containing wood in a chemical seasoning process when the urea is applied by brushing, spraying or relatively rapid dipping in a urea bath. Another object of this invention is to chemically season moisture-containing wood by applying to the surface thereof a controlled amount of urea. It is another object of this invention to obviate the necessity for long soaking treatments in the chemical seasoning of moisture-containing wood with urea. A still further object of the invention is to eliminate the necessity for hand application of solid crystalline urea to moisture-containing wood in chemical seasoning processes. Yet another ob-

ject of the invention is to precisely control the amount of urea retained upon moisture-containing wood to which a urea solution has been applied. Still a further object is to provide methods and means for permitting moisture-containing wood having a thick, cross-sectional area to be chemically reasoned by urea treatment by means of a quick dip method or a painting, brushing, or spraying method for applying the urea solution. Another object is to provide a desirable composition for "end-sealing" moisture-containing timber, whereby end-checking, cracking and honeycombing is inhibited. Another object is to prepare urea solutions having any desired viscosity ranging from labile liquids to viscous jell-like pastes. Other objects and advantages of the invention will be apparent hereinafter.

These objects are accomplished by this invention wherein moisture-containing wood is chemically seasoned by treating the wood with a urea solution, the viscosity of which has been increased to a predetermined value by admixture therewith of an organic thickening agent.

By controlled thickening or increasing the viscosity of the urea solution with a thickening agent, and using the thickened solution thus prepared to surface-treat moisture-containing wood, the quantity of urea applied to the moisture-containing wood undergoing chemical seasoning can be precisely controlled. For any variety or size of moisture-containing wood to be seasoned, it is only necessary to increase the viscosity of the urea treatment solution, by addition of a suitable quantity of thickening agent, to such an extent that the moisture-containing wood will retain upon its surface enough urea to insure protection against subsequent seasoning degrade. Thus, the thickened urea solution may be applied to the wood by a relatively rapid dipping of the wood into the urea solution suitably thickened, or by brushing, painting, spraying, or otherwise applying the thickened urea solution to the wood to be seasoned.

In general, the urea solution is thickened to such an extent that the viscosity thereof as measured by the "Parlin cup method" (described in Gardner's "Physical and Chemical Examination of Paints, Varnishes, Lacquers and Colors," 9th edition, page 224 (1939)), is maintained within the range of about 0.4 minute to about 8.0 minutes employing a #7 cup. Preferably, the viscosity of the thickened urea solution is maintained within the more restricted range of from about 0.5 minute to about 3.0 minutes (#7 Parlin cup). Any thickening agent which will increase the viscosity of the urea solution without adversely affecting the wood undergoing treatment may be used. In general, satisfactory organic thickeners are satisfactory, such as starches, gelatin, glue, polyvinyl alcohol, partially hydrolyzed polyvinyl acetate, gum arabic, tragacanth, locust bean gum, alginates, water-soluble cellulose ethers, highly polymerized ethylene oxide, soybean proteins and glycol polyformals. Preferably, starch is employed as the organic thickener. Suitable starches include corn starch, potato starch, tapioca starch, barley starch, rice starch, and the like. Of the starches, the preferred starch is corn starch, since it is inexpensive, relatively uniform, and readily obtainable. Preferably, a "thick-boiling" corn starch, (separated from the corn kernel by physical means only) such as the grades known to the trades as "Pearl Starch" or "Pure Food Powdered Starch," is employed to thicken the urea solution.

The aqueous urea solution employed is at least 35% by weight urea, based on the total solution. More concentrated urea solutions, such as 40%–60% urea are preferred, and saturated aqueous urea solution can be employed.

In preparing the starch-modified urea solution, it has been found that from about 0.5% to about 5.0% starch, based on total weight of solution, provides a suitably increased viscosity for the urea solution. Preferably, the starch is utilized within the more restricted range of from about 1.0% to about 3.0% starch, based upon the total weight of the urea solution. The starch is utilized in an amount sufficient to secure the desired viscosity in the final urea solution.

The following examples, in which parts and proportions are by weight unless otherwise designated, illustrate the practice of the invention without, however, limiting it thereto:

Example 1.—A green cypress block measuring 3" x 6" x 6" was dipped for 10 seconds in a 50% aqueous urea solution containing 1.25% corn starch. The green cypress absorbed 38 lbs. urea per 1000 sq. ft. Subsequent drying at 100° F. and 60% relative humidity produced a well-seasoned cypress block free from surface checks and honeycomb. When the same operation was carried out in the absence of starch, only 13 lbs. of urea per 1000 sq. ft. was absorbed, and subsequent drying produced severe surface checking and end honeycomb, as well as end-check.

Example 2.—The absorption on 3" x 6" x 6" green cypress blocks in a 10-second dip in 50% urea solution at room temperatures, employing corn starch, is shown by the following table:

Table I

Per cent starch	Pounds of urea per 1000 sq. ft.
0	18
1	21
1.7	38
2	54

In the seasoning of moisture-containing wood by surface-treating with starch-thickened aqueous urea, the amount of urea adhering to the wood in a dipping process is a function of the increased viscosity produced by the starch added. The following table shows the influence of starch on the viscosities of 50% urea solutions and 40% urea solutions. The viscosity determinations were made by adding corn starch to water at 60° F., stirring, then adding the urea, then heating to 90° F. with stirring. Other methods of preparing the solutions can, however, be used.

TABLE II

Aqueous starch-urea solutions

Test	Urea	Starch	Parlin #7 cup viscosities (minutes)	
			90° F.	70° F.
	Per cent	*Per cent*		
1	50	1.75	0.57	0.62
2	50	1.9	0.62	0.69
3	50	2.0	0.66	0.78
4	40	2.0	0.52	0.56
5	40	2.5	0.70	0.81
6	40	2.55	0.79	0.99

Different types of moisture-containing wood such as oak, Douglas fir, cypress, and the like require variously differing amounts of urea in their chemical seasoning. However, a simple test will serve to indicate the exact amount of starch or other thickener required to produce a urea solution of a viscosity which will give the desired urea dosage on the wood. Thus, it has been found in the chemical seasoning of cypress, that green boards of less than 6" in thickness, side cut, require approximately 40 lbs. of urea per 1000 board feet. A simple trial of 50% aqueous urea thickened with starch showed that a viscosity within the range of 0.6 to 0.7 minute, as measured by the Parlin #7 cup method, provided the required urea dosage. Employing a 50% aqueous urea solution, it required about 2% starch, derived from corn, to thicken the urea solution to the required viscosity, which in turn resulted in a suitable deposition of urea. In like manner, the amount of any starch required to produce a pre-determined viscosity in the urea solution which in turn will produce the required urea absorption by the moisture-containing wood to be chemically seasoned, can be determined by a simple trial.

Although corn starch is the preferred thickener or viscosity-increasing agent by reason of the ready obtainability, uniformity, and especially the low cost thereof, other starches may be used as before explained, and may be somewhat more effective than corn starch in increasing the viscosity of the urea solution.

The urea solution thickened with some agents tends to increase somewhat in viscosity upon ageing. In normal practice, however, the urea solution is applied as soon as it is prepared.

In order to secure a suitable viscosity, resulting in a high absorption of urea upon the moisture-containing wood to be seasoned, it is generally preferred to use a concentrated aqueous urea solution employing the minimum amount of starch to secure the desired viscosity rather than to employ a less concentrated urea solution together with a large amount of starch, because with concentrated urea solutions and low starch content the viscosity change resulting from a small change in starch concentration is lower than when a weaker urea solution plus a strong starch solution is used.

The temperature at which the starch-thickened urea is applied to the moisture-containing wood to be seasoned influences the viscosity to an appreciable extent with starch concentrations exceeding 1.25%. Within the temperature range of 60° F. to 90°F., the change in viscosity is inversely proportional to the temperature, that is, when the temperature is decreased from 90° F., to 60° F., the viscosity increases approximately 20%. Therefore, to secure best results in precisely controlling the urea applied to any moisture-containing wood being seasoned, the urea solution should be thickened with such a quantity of starch that the viscosity is suitable for applying the proper amount of urea at the temperature at which the application is to be carried out. Temperature control offers however, an effective means of regulating the urea dosage applied to the wood.

As previously stated, many varying substances may be used to increase the viscosity of the urea solution. However, starch is preferred, because the starch cooperates in a surprisingly efficient manner with the urea to thicken the urea solution. The urea solution cooperates with the starch to gelatinize and swell the starch which in turn greatly increases the viscosity of the urea solution in a unique and efficient manner.

Another advantage of starch in this invention is that the urea selectively migrates into the moisture-containing wood being seasoned, while the starch does not penetrate the wood surface, but remains as an exterior coating. Furthermore, the starch-urea solution is very resistant to attack by molds and other fungi, and even protects the moisture-containing wood from attack by fungi to a great extent during seasoning.

The urea solutions thickened with starch or other thickeners in accordance with this invention are especially suitable as "end-sealers" for moisture-containing wood being seasoned. For example, the urea-starch solution is applied to the cut ends of the moisture-containing timber. The usual end-checking, honeycombing, cracking and splitting during the ensuing seasoning are entirely prevented.

In the large-scale preparation of starch-thickened urea solutions, it has been found preferable to first dissolve the urea in water, employing such heating as is necessary to supply the heat of solution, then to cool the urea solution and add the starch (Pearl or Pure Food Powdered Corn Starch). This procedure avoids degradation of the starch which may occur if the aqueous starch solution is heated with subsequently added urea.

Although the invention has been particularly described with reference to the chemical seasoning of wood, it will be apparent that the concentrated aqueous urea solutions of increased viscosity described herein are potentially useful in many arts, such as protein solvents, textile treatment, ruminant nutrition, and others too numerous to detail at length.

The invention can be utilized to season any variety of moisture-containing wood, such as oak, Douglas fir, walnut, cypress, cherry, spruce, and the like. Starch-thickened urea in accordance with this invention can be used to end-seal the above and other varieties of moisture-containing wood.

Various changes may be made in the detailed practice of the invention without departing from the spirit and scope thereof.

What is claimed is:

1. In a process for chemically seasoning moisture-containing wood involving application thereto of a urea solution, the method of increasing the quantity of urea retained on the wood which comprises treating the wood with a jellified aqueous solution of urea.

2. In a process for chemically seasoning moisture-containing wood involving application thereto of a urea solution, the method of increasing the quantity of urea retained on the wood which comprises incorporating starch with the urea solution, and thereafter applying the thus-modified urea solution to the wood to be treated.

3. In a process for chemically seasoning moisture-containing wood involving application thereto of a urea solution, the method which comprises applying to such wood a concentrated aqueous urea solution containing 0.5 to 5.0% starch based on total weight of the solution, then drying the thus-treated wood.

4. In a process for chemically seasoning moisture-containing wood involving application thereto of a urea solution, the method which comprises applying to such wood a concentrated urea

solution, and thereafter applying the thus-modified urea solution containing 1.0 to 3.0% starch, based on total weight of solution, and then drying the thus-treated wood.

5. In a process for chemically seasoning moisture-containing wood, involving application thereto of a urea solution, the steps which comprise dipping the wood into an aqueous urea solution containing a predetermined amount of starch sufficient to bring the viscosity of the said solution to not less than 0.5 minute (Parlin #7 cup), allowing the wood to remain in the said solution for 5–30 seconds, and withdrawing the wood together with adhering urea-starch solution.

6. A wood-seasoning process which comprises surface-treating moisture-containing wood with aqueous urea-starch solution having a viscosity between about 0.5 minute–5.0 minutes (Parlin #7 cup), and a urea content of at least 35% based on total weight of solution, and then drying the thus treated wood.

7. Moisture-containing lumber end-sealed with urea-starch solution.

8. Moisture-containing wood surface-treated with urea-starch solution.

9. As a composition for the chemical seasoning of wood a viscous, jell-like paste comprising a concentrated aqueous solution containing 35 to 60% urea thickened with not more than 5% by weight of starch.

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