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Bibliography of Special Seasoning Methods

by

C. J. Kozlik

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Bibliography of Special Seasoning Methods

compiled by

C. J. Kozlik

INTRODUCTION

Wood as it comes from the tree contains too much water for many uses. Removal of excess water by conventional air drying or kiln drying results in satisfactory products, but requires time and expense. Many attempts, often highly ingenious, have been made to develop methods or apparatus for drying wood at lowered expense, in shortened time, or with some qualities improved for particular uses.

A review of literature about special seasoning methods was made at the Forest Products Research Center to provide information of value in operating newly installed experimental kilns capable of drying with steam at temperatures above 212 F. With expectation that such information may be valuable to others, selected publications have been compiled.

Publications were selected with attention toward usefulness for Oregon readers in particular. Most are printed in English, although some are in French and German and a few are in Russian or Scandinavian languages. Many are available at Oregon State College library, or at the Forest Products Research Center; items not held at either agency are marked with asterisks.

Contents of some publications have been indicated by short notes along with the bibliographical entry.

Publications were recorded alphabetically by author in one of several groups segregated according to drying method. The groups are listed in the Table of Contents.

GENERAL

*Eisenmann, E. "Output and Economic Aspect of New Wood Seasoning Methods." Holz-Zbl. 78:76 (1090-1092) 1952.

Kollmann, F. The Development of Timber Seasoning. Medd. Svenska Tråforsk. Inst. 13(B), 1951. Translation No. 3 by For. Prod. Lab. Div., Canada, 1952.

Author describes various special seasoning methods.

Modern Techniques for the Drying and Conditioning of Timber. Organization for European Economic Co-operation, 1957.

A general discussion of American research and achievements in the timber drying and conditioning field.

List of Publications on the Seasoning of Wood. Report 446, U. S. For. Prod. Lab., Madison, Wis. 1957.

Seasoning (novel methods). Report 31, (60-61), For. Prod. Res. Bd., London. 1939-1947, 1950.

*Spitkovskii, Z. M. "Rapid Seasoning Methods for Small-Section Beech Timber." Lesn. Prom. 12 (22-23) 1950.

Stevens, W. C. "The Seasoning of Wood at Temperatures Below the Boiling Point of Water." Wood, London. 76:6 (260-262). 1951.

Author describes various special seasoning methods and believes such methods offer opportunities only in special instances.

*"An Interesting Development in the Artificial Seasoning of Very Thick Wood." Rev. Bois Appl. 3:6 (23-24). 1948.
Contents unknown.

Tiemann, H. "Extraordinary Drying Schemes." Southern Lumberman 173:2169 (59-60). 1946.

Wright, G. W. "Recent Developments in Timber Drying." For. Prod. News Letter. C.S.I.R.O., Australia, No. 145 (3-4). 1946.

Author gives a short account of solvent seasoning, vapor drying and high-frequency drying.

* Literature not available at Forest Products Research Center or at Oregon State College library.

ACCELERATED AIR DRYING

Bollman, L. "Accelerated Air-Drying." Holz Zbl. 81:98 (1173-1174) 1955.

Author describes the mobile axial fan, which is equipped with moisture and airstream controls.

Pfeiffer, J. "Forced Air Drying Pays Dividends." Forest Products Journal.

8:11 Nov. 1958.

"Cross Ties are Seasoned in 18-21 Days by New Process." Wood Pres. News 33:3 (8, 31-33). 1955.

Process consists of subjecting incised green sleepers to controlled air seasoning (enclosed drying shed with heated air being circulated).

BOILING IN OIL

Bucholz, E. "The Drying of Beech Wood with Petrolatum in the Soviet Union." Holz-Zbl. 82:73 (923). 1956. Translation No. 325 by U. S. For. Prod. Lab., Madison, Wis. 1956.
Author describes apparatus employed and the drying process.
Compares this type of drying with kiln drying in cost and time.

Drying by Boiling in Oil. Report 11-12, For. Prod. Res. Bd., London. 1951, 1952.
Beech and Oak were used in the experiments and the results showed serious degrade and abnormal shrinkage in both species.

*Efimov, G. V., and N. N. Stepanov. "Drying and Impregnation of Beech with Petrolatum." Lesn. Prom. 34:4 (15-16). 1956.
Article contains an illustrated description of equipment used and gives function, time, temperatures in the entire process.

*Folomin, A. I. "High Temperature Seasoning of Wood in Petrolatum." Derev. Prom. 4:4 (3-7). 1955.
The process, and advantages of lowered cost, uniform moisture content, shortened drying cycle, and resistance to fungal attack are discussed.

_____ "Rapid High-Temperature Timber Drying in Non-Aqueous Fluids." Wood, London, 21:6 (220-224). 1956.
Author describes a commercial process (petrolatum drying), plus an adequate description of the role of temperature in the process. Also, benefits gained by this method and amount of energy consumed are given.

*_____, and S. E. Shteinberg. U.S.S.R. Patent No. 103, 493.
Wood Treatment.
Treating wood with petrolatum.

*Keylwerth, R., and H. Kübler. "Wood Seasoning in Hot Tar Oil and Evaluation of Seasoning Periods for High-Temperature-Seasoning." Holz-Zbl. 78:12 (135-136) 1952.
Authors give a formula for period of seasoning based on thickness of stock to be dried and temperature of oil bath.

*Kruml, J. "Seasoning of Woods in Liquids." Drevo. 11:2 (47-51). 1956.

Pecenik, J., and Z. Staniszewski. "Laboratoryjne proby suszenia drewna sosnowego w syntetycznym petrolatum." Przem. Drzewny 8:6 (22-26). 1957.

*Special Methods of Seasoning Wood--Boiling in Oil. Report R1665, U. S. For. Prod. Lab., Madison, Wis. 1956.

*Vintila, E. "Seasoning Beech Veneer in Petrolatum." Industr. Lemn. 5:12 (516-523). 1956.

CENTRIFUGAL DRYING

(See also Whirl Driers)

*Eisemann, E. "Mechanische Holztrocknung mit Trockenzentrifugen." Holz Zbl. 76 (1153-1154). Sept. 5, 1950.

* _____, "Quick Drying of Timber Using Moderate Temperatures." Holztechnik 31:6 (164-167). 1951.
Author describes principle, construction, operation, and working costs of a hydro-extractor with spiral air circulation.

* _____, "Holztrocknung mit Klima-Spiralzentrifugen." Internat. Holzmarkt 42:18 (30-33). 1951.

* _____, "Wood Drying with Spiral Air Centrifuge." Holz 5 (192-196). Aug. 1951.

Fessel, F. "Turbulence Drying of Wood, Using Centrifugal Driers, Turbulent-Air Kilns, or Butterfly-Damper Adaptations on Conventional Kilns." Holz Zbl. 11. Jan. 24, 1953. Translation No. 138 by U. S. For. Prod. Lab., Madison, Wis. 1955.
Author describes each type of drying installation and gives results of drying (time) for each.

* _____, "Practical Results of Seasoning in Centrifugal Hydro-extractors." Holz 8:9 (205-209). 1954.

_____, "A Turning-Point in Seasoning Reached Through the Breaking-up and Removal of the Air Boundary Layer (on the timber surface)." Holz Zbl. 79:11 (95-96). 1953.
Article mainly is concerned with different types of kilns.

_____, "Drying of Hardwoods in a Centrifuge." Holz Roh-u. Werkstoff 10:10 (391-394). 1952.
Author attributes success of centrifuge driers over kilns to indirect action of the centrifugal force in separating the boundary layer from the wood. He describes drier and power requirements and methods of measuring temperature and air circulation.

* _____, "Die Trocknung von Rohfriesen in der Klima-Spiral-Zentrifuge." Parkett, Wiesbaden 6 (65-68). 1956.

Gottstein, J. W. and W. G. Kauman. "Centrifugal and Pulsation Drying; Overseas Developments in the Design of Timber Driers." South African Builders' Merchant, Timber Hardware Mag. 4:11 (16-18) 1954; and For. Prod. News Lett., C.S.I.R.O., Australia, No. 198, 1954.
Discussion of previous work done by Fessell and Kastmark.

*Gratzl, A. "Betrachtungen zur Wirkungsweise der Holztrockenzentrifuge." Holzforsch. u. Holzverwert. 9:1 (8-10). 1957.

Jacobsen, H. "Seasoning of Beech Wood by Centrifugal Force." Holz Roh-u. Werkstoff 11:10 (389-392). 1953. Translation No. 76 by For. Prod. Lab. Div., Canada. 1954.

Author utilized high r.p.m. to show that the pit apertures do not close and restrict moisture movement as previously thought.

*Kastmark, C. F. "Removing Free Water from Timber by Using Centrifugal Force." Pap. ja Puu 33:11 (346-352). 1951.

The results of experiments were uniform moisture distribution; free moisture leaves the wood in about four hours and kiln drying after removal of free water was recommended.

*Kreuzer, A. "Artificial Seasoning of Green Beech Wood in Turbulent-Air and Spiral Air-Circulation Driers." Holz Zbl. 83:140/141 (1705). 1957.

*Mathieu, H. "Le sechoir centrifuge helicoidal." Bois et Scieries, Paris 14 (367-368). 1953.

*Mueller, M. L. U. S. Patent No. 1,772,222. Method of Drying Lumber. Aug. 5, 1930.

Method employs centrifugal force to remove free moisture and then heat to remove combined moisture.

*Scotten, M. "Centrifugal Drying of Wood." Ital. For. mont. 5, (83-84). Mar/April 1950.

*Stadler, S. "A Substantial Advance Achieved by Hydro-Extractors with Spiral Air Circulation." Holz 6:9 (213-217). 1952.

Author gives results of tests conducted with an Eisemann hydro-extractor.

*"Une nouvelle methode de sechage du bois. Le sechage centrifuge." Le Bois National, Paris, 21:19 (362). 1950.

*Villiere, A. "Nouvelles techniques de sechage artificiel. sechage a haute temperature; sechage par centrifugation." Revue du Bois 20:185 (195-197, 214). 1953.

CHEMICAL SEASONING

*Berliner, J.F.T. "Urea Aids Lumber in Drying and Bending. Part I. The Problem of Wood Drying." Furniture Mfr. 58:6 (24-26). 1943.

*_____, "Urea Aids Lumber in Drying and Bending. Part II. Economics of Urea Treatment." Furniture Mfr. 58:7 (25-26). 1943.

_____, U. S. Patent No. 2,346,286. Wood Seasoning Process. April 11, 1944.

Process consists of an aqueous solution of urea and a thickening agent.

*Chemical Seasoning. Report 13, For. Prod. Res. Bd., London. 1948, 1950.

"Chemical Seasoning of Timber; the Use of Urea." Chem. Age 49 (153-156). Aug. 14, 1943.

Article explains cause and prevention of checking, properties of urea, method of application, and kiln schedules to be used for treated lumber.

Colgrove, W. H. "Chemical Seasoning of Lumber." For. Prod. J. 6:10 (417-419). 1956.

Author discusses chemicals used, modes of application, effectiveness, influence on drying schedules, and effect on wood properties.

Desch, H. E. "Chemical Seasoning." Aust. Timber J. 12 (375-376). Aug. 1946.

Lippman, A., Comstock, R. L. and Benjamin, E. B. U. S. Patent No. 2,449,785. Composition and Process for Curing Lumber and Product. Sept. 21, 1948.

Composition consists of a buffered salt solution. Product unknown.

Loughborough, W. K. "Chemical Seasoning of Wood." West Coast Lumberman 63:10 (52-54). 1936.

Author explains the salt treatment process and gives some results.

_____. U. S. Patent No. 2,455,427. Impregnating Wood and Composition Thereof. Dec. 7, 1948.

Composition consists of a buffered urea mixture.

_____. Chemical Seasoning: Its Effectiveness and Present Status. Report D1721, U.S. For. Prod. Lab., Madison, Wis. 1948.

Author explains how the process works, application of chemical, properties and effectiveness of chemicals, and properties of the wood after treatment.

_____. Major Experiments in the Seasoning of Wood. Report R1701, U.S. For. Prod. Lab., Madison, Wis. 1948.

_____ and Espenas, L. U.S. Patent No. 2,500,954. Method Involving the Use of Chemicals for Increasing the Drying Rate of Wood. Mar. 21, 1950.

Patentees claim a mixture of sodium bicarbonate and urea is especially good for chemical seasoning of woods having water pockets, high initial moisture content, or high extractive content.

_____, _____, and J. M. McMillen. U.S. Patent No. 2,546,162. Drying Wood. Mar. 27, 1951.

Composition of chemical is an unpolymerized urea-formaldehyde and a thickening agent.

Mottet, A. L. "Chemical Seasoning of Forest Products." West Coast Lumberman 69:6 (26, 44-45). 1942.

Author discusses advantages and disadvantages of salts, urea, invert sugar, and diethylene glycol as chemical seasoning agents.

Newins, H. S. "Chemical Seasoning of Lumber." Proc., Fla. Acad. Sci. 5 (85-95). 1940, 1941.

Peck, E. C. "Chemical Seasoning of Wood: Hygroscopic and Anti-Shrink Value of Chemicals." Ind. Eng. Chem. 33:5 (653-655). 1941.

*Smith, F. B. U.S. Patent No. 2,347,635. Chemical Seasoning of Wood. April 25, 1944.

Chemical composition consists of an aqueous solution of urea and water-soluble chlorophenolate.

Special Methods of Seasoning Wood--Chemical Seasoning. Report R1665-6, U. S. For. Prod. Lab., Madison, Wis. 1957.

*Tregis, L.A.J. France Patent No. 1,001,957. Method of Wood Drying. Feb. 29, 1952. Translation No. 66 by For. Prod. Lab. Div., Canada, 1953.

Patent describes a dipping treatment in a salt solution.

*Woodhouse, J.C. and C.D. Bell. U.S. Patent No. 2,395,311. Treatment of Wood. Feb. 19, 1946.

HIGH-FREQUENCY DIELECTRIC HEATING

- *Aptekman, I. B. "Radio Frequency Seasoning of Wood." Torfjanaja Promyšlennostj, Moskva, 28:1 (23-25). 1951.
Author describes a radio-frequency seasoning plant operating in Russia since 1950.
- *Billig, K. "High Frequency Currents for Timber Processing." Timber News 58:2129 (114, 117-118). 1950.
Author explains Russian methods of high-frequency seasoning and gives time of seasoning, energy required, and costs.
- *Biriukov, V. A. "Uniformity of Lumber Drying During Speedy Seasoning with the Use of Dielectric and Conventional Heating." Lesn. Prom. 13:7 (25-27). 1953.
- *Blin, H. "The Seasoning of Wood with High-Frequencies." La Nature 66 (Part 1) (180). Mar. 15, 1938.
- *Blond, L. "The Drying of Wood and its Gluing at High Frequencies." Rev. Bois Appl. 3:5 (10-15). 1948.
- Bouf, G. "Le sechage artificiel du bois et la haute frequence." Le Marche du Bois, Paris, 1:2 (1, 4). 1952.
- *Brajnikoff, B. J. "The Theory of Dielectric Heating." Timber News 56:2105 (95-96). 1948.
- *_____. "Wood Improvement by Dielectric Heating." Timber News 56:2104 (49, 50, 59). 1948.
- *Bremer, R. C. The Economy of the New Process. Bremer and Company, Zürich, Germany.
- *Brezinšćak, M. "The Radio Frequency Seasoning and Heating of Wood." Šum. List. 75:8/10 (277-286). 1951.
Author gives a technological and economical analysis of the use of radio frequency in timber seasoning.
- Brumleve, C. C. "High Frequency Produces Heat Within Wood." Veneers and Plywood 38:6 (18, 20). 1944.
Author discusses its application to wood seasoning.
- *Dumitrescu, N. High-Frequency Seasoning Kilns. An. Romano-Soviet. Silv., 10 (31-50). 1951.

- *Egund, K. E. "Törring av traee ved hojfrekvensopvarmning." Traeindustrien 3:3 (31-34). 1953.
- Ewbanks, K.E. "Theory and Application of Dielectric Heating." J. For. Prod. Res. Soc. 1:1 (33-35). 1951.
- Fessel, F. "Practice of Wood Drying in the High Frequency Electric Condenser Field in Different Countries." Holz Roh-u Werkstoff 14:2 (41-47) 1956. Translation No. 95 by For. Prod. Lab. Div., Canada, 1956.
Author describes several types of driers and the relationship of this type of drying to wood quality, moisture uniformity, etc.
- _____. "Radio-Frequency Drying of Hardwoods. Results of Experiments." Holz Roh-u Werkstoff 10:7 (280-283). 1952.
- *Gei, N. N. Seasoning of Wood with the Aid of Sonic-Frequency Electric Current. Sbornik Ukr. NIIMOD, Kiev, pp. 85-103. 1950.
The author gives seasoning schedules, effect on wood, and describes the apparatus.
- *Hafner, T. Technological Principles of Dielectric Seasoning. Bremer & Company, Zürich, Germany.
- *_____. "Hochfrequenzerwärmung in der Holzindustrie." Elektr.-Verwertg., Zürich, 28:12 (6-9). 1953.
- *Hafner, T. "The Economics of Using High-Frequency Heating in the Wood Industry." Int. Holzmarkt. 15 (21-24). 1955.
- *Hamada, R., T. Maku and S. Kadita "Wood Drying by Radio Heating." Wood Res., Kyoto, 8 (44-54). 1952.
- Hartshorn, L. "Radio-Frequency Heating." Wood, London, 15:2 (61). 1950.
- "High Frequency Kiln." Wood Notes 13(1), Northeastern Wood Utilization Council, 1950.
- Holland, F. "Radio Frequency Drying of Birch Stock for Broomheads." Wood, London, 20:3 (86-89) 1955.
Author describes the equipment and reviews past work in the field. He also gives a break-down on equipment and operating costs.

_____. "Wood Drying by Radio Frequency." B. C. Lumberman 39:9 (42, 44-45). 1955.

Author gives a summary of drying by R. F. heating and concludes it is suitable for hardwood specialty items.

Ishaq, S. M. High Frequency Drying of Wood. Report R1681, U. S. For. Prod. Lab., Madison, Wis. 1947.

Author discusses theory and application of high frequency and gives results of his experiments on various woods.

*Kauffmann, G. "Les applications de la haute frequence a l'industrie du bois." Revue du Bois 6:11 (28-30). 1951.

Kegal, K. "Possibilities of Dielectric High-Frequency Drying in the Timber and Paper Industry." Das Papier 4:21/22 (405-410). 1950.

Translation No. 1476 by Commonw. Sci. Ind. Res. Org., Australia.

Author gives an illustrated discussion on use of high-frequency drying in wood industry, especially in paper. He concluded in wood drying that thickness increases time and energy progressively.

*Kollman, F. Untersuchungen über die Ursachen von Schaden bei der Trocknung von grünem Eichenholz; zugleich Mitt. über Festigkeitsprüfungen an Holz in hochfrequenten Wechselfeld. Svenska Traforskningsinstitutet, Stockholm. Tratekniska Avdelningen. Meddelande 21 (32). 1950.

*Kühne, H. Dielectric Seasoning of Wood. Bremer & Company, Zürich, Germany.

Miller, D. G. "Experimental Drying of Wood by Dielectric Heating." Canada Lumberman 68:11 (40-41, 50, 52, 54). 1948.

Author conducted small-scale tests mainly on the theory of high-frequency heating. After the tests, he concluded dielectric heating is suited to drying below the fiber-saturation point.

_____, "Application of Dielectric Heating to the Seasoning of Wood." Proc. For. Prod. Res. Soc. 2 (235-241). 1948.

*Mittleman, E. and J. L. Stephen. "Drying of Wood by High Frequency Current." Wood Products 46:10 (16-17) 1941.

Their experiments indicated green wood can be dried effectively and at a low cost.

- *Netusil, A. V. and B. A. Goljdblatt. "High Frequency Drying and Impregnation of Timber." Elektricestvo Moskva 4 (12-17). 1948.
Author tells of high-frequency kilns operating in Russia and describes method and calculations in arriving at a drying schedule.
- *Osawa, K. "On the Drying of Flooring Boards of Isu by High Frequency." Jap. Forestry Soc. J. 32 (135). April 25, 1950.
- Pratt, G. H. and A. R. Dean. Report on an Investigation into the Drying of Timber by the Application of Radio Frequency Heating. For. Prod. Res. Lab., Princes Risborough, Aylesbury, Bucks., England. Oct. 1951.
Authors give results of experiments on drying different wood species by either boiling or temperature-gradient method. Report is a good guide for experimental procedure.
- Radio Frequency Drying. Reports 13-14, 20, 12-13, For. Prod. Res. Bd., London. 1948-1950; 1950-1951; 1955-1956.
- Russell, G. F. "Drying and Laminating by Radio Frequency; New Technique Declared to Offer Possibilities in Connection with Methods." Timberman 45:10 (38, 40, 42). 1944.
Author relates general statements on R. F. heating. Results of tests indicated good drying times, but honeycombing occurred.
- *Sauter E. German Patent No. 698,964. Drying, Particulary Lumber and Cellulose, by Means of a High-Frequency Field with Short or Ultra-Short Waves. Oct. 24, 1940.
- *"Sechage du bois par chauffage dielectrique." Le Bois National, St. Etienne, 23:5 (25). 1952.
- *Simorda, J. "Vysokofrekvencni ohrev silnych vrstev nevodivych materialu." Drevo, Prag. 10:10 (228-229) 1955.
- Special Methods of Seasoning Wood--High Frequency Dielectric Heating. Report R1665-7, U. S. For. Prod. Lab., Madison, Wis. 1954.
- Taylor, J. P. "Heating Wood with Radio-Frequency Power." Trans., Amer. Soc. Mech. Engrs. 65 (201-212) 1943.
Author reviews the theory of R. F. heating, factors determining its applicability and usefulness and presents data for calculating power requirements, time cycle, and operating cost.

Taylor, J. P. "ABC of Heating Wood with High Frequency Power." Canada Lumberman 63:19 (14-16). 1943.

Terazawa, S. and M. Irvashita. High Frequency Drying of Wood. Bul. 86, pp. 229-243, Gov't. For. Exp. Sta., Japan. Feb. 1954. Translation No. 87 by For. Prod. Lab. Div., Canada. 1955.

Authors describe a small-scale test on drying flooring boards, but they did work on moisture gradients and actual temperature measurement in the lumber,

Venable, D. "Dielectric Heating Fundamentals." Electronics 18:11 (120-124). 1945.

Villiere, A. "High Frequency and Wood Drying." Rev. Bois Appl. 12:1 (26-28). 1957. Translation No. 114 by For. Prod. Lab. Div., Canada. 1957.

Author states all tests were on small specimens and the economic aspects were considered. He concluded uniformity in moisture content and holding stresses to a minimum can be accomplished.

* _____, "Seasoning of Lumber by High Frequency Currents." Rev. Bois Appl. 11:1 (26-31). 1956. Translation No. 103 by For. Prod. Lab. Div., Canada. 1956.

Author describes methods and apparatus employed by an industrial plant in Switzerland. Results and cost estimations are included.

Vodoz, J. "A New Experimental Set-up for Studying the Behavior of Various Wood Species in High Frequency Drying." Holz Roh-u. Werkstoff 14:10 (407-409). 1956.

HIGH-TEMPERATURE DRYING

- Brown, W. H. "High Temperature Drying." Timber Technol. and Mach. Woodworking 65:2212 (93-94). 1957.
Review of work accomplished at the Ottawa Forest Products Laboratory.
- *Czepek, E. "Artificial Drying of Timber in Practice." Holz 4:9 (169-173). 1950.
Discusses problems of drying at temperatures above 100 C.
- *_____. "Timber Drying at Temperatures Above 100°C." Holz 4:12 (246-247). 1950.
Author details procedure, efficiency and energy consumption of a modern high-temperature kiln.
- _____. "Theory and Practice of High Temperature Wood Drying." Holz Roh-u. Werkstoff 10:1 (1-6) 1952.
- *_____. "Wood Seasoning at Temperatures Above 100°C." Allgemeine Wärmetechnik Dissen. 4:3 (54-59). 1953.
- *"Die Hochtemperaturtrocknung für Holz." Internat. Holzmarkt 15/16 (25). 1954.
- Egner, K. "Drying of Wood at Temperatures Above 100°C." Holz Roh-u. Werkstoff 9:3 (84-97). 1951.
Author describes the kilns and states that uniform moisture content and physical behaviour of the wood was unchanged from that of normal kiln drying.
- *_____, "Heiss trocknung von Holzern." Schweiz. Arch. Angew. Wiss Techn. 18:9 (292-307). 1952.
- *"Eine Holztrockenanlage bei Verwendung von Temperaturen über 100 Grad." Internat. Holzmarkt 42:5 (33). 1951.
- *Eisemann, E. "Rapid Kiln Seasoning at Temperatures of Over 100°C." Holztechnik 29:8 (151-155). 1949.
A graphical comparison is presented of drying hardwoods and softwoods by high temperature and normal kiln drying.
- *_____. "Sechage du Bois a Temperatures elevees." Le Bois National, Strazburg, 22:2 (26). 1951.

Fleischer, H. O. Drying Rates of Thin Sections of Wood at High Temperatures. Bulletin No. 59, Yale School of Forestry, 1953.

Author concluded moisture diffusion is not the major controlling factor in drying thin sections, but that temperature gradient and heat transfer must be considered.

*Gratzl, A. "High Temperature Seasoning." Internationaler Holzmarkt 1 (1-6). 1951.

Author discusses characteristics of high-temperature kiln and savings of time and energy compared to that of a regular kiln.

*_____, "Der Weg Zur Hochtemperaturkrocknung." Internat. Holzmarkt 42:1 (18-23). 1951.

*_____. "Die Hochtemperaturtrocknung." Osterr. Zimmermeister 6 (5-6). 1951.

*_____. "Le sechage des bois a haute temperature." Revue du Bois 6:7/8 (19-22). 1951.

Guernsey, F. W. "High-Temperature Drying of British Columbia Softwoods." For. Prod. J. 7:10 (368-371). 1957.

Author reviews past history, describes equipment at Vancouver Laboratory, and gives results of tests on Douglas Fir and hemlock.

*Hartwig, G. "Drying Wood Above 100°C." J. South African For. Assoc. 24 (29-43). 1954.

Author relates principles and methods of high-temperature drying and gives results of tests conducted on various European and Canadian wood species.

*_____, "Seasoning of Wood at Temperatures Above 100°C." South African Builder's Merchant, Timber and Hardware Magazine 5:8 (7-15) 1955; and 7:5 (12-20). 1957.

*"High Temperature Kilning." Wood, London, 17:10 (409). 1952.

"High Temperature Kilns." Timber Canada 13:11 (22-23, 36). 1953.

*"High Temperature Kilns." Timber Trade J. 202:3967 (1957-1958). 1952.

*Jiru, P. "Development of a Compartment Kiln for Drying Converted Timber at Temperatures up to 100°C." Drev. Vyskum 1:1/2 (195-223). 1956.

- *Kaiser, H. "Ein interessanter Fortschritt auf dem Gebiet der Holz-trocknungstechnik. (Super-Hochtemperatur-Holz-trocknungs-maschine.)" Internat. Holzmarkt 8 (26-27). 1955.
- *Karlsen, O. "Artificial Drying of Wood at Temperatures of over 100°C." Norsk Skogind. 5:5 (138-140). 1951.
- *Kauman, W. G. "Superheated Steam Seasoning." For. Prod. News. Lett., C.S.I.R.O., Australia, No. 201, 1954.
- *Kauman, W. G. "Superheated Steam Seasoning." South African Builders' Merchant, Timber and Hardware Magazine 5:2 (23-24). 1955.
- _____. "Equilibrium Moisture Content Relations and Drying Control in Superheated Steam Drying." For. Prod. J. 6:9 (328-332). 1956.
Author presents tables of relative humidity and equilibrium moisture content in superheated steam. Also, he discusses the application of superheated steam drying and control thereof.
- Keer, G. A. "High-Temperature Kilning." Wood, London, 22:10 (416-417), 1957 and 22:11 (451-453), 1957.
Gives a general review of Ladell's work at the Ottawa Forest Products Laboratory.
- Keylwerth, R. "Fundamentals of High-Temperature Drying of Wood." Holz Zbl. 76, Sept. 23, 1949. Translation No. 60 by For. Prod. Lab. Div., Canada, 1953.
The article is basic in nature and deals mostly with temperature and relative humidity during the drying process.
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Authors review past literature and give schedules for coniferous timber. They state elevated temperatures do not cause additional internal stresses or poor uniformity of drying.
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_____. "High-Temperature Drying of Yellow Birch." For. Prod. J. 6:11 (469-475). 1956.

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Author determined a high circulation rate and periodic fan reversal gave good moisture uniformity. Also, he describes the new kiln constructed at the Ottawa Laboratory.

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*Mikit, E. A., and K. K. Upmanis. "High-Temperature Seasoning of Sawn Timber." Derev. Lesohim. Prom. 3:8 (3-5). 1954.

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Authors give schedules for drying coniferous and hardwood timbers in superheated steam.

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Pratt, G. H. High-Temperature Drying of African Mahogany. Dept. Sci. Ind. Res., For. Prod. Res. Lab. (Seasoning Section), Princes Risborough, Aylesbury, Bucks, England. Sept. 1954.

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- *Dérivé, M. "Wood Seasoning by Infra-Red Rays." Rev. int. Bois 9:94 (121-126). 1942.
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Pine (Pinus) Lumber. Ala. Polytech. Inst. Eng. Expt. Sta., Eng.
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- *Rajkowski, M. "Dalsze uwagi o suszarni touenowej." Przemysl Drzewny, Warsz. 6:7 (14-17). 1955.
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Seasoning and Treating Water Swollen Fibrous Materials. Nov. 17,
1936.

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- *Vapor Drying Process. Charge No. 2. Main Plant. Oak Crossties. Tech. Rep. No. 52, Taylor-Colquitt Co. Res. Lab. 1945.
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- *Waligora, A. "Uwagi nad metoda pospiesznego suszenia drewna toluena." Sylwan 99:5 (409-422). 1955.
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WHIRL DRIERS

(See also Centrifugal Drying)

*Egner, K. "Investigations on the Natural Seasoning of Wood ('swing rack' seasoning)" Holz 3 (7-15). 1940.

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Article describes the drier and its mode of operation.

UNCLASSIFIED METHODS

- *Barksdale, B. E. U. S. Patent No. 2,464,429. Apparatus for Drying Lumber. Mar. 15, 1949.
Process consists of subjecting wood to molten paraffin at 250 F.
- *Crail, A. O. U.S. Patent No. 1,416,269. Seasoning Wood. May 16, 1922.
Method consists of boiling wood in a common salt solution for six hours, then placing the wood in a heated chamber to complete drying.
- Creighton, J. W. and S. T. Dexter. Drying Lumber by Desiccating Agents. Mich. Agric. Exp. Sta., Quart. Bul. 33:2 (114-123). 1950.
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- *Dhe, P. H. U.S. Patent No. 1,497,362. Desiccation of Wood. June 10, 1924.
Wood is subjected simultaneously to heat and a desiccating agent.
- Elmendorf, A. U.S. Patent No. 2,556,686. Drying Hardwoods. June 12, 1951.
After removal of free moisture, the patentee suggests further drying be done with the boards under constraint in the presence of heat and pressure.
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- Ghai, M. L. "Seasoning of Timber with Solar Energy." In F. Daniels and J. A. Duffie Solar Energy Research. Univ. Wis. Press, Madison. Pp. 243. 1955.
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- *Goodall, C. Germai. Patent No. 517,714. Sept. 15, 1929.
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- *Hoffman, W. P. U.S. Patent No. 2,534,714. Wood Conditioning Process. Dec. 19, 1950.
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- *Javal, R. "The 'Irradios' Wood-Seasoning Kiln." Les Techniques du Bois 2 (44-46). 1947.
- *Kapur, S. N. Results of Experiments on the Kiln Drying of Wood with Ozonized Air. Manager of Publications, Indian Forest Records, Delhi, 20:13. 1935.
- *Kvalnes, H. M. U.S. Patent No. 2,302,611. Treatment of Wood. Nov. 17, 1942.
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- *Lyon, G. F. U.S. Patent No. 1,456,809. Treating Wood. May 29, 1923.
Wood is subjected to reduced atmospheric pressure and treated with ozonized air.
- *_____, U.S. Patent No. 1,693,486. Apparatus for Treating Wood with Ozone. Nov. 27, 1928.
- "New Method of Seasoning Wood." Scientific Amer. 116 (42). 1917.
Method consists of placing wood in a pit in the ground and spreading a desiccating agent over the lumber.
- *Toney, W. U.S. Patent No. 2,296,546. Artificial Seasoning of Lumber. Sept. 22, 1942.
- *Twyble, J. A. Great Britain Patent No. 578,379. Nov. 26, 1943.
Timber is heated in a kiln having a hot floor surface containing lime or sodium bicarbonate. After such treatment, dry air is circulated.

