Wood Machining Highlights, 1972 and 1973

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Editor's Note

The abstracts from the compilations listed in the footnote on this page have recently been inserted in the Forest Products Research Society's Abstract Information Digest Service (*AIDS*). This system offers an efficient and economical means of retrieving data not only on wood machining but in all other fields of forest products utilization. Users can order abstracts directly from the Society or can obtain reference data in the form of computer printouts. Also available to subscribers is a simple desk-top microfiche system. Rapid manual retrieval of citations and abstracts is made possible through the use of comprehensive keyword and species indexes.

Abstract

Important wood machining research published during 1972 and 1973 is highlighted to provide the reader with a concise summary of activity in 17 fields of endeavor. The review is based on 427 references and contains 154 citations. Fields of activity covered include:

History and general texts
Properties of wood
Orthogonal cutting
Peripheral milling parallel to grain
Barking
Sawing
Jointing, planing, molding, and shaping
Boring, routing, carving, and turning
Machining with coated abrasives
Veneer cutting, chipping, flaking, and grinding
Defibrating
Properties of the cutting edge and cutter
Computer, tape, and card control of machines
Research instrumentation and techniques
Machinability of species and reconstituted wood
Safety, including noise

THE PURPOSE OF THIS PAPER is to highlight important wood machining research published during 1972 and 1973. No attempt is made to elaborate on the impact or significance of individual contributions. Rather, the style and format of previous reviews (Koch 1968, McMillin 1970) were followed in an attempt to give the reader a concise summary of activity in various categories of endeavor.

Any survey of this nature must inevitably omit much notable research. Partly in the hope of rectifying omissions, the author has prepared a complete classified listing, with abstracts of most entries, of the 427 publications considered. The listing is titled "Wood machining abstracts, 1972 and 1973," and comprises Research Paper SO-101 of the Southern Forest Experiment Station.[1]

The publications to be mentioned are mainly of a research nature, but trade journal articles have been included when judged to be of interest. While most of the literature is from 1972 and 1973, an attempt was made to include important papers that had been missed in the earlier searches. Principal sources were archival journals in wood science and technology, but

[1]The Research Paper, together with prior wood machining reviews and texts, provides a comprehensive set of abstracts complete from 1957 through 1973. The earlier compilations were:

Committee on Recent Wood Machining Literature. 1959. Wood machining abstracts, 1957-1958. Forest Prod. Res. Soc., Madison, Wis. 20 pp.

Committee on Recent Wood Machining Literature. 1960. Wood machining abstracts, 1958-1959. Forest Prod. Res. Soc., Madison, Wis. 19 pp.

Committee on Recent Wood Machining Literature. 1961. Wood machining abstracts, 1959-1961. Forest Prod. Res. Soc., Madison, Wis. 18 pp.

Koch, P. 1964. Wood Machining Processes. Ronald Press Co., New York, N. Y. 530 pp.

Koch, P., and C. W. McMillin. 1966. Wood machining review, 1963 through 1965. Forest Prod. J. Part I, 16(9):76-82, 107-115; Part II, 16(10):43-48.

Koch, P. 1968. Wood machining abstracts, 1966 and 1967. USDA Forest Serv. Res. Pap. SO-34. So. Forest Expt. Sta., New Orleans, La. 38 pp.

McMillin, C. W. 1970. Wood machining abstracts, 1968 and 1969. USDA Forest Serv. Res. Pap. SO-58. So. Forest Expt. Sta., New Orleans, La. 35 pp.

Koch, P. 1973. Wood machining abstracts, 1970 and 1971. USDA Forest Serv. Res. Pap. SO-83. So. Forest Expt. Sta., New Orleans, La. 46 pp.

Research Papers SO-34, SO-58, and SO-83 and the 1963-1965 review by Koch and McMillin are available from the So. Forest Expt. Sta., Room T-10210 U.S. Postal Services Bldg., 701 Loyola Avenue, New Orleans, LA 70113. The remaining reviews must be sought from the publishers.

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Forestry Abstracts, published by the Commonwealth Agricultural Bureaux, Farnham Royal, England, and the Bureaux' Card Title Service were invaluable. The search also included the *Abstract Bulletin of the Institute of Paper Chemistry* and publications lists and annual and periodic reports issued by the regional Forest Service experiment stations and the Forest Products Laboratory, Madison, Wisconsin.

During the review, it became apparent that research is continuing at a high level. The total number of references netted was 427. Of these, 199 were from 1972 and 148 from 1973. The remaining 80 were published prior to 1972 (or undated) but not included in previous reviews. Probably the present search omits some publications that appeared late in 1973. As the following tabulation indicates, the subject matter categories with the most publications were sawing, defibrating, properties of the cutting edge and cutter, and safety:

Category	No. of publications
History and general texts	
Properties of wood	
Orthogonal cutting	
Peripheral milling parallel to grain	
Barking	
Sawing	
Jointing, planing, molding, and shaping	
Boring, routing, carving, and turning	
Machining with coated abrasives	
Veneer cutting, chipping, flaking, and grinding	
Defibrating	
Properties of the cutting edge and cutter	
Computer, tape, and card control of machines	
Research instrumentation and techniques	
Machinability of species and reconstituted wood	
Safety, including noise	
Other subjects not included in this review	
Total	

History and General Texts

In a 1,663-page textbook on utilization of the southern pines, Koch (1972) devoted 193 pages (including 116 illustrations) to wood machining. The chapter covers 14 fields of machining activity and cites 148 references, including much recent research and data specific to southern pines. Dost (1971) collected papers of 12 authors in a 172-page proceedings. Subjects include wear, circular saw stability, machining with coated abrasives, dimensional accuracy in sawing, machinery and mill layout, and technological progress in North America.

Properties of Wood

Borgin (1971), Saiki, Furukawa, and Harada (1972), and Scurfield (1972) employed the unique characteristics of the scanning electron microscope to describe the surface morphology of wood stressed to failure. Furukawa, Saiki, and Harada (1973) and Page, El-Hosseiny, Winkler, and Bain (1972) measured the strength and observed the fracturing of single tracheids stressed in tension. Morphologies of fractures in shear parallel and perpendicular to the grain were elucidated by DeBaise (1972).

Knudson and Schniewind (1972) examined the effect of some organic solvents on the coefficient of friction between wood and steel. Other physical and mechanical properties basic to the wood machining process were reported by Palka and Holmes (1973a), Tomin (1972), and Dhar and Purkayastha (1973).

Orthogonal Cutting

An anonymous author (n.d.) produced a black and white sound film of the rupture patterns occurring when wood is cut in each of the three cardinal directions and in the pulp chipping orientation. Hamamoto and Mori, in a series of three papers, dated 1972, continued their fundamental studies of the low frequency vibratory cutting of wood, while Huang and Hayashi (1973) analyzed stresses in orthogonal cutting parallel to the grain. Varbanov (1972) proposed scraping wood with a heated, fixed knife as an alternative to sanding. In his experiments, surface quality was as good as that obtained with abrasives. Various aspects of splitting logs were discussed in two papers by Altman (1973) and in a publication by Vries (1973).

Peripheral Milling Parallel to Grain

Mihut (1971) reviewed the kinematic theory of peripheral milling with special attention to the case where the axis of the cutting head is not perpendicular to the direction of feed. Murga and Ivanovskii (1972) reported on various factors related to surface roughness, while Rushnov, Pryakhin, and Maslovskii (1973) studied the effect of chip breakers on the quality of chips. Sima, Mihut, and Lazar (1972) described a system for imparting axial oscillations to a rotary cutterhead. In trials, such action greatly improved surface quality.

Barking

Polozov (1971 and 1972), in continued investigations on barking wood with jets of compressed air containing a sawdust filler, found the optimum mixture to be about 65 percent air and 35 percent sawdust (by weight). New barking machines or barking systems were the subject of papers by Zimmerman (1971) and an anonymous author (1972).

Removal of bark from barky chips commanded considerable attention. Papers included those by Arola and Erickson (1973), Arola and Hillstrom (1972), Erickson (1972), Harkin and Crawford (1972), and Julien, Edgar, and Conder (1972).

Sawing

Holemo and Dyson (1972) described a method to determine the percentage of idle time and the causes of work stoppages, while sawmill machinery and layout were the subjects of papers by Montague (1971), Thunell (1972a), and White (1973). Dobie and Sturgeon (1972) found the productivity of double-cutting band headrigs to be 14 to 23 percent greater than that of single-cutting rigs. Hallock and Lewis (1971) explained the BOF (Best Opening Face) program–the process substantially increases softwood dimension yield from small logs and is expected to be rapidly applied by industry.

Sukhanov (1973) reviewed his previous research on vibration cutting and described a new sash gangsaw that differs from conventional saws in the considerably reduced stroke and increased speed. Borovikov and Pozdeev (1971) observed that both cutting and thrust forces increased only slightly with decreasing clearance angle and concluded that teeth of sash gangsaws can be strengthened by reducing the clearance angle.

Malcolm and Hallock (1972) compared the effect of three circular sawing methods on warp of hard maple dimension cuttings and found that grade sawing produced greater areas of skip-free surface than did live sawing. St-Laurent (1973) noted that the surface quality of ripsawn lumber was high when blade protrusion was minimum, an arrangement that produced long ribbonlike chips in the waste. The chainsaw was the subject of considerable research aimed at reducing vibration and noise.

The reporting period of this review saw the first commercial application of fluid jets to cut furniture components from convolutely laminated and spirally wound paper tubes (Chamberlin 1973, Eberle 1973). Seeking further applications for high-energy jets, Szymani (1972) explored cutting of corrugated board. Cuts were of acceptable quality and were made at speeds in excess of current production methods.

McMillin (1972) provided a status report on machining with lasers. With an air-jet-assisted, 200-watt carbon dioxide laser, he was able to cut 0.25-inch-thick southern pine boards at a rate of 111 in./min. Cuts as deep as 1 inch were possible but at reduced speed. Klante (1972) and Ratoff (1973) suggested that cutting with lasers should also find increased application in the paper industry.

A practical procedure for estimating (with nomographs) the force and power requirements to shear roundwood of various densities and diameters was provided by Arola (1972). Various types of commercial tree-length harvesters were evaluated by Picard (1972), Powell (1970, 1971, 1973), and Sterle (1971, 1973).

Jointing, Planing, Molding, and Shaping

Bunemovich, Vekshin, and Kleba (1971) commented that helical knives for planers permit high feed speeds without reduction of surface quality. Stewart (1972) compared the power requirements and surface quality of wood planed with knives and abrasives. In another paper, Stewart (1973) explained the advantages of cross-grain knife planing.

Boring, Routing, Carving, and Turning

The use of ultrasonic vibration in turning was explored by Noguchi, Fujiware, and Sugihara (1973). Mater (1972) described the design of a machine for boring 2-1/2-inch-diameter holes lengthwise through 40-foot-long electrical transmission poles at a rate of 12 ft./min. In tests, bored poles were found to dry faster and absorb more preservative than solid poles. Strength was slightly reduced.

McMillin and Woodson (1972) studied the moisture content (MC) of southern pine as related to thrust, torque, and chip formation in boring. For the 1-inch spur machine bit tested, they found that net power at the spindle required to cut 0.020-inch-thick chips is not likely to exceed 2 horsepower, regardless of boring direction or MC. Thrust did not exceed 200 pounds, and chip types resembled those obtained in orthogonal cutting. In a second paper (Woodson and McMillin 1972), thrust, torque, and hole quality in southern pine were evaluated when deep (10-1/2-in.) holes were bored with a ship auger and a double-spur, double-twist machine bit.

Machining with Coated Abrasives

An anonymous author (1973) described the use of bonded abrasive wheels, individually shaped to fit the contour of the workpiece, to sand moldings and other complex shapes. Kato, Fukui, and Ono (1972) shed light on the performance of various types of abrasive belts. Hamamoto and Mori, in two papers dated 1973, continued their studies of vibratory sanding by elucidating the effects of vibration on the service life of abrasives, rate of material removal, and surface roughness.

Veneer Cutting

The process, properties, and economics of producing structural lumber from laminated veneer were detailed by Koch (1973) and by Bohlen (1972). Dobie and Neilson (1973) noted that when lumber prices are high it may be profitable to increase the core size and thereby the yield of lumber from the core. Feihl (1972) tabulated heating times for frozen and unfrozen logs of seven Canadian conifers and hardwoods. In two 1973 papers, Feihl and Carroll provided additional data on peeling veneer with a floating nosebar. Lutz (1971, 1972) described the physical and mechanical properties of wood important to veneer production and use.

Palka and Holmes (1973b) reported the effect of log diameter and clearance angle on the quality of 0.125-inch-thick veneer of Douglas-fir. For best control of roughness, they found the clearance angle should increase from 0°00′ at the periphery to 0°30′ in the central heartwood, and decrease again to −0°30′ near the core. Peters, Mergen, and Panzer (1972), in a further study of slicing thick veneer, found that inclining the knife relative to the workpiece did not result in the best overall quality. Sugiyama and Mori (1973), in continued fundamental studies, analyzed stress distribution in the workpiece when various types of nosebars were used. Tochigi and Hayashi, in two papers dated 1972 and one dated 1973, reported experiments in which a high pressure air jet was used in place of a nosebar. A simple, accurate tool costing about $40 was described by Walser (1972) to assist lathe operators in adjusting knife heights.

Chipping, Flaking, and Grinding

Edberg and Eskilsson (1972) devised a screening technique to analyze the distribution of undersize chips in mill run samples, while Hakkila and Saikku

(1972) developed a simple method of estimating the percentage of bark in sawmill chips used for pulp. The effect of chip geometry and MC on yield and quality of kraft pulps was detailed in two publications by Hatton and Keays (1972, 1973). The possibility of hydraulic transport of chips was advanced by Goru (1971) in a basic engineering study. Keating and Albertson (1972) described a chipper having an improved method of discharge that reduces chip damage. Neubaumer (1971) gave an illustrated account of different types of horizontal hogs, while Radulescu (1972) compared the advantages and limitations of disk and drum chippers with data on commercial models.

Fahey and Hunt (1972) evaluated lumber recovery from Douglas-fir thinnings at a bandmill and two chipping centers. Galloway and Thomas (1972) compared the characteristics and pulping properties of chips produced by a Chip-N-Saw to those from a conventional disk chipper. The Chip-N-Saw chips cooked faster in kraft pulping, gave comparable yields, and had fewer rejects. Mason (1973) described a shaping-lathe headrig developed by Koch. The machine can make cants of any desired geometry together with flakes for structural, exterior particleboard.

Defibrating

Koran (1970) produced electron micrographs illustrating the surface structure of thermomechanical pulps, while Kibblewhite (1972) described the effect of beating on fiber morphology and surface structure. Breck, Jackson, and Ranger (1972) reported that properties of stone groundwood pulps are strongly influenced by the orientation of the wood surface at the grinding zone and that the fiber-removal mechanism differs with tissue type. Markov, Tret'yakova, and Nechkin (1973) calculated the average temperature at the interface of the pulpstone and wood surface to be 135° to 150°C., while May, Miles, and Jeffreys (1973) measured the temperature in the working zone of a chip refiner. Various optical devices to characterize the quality of mechanical pulps were described by Hill and Eriksson (1973), Reiner and Jackson (1973), and Johnsson (1973). For graphic papers, mechanical pulps are generally thought to be inferior to chemical pulps, but Rudstrom, Samuelsson, and Uhlin (1973) surveyed the Swedish market and found the papermakers' and the printers' requests for quality exaggerated and considerably higher than demanded by the end user.

McMillin (1973), seeking to corroborate a previously advanced theory, stressed individual tracheids of loblolly pine in torsion and observed the mechanism of failure at high magnification in a scanning electron microscope. Desirable ribbonlike fragments formed after initiation of a crack and were unwound with further twisting. The cracks were generally parallel to the zone of weakness delineated by the fibril helix. Additional fundamental data on fiber separation and strength development in mechanical pulps were provided by Atack (1972), Blechschmidt and Unger (1973), Corson (1973), and Hoglund and Tistad (1973).

Atack and Wood (1973) reported that when dilution water was fed into the eye of a refiner in the form of high speed jets, the refiner could be operated at discharge consistencies of 30 to 35 percent with reduced energy consumption. Bergstrom, Dahlquist, Fredriksson, and Peterson (1972) found that refiner plates made of a martensitic stainless steel yielded satisfactory pulps after 1,500 hours of operation, while those of conventional white cast-iron lasted only a few hundred hours.

Beath, Mihelich, Wild, and Beaulieu (1973) reported on the use of sodium sulphite as an additive in the manufacture of refiner groundwood. Chow, Walters, and Guiher (1971) found that the pH of fiber made from various hardwoods and nonwoody residues differed after processing in a steam-pressurized refiner. When such fiber is used in boards, the authors noted, adhesive selection should be based on an afterprocessing pH value. Numerous other authors gave data on the refining and grinding of various species at particular installations.

Properties of the Cutting Edge and Cutter

Dem'yanovskii (1972) provided information on the properties of the main steels used in woodworking and on thermal treatment of tools. Practical information on sharpening, setting, and tensioning circular saws was the subject of papers by an anonymous author (n.d.) and by Stephenson and Plank (1972). Karpunin (1970) described a procedure for swage-setting sash gangsaw teeth at 1,200°C; by comparison with conventional cold swaging, the method increased tooth life twofold.

Stability of sash gangsaws received the continued attention of Thunell (1972d). Data on circular saw stability were provided by McKenzie (1973), McLauchlan (1972), and Mote and Nieh (1973). Stability effects in bandsaws were reported in two papers by Pahlitzsch and Puttkammer (1972, 1973) and in two 1972 (b,c) publications by Thunell. A method of calculating the temperature distribution in a cutting tool was disclosed by Ohushima and Sugihara (1972).

Computer, Tape, and Card Control of Machines

Airth and Calvert (1973) and Erickson and Markstrom (1972) described the use of computer-simulated sawing to maximize yield. Porter (1972) reviewed European and North American developments in electronic log scaling systems and in minicomputers with programs for yield optimization. Ward (1972) described a computer-controlled cutoff saw that can process about 10,000 board feet in 8 hours.

Research Instrumentation and Techniques

Kumar (1972) and Treiber (1971) discussed applications of the transmission and scanning electron microscopes in wood processing research. Operational principles of strain gages, the construction of transducers, and use of associated instrumentation were subjects of a paper by Johnston and St-Laurent (1973). Data on research instrumentation were given a number of additional references:

Function	Reference
Veneer bolt temperature	Anonymous (1973)
Laboratory chipper	Bagley and Jacobsen (1972)
Veneer roughness	George and Miller (1970, Hse (1972)
Chip density	Hudson and Williams (1973)
Fiber length	Karnis, Kerr, and Forgacs (1972)

Machinability of Species and Reconstituted Wood

Glebov and Kucherov (1972) measured cutting forces in hot-pressed particleboards made without binder, and Lyubimov (1972) measured the surface roughness of compreg sanded with a glass abrasive disk.

A number of publications gave data on the machinability of wood species:

Species	Cutting Process	Reference
Black spruce		
Western redcedar	Peeling	Hailey, Hancock, and Walser (1973)
Red pine	Sawing	Hallock and Malcolm (1972)
Pine	Peeling and slicing	Newall, Hudson and White (1969)
Poplar	Sawing, planing, and peeling	Sacre (1973)
Ponderosa pine	Peeling	Woodfin and Lane (1971), Yerkes and Woodfin (1972)
Black locust	Slicing	Achterberg, Bucher, and Matschey (1972)
Hard maple	Peeling	Feihl and Godin (1973)
Rosewood	Peeling	Jain, Gupta, and Bagga (1973)

Safety, Including Noise

An anonymous author (1973) prepared a preliminary noise code by specifying test conditions, machine operating modes, instruments and procedures for measuring noise, and methods of reporting test results. Bryant (1972) discussed noise pollution and environmental aspects of preservatives and extractives in streams. The medical aspects of exposure to noise were presented by Glorig (1972). He concluded that information is sufficient to institute hearing-conservation programs and prevent hearing loss in most individuals.

Lowery (1973) stated that many noise problems can be solved by one or more of the following procedures: 1) replace noisy equipment with less noisy machinery; 2) dampen vibrating surfaces; 3) cut transmission by isolation or enclosure; 4) change directivity by barriers; and 5) (least desirable) apply sound-absorbing material on wall surfaces.

An anonymous author (1972) noted that one out of every four job-related injuries involves fingers and hands and that gloves of proper specifications reduce the hazards in many situations. Another anonymous author (1971) summarized the mandatory requirements of the British 1961 Factories Safety Act and gave useful suggestions for preventing accidents and fires. Many additional references attested to current interest in the subject of safe working conditions.

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