Forest Products NEWSLETTER

Introduction to a new series of Forest Products Newsletters

by Dr Warren Hewertson
Chief CSIRO Division of Chemical and Wood Technology

Dr W. Hewertson, Chief of the CSIRO Division of Chemical and Wood Technology.

Almost ten years have elapsed since Number 401, the last Forest Products Newsletter was issued. Shortly after the Division of Chemical and Wood Technology was formed I had the occasional discreet enquiry as to whether I intended resuming the practice of providing the wood utilisation industry with an informative and informal newsheet. The decision to supplement our industry contact with this new series of Forest Products Newsletters was influenced strongly by the recognition that many of our 'customers' and colleagues in industry do not have ready access to the range of journals and patent abstracts in which our work is published. Indeed, not all of our research finds its way to the printing press.

Over half of the Division's effort is devoted to wood utilisation. In his foreword to the Division of Forest Products first monthly News Bulletin, the Chief then informed his readers that 'The Division exists to assist the timber industry in all its branches (was that word chosen with care?) and desires to be of service'. *That statement is as true today as it was in 1932.*

The policy behind our research is perhaps a little different today, however. The forerunners to the present Division had, of necessity, much concern with relatively short term research to help Australian industry cope with a great variety of feedstocks and with little in common with northern hemisphere timbers. Outstanding achievements in chemical and mechanical pulping, high temperature seasoning, and the development of preservative systems for indigenous and exotic timbers were, however, of great long term strategic importance to Australian industry.

Industry-research collaboration, in setting priorities on research needs, is most efficiently achieved through both the Forest Products Research Advisory Panel (FPRAP) and the Wood Fibre Research Advisory Group (WFRAG). This Division's policy on Commonwealth-funded research is to concentrate on areas of strategic importance which could have considerable impact on increasing the efficiency and profitability of wood utilisation. We encourage shorter term 'tactical' research by collaborative or contract ventures with industry. Currently about 10% of our wood utilisation research is funded by such arrangements.

Budgetary pressures and CSIRO's need to mount new initiatives in emerging fields of research have created considerable pressure on maintaining a high level of effort in areas which are not afforded priority. The Division is seeking to increase its industry supported work to about 20% of the Commonwealth allocation. Perhaps the newly announced 150% tax allowance for research will assist the forest products industries to help us to help you.

in this issue . . .

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CSIRO Division of Chemical and Wood Technology

Print this page

CCA-Treated Timber Facts, Figures and Comments on Health and Safety in Use

H. Greaves

Each year in Australia more than 3500 tonnes of waterborne copper-chrome-arsenate (CCA) preservatives are used to treat a range of timber products. Both sawn and round wood is treated for diverse uses including fencing, decking, house framing, poles, landscaping timbers, marine piles and marina construction, log cabins, playground equipment, etc. The treatment is clean and non-hazardous and provides the timber with resistance to biological degradation caused by fungi, bacteria, termites and wood-boring insects. Although CCA-treated pine may develop checks in service the preservative may limit excessive weathering, since the chromium is believed to enhance the cell wall's resistance to dimensional changes. In addition, we know that the preservative can improve the performance of paints and clear finishes on some timbers.

CCA treatment is not as effective in stabilising and water-proofing wood as some other treatments containing specific water-repellent chemicals, such as light organic solvent preservatives (LOSPs). LOSPs tend to improve the durability of paints and other surface coatings as a result of their stabilising effect, although the white spirit solvent must be allowed to evaporate before the paints and coatings are applied. Unlike CCAs we do not recommend the use of LOSP treated wood in direct contact with the soil. This is because LOSPs do not chemically fix within the wood structure as do CCA preservatives. Thus LOSPs are best suited for the initial treatment of joinery, cladding, framing, flooring, etc. which will be used above the ground.

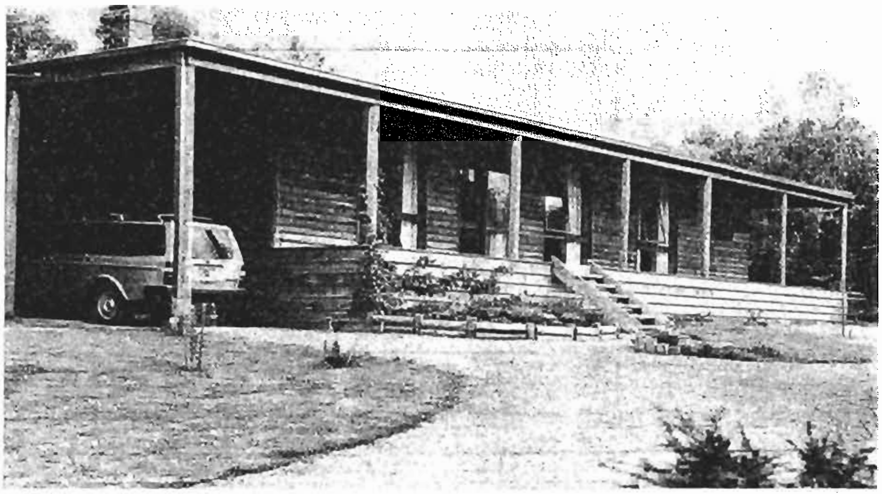
In Australia, CCA preservatives are of the Type C formulation, being made up from salts of bivalent copper, hexavalent chromium and pentavalent arsenic dissolved in water. At the present time, Type B CCAs, as used extensively in parts of north America and Europe, are being examined for Australian use since they are claimed to be less corrosive and, when used for the treatment of electricity poles, initially less conductive than the Type C salts. Type B CCA preservatives are empirically formulated from the oxides of copper, chromium and arsenic, and contain slightly more copper, lower levels of chromium, and more arsenic than the Type C formulations.

Typical proprietary brands of CCA preservatives used in this country are Tanalith C, Celcure A, and Sarmix. In addition, a specialised formulation has been developed specifically for use in Australian conditions. This CCA is known as the anti-afterglow formulation and is made up with the addition of zinc oxide and phosphoric acid to inhibit glowing and charring of treated fence posts, etc. should they ever be exposed to bush- and grass-fires during their service life.

CCA preservatives are supplied to the treatment plant in paste form or as aqueous concentrates in order to avoid the problems associated with mixing solutions from dry powders. Dilute treatment solutions are used to vacuum-pressure impregnate the timber to fixed preservative levels depending upon end-use requirements.

Fixation of CCA within the timber

The ability of the chemicals in CCA to fix within wood cells means that very little preservative is lost during the service life of treated timber. Detailed laboratory studies of leaching from CCA-treated radiata pine blocks have shown that less than 3.5% of the major elements Cu, Cr, and As are removed if the timber is subjected to the action of running water at ambient temperatures, even after one month. In other words, the treated wood retained more than 96% of the preservative put into it under



CCA-treated timber is commonly used in the construction of homes.

severe artificial exposure conditions; under normal exposure to the weather almost all of the CCA would be expected to remain fixed within the wood.

Freshly treated timber requires a short time after removal from the treatment plant for the fixation process to be completed. This process is rather complex and dependent upon a number of variables, including wood species and pH, temperature, the drying conditions, etc. The essential feature is that the soluble components of CCA are essentially converted to insoluble products in the wood, such as copper arsenate and chromium arsenate.

Different studies of the fixation mechanism have indicated that the time for stable, fixed chemicals to be produced within the wood is relatively short, and in Australian conditions should be completed in about seven days, at the most. Thus, provided CCA-treated timber is not supplied to merchants or retailed to the public before this time, and provided that the timber is allowed to dry out following treatment, there should be no risk of unfixed chemicals contaminating the wood surface.

It should be noted that wet CCA-treated timber can corrode fittings and we recommend a holding time of about 3 weeks (depending upon the time of year, local weather conditions, etc.) between the treatment process and use of the treated timber. We also recommend the use of hot-dipped galvanised fittings when building with CCA-treated timber, dry or otherwise.

Surface deposits on CCA-treated timber

Some treatment processes may give rise to deposits of what is termed "sludge" on the timber. This "sludge" is a mixture of the CCA chemicals with wood extractives, and general surface dirt on the timber. "Sludging" is not a normal feature of CCA-treatment operations and usually occurs if the treatment plant has a poor record of process monitoring, treatment solution maintenance, and/or general plant housekeeping. Timber with dried surface "sludge" on it should preferably be hosed or scrubbed down before being supplied to the public.

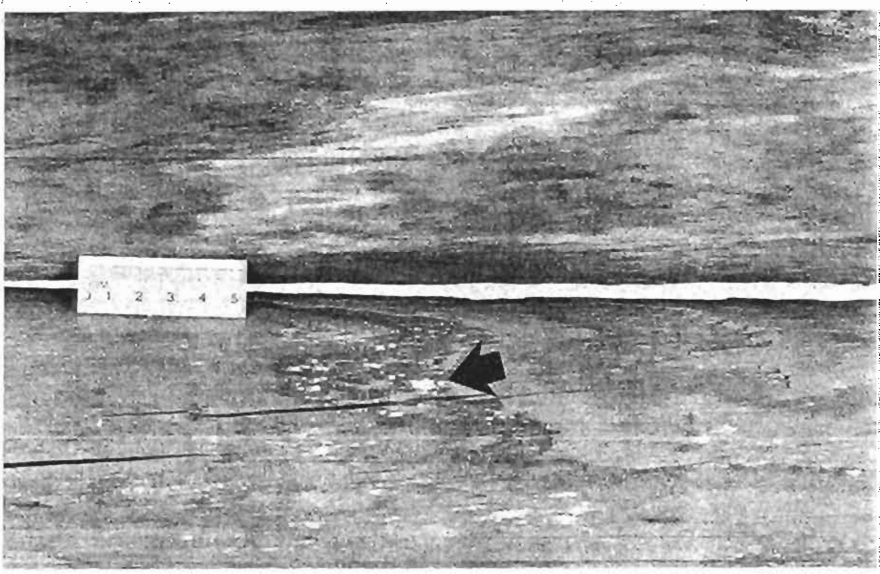
Normal treatment processes leave the wood with a relatively clean surface. However, a white powder may sometimes be seen, particularly as the treated timber dries. This surface deposit is a harmless by-product of the CCA-salts and consists of hydrated sodium sulphate, or Glauber's salt. It does not form with oxide or Type B CCAs since there is no sodium or sulphate present in these formulations. As the treated timber begins to weather if it is exposed in service, Glauber's salt may continue to bloom with the cyclic wetting and drying that will inevitably occur. Eventually, of course, all of the unfixed sodium and sulphate present in the wood will be removed by such processes, and the surface of the wood will cease to yield these efflorescing salts.

From time to time, small amounts of unfixed soluble preservative components may be present in any efflorescent surface deposit. We have carried out analyses on such surface deposits, either by scraping off the efflorescence, or by washing the surfaces and analysing the liquids obtained. Levels of arsenic detected in our measurements varied from 0.16 mg in a deposit which covered approximately 25 cm^2 to 4.03 mg in the liquid from four successive washings of a surface area which measured 100 cm^2. A fifth wash reduced even this small amount of arsenic by 40 times. In other words the unfixed CCA on the surface of treated wood is minimal and is readily removed by washing down or even the action of the weather.

Health and safety of CCA-treated timber

Concern is expressed from time to time about the health and safety aspects associated with the use of CCA-treated timber. This mostly stems from the popular belief that the arsenic component in CCA represents a potential source of poisoning or even cancer. There have been many studies and investigations over the years into this belief, including detailed epidemiological studies of workers at preservation plants who are constantly handling treated wood and the CCA treating solutions. The evidence from most of these numerous studies indicates that arsenic is not a cumulative poison, nor is it a primary carcinogen or mutagen. Where contrary suggestions have been made the data have been shown to be rather suspect, either because of confounding factors present in the studies, e.g. smelter workers exposed to both arsenic and sulphur compounds in dusts, or because of poorly designed experiments, e.g. using rats as test animals, since these rodents are shown to store arsenic in their blood cells, a pecularity not found in any other animal, including humans.

The form of the arsenic is a very critical factor in statements associated with the health hazard of this widely distributed element. For example, trivalent arsenicals are generally



CCA-treated log showing some surface efflorescence of harmless Glauber's salt (arrow). These deposits are easily removed by scrubbing with water.

more toxic than pentavalent arsenicals. In wood preservation only pentavalent forms of arsenic are used and these are fixed by chemical reactions within the wood.

In studies involving the feeding of CCA-treated wood to animals (doses of arsenic varied from 39 mg/day in dogs to 220 mg/day in sheep) no adverse effects were observed and the arsenic was rapidly excreted in the urine. Furthermore, it has been shown in both animals and humans that even potentially toxic trivalent arsenic is rapidly converted to the much less toxic pentavalent form and then methylated and detoxified further before excretion. No form of arsenic is stored long in the body - it has a half-life of 24-36 hours.

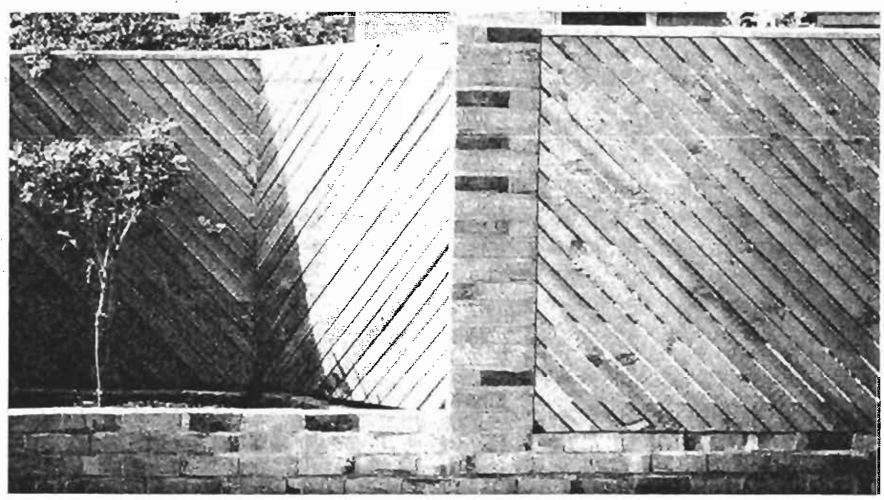
It has been stated that trace amounts of arsenic are nutritionally beneficial, and it is undoubtedly true that small amounts exist in most water, soils, and many of our foodstuffs.

There are various sources of data relating to what is considered to be safe and unsafe levels of arsenic intake by humans. For example, the US Occupational Safety and Health Administration consider up to 0.5 mg arsenic per day to be safe for human ingestion, while Martindale's Extra Pharmacopoeia lists 15 mg/day as the maximum permitted therapeutic dose of arsenic.

The following table has been prepared to place in perspective some of the preceding comments on the potential health hazards of unfixed arsenic on the surface of CCA-treated wood. It should be noted that inorganic and organic forms of arsenic may differ in their relative potential toxicities. The figures are examples of many analyses carried out around the world.

Item	Arsenic content
Fish and seafood	4.6 - 12.0 mg/kg (shrimps and scallops can contain much higher levels)
Meats	0.5 - 5.0 mg/kg
Vegetables and grains	4.1 - 6.3 mg/kg
Cows milk (UK data)	0.01 - 0.06 mg/L
Some soil types (USA data)	5.0 - 15.0 mg/kg
Surface deposits on CCA treated wood	0.006 - 0.04 mg/cm^2

Playground equipment built with CCA-treated timber is not a health hazard to children.

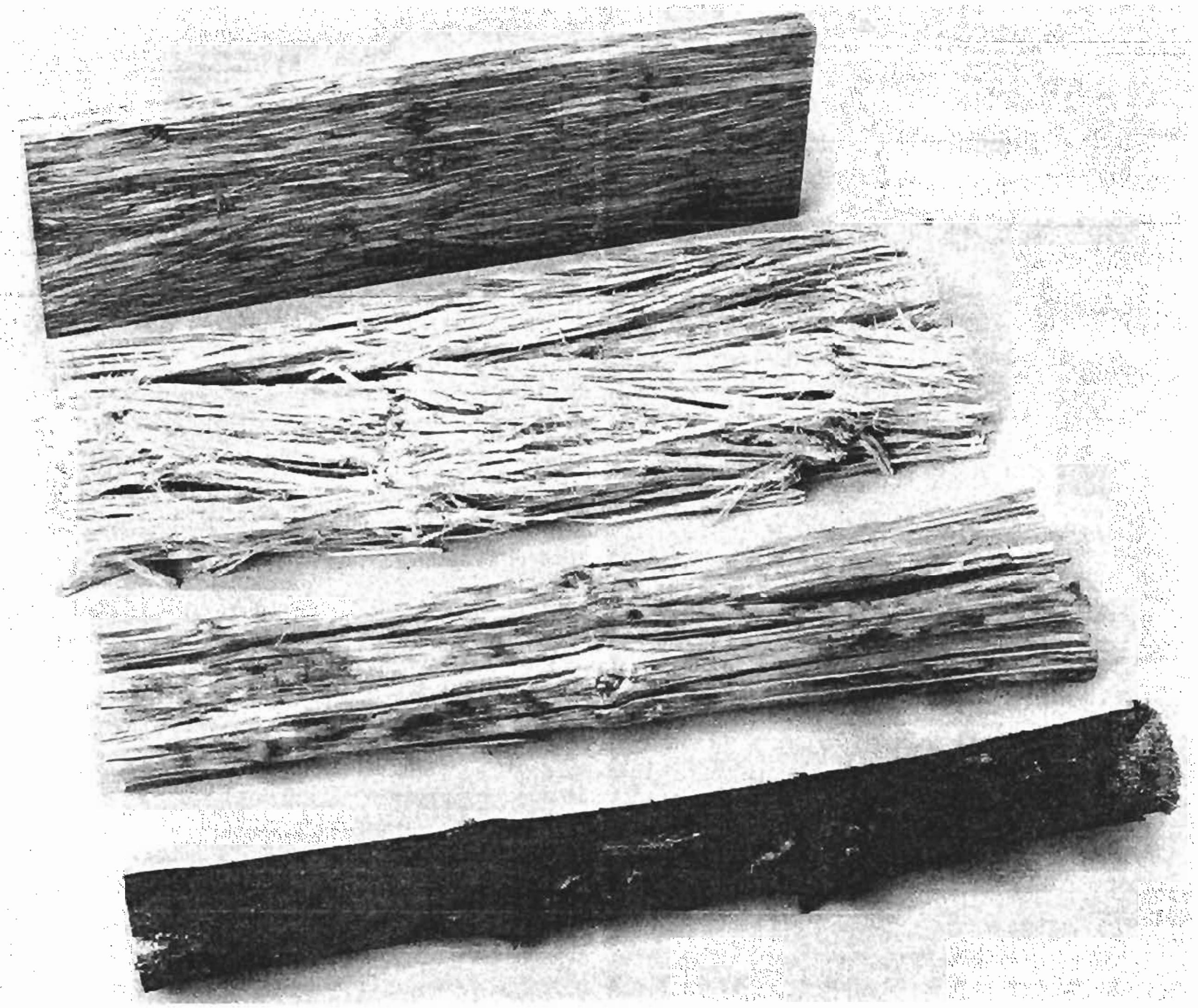


Domestic fencing—a rapidly expanding market for CCA-treated timber.

With regard to the copper and chromium present in or on CCA-treated wood, we again believe that the available data indicate the levels and nature of these elements should not represent a hazard to those who use the timber. The form of the element is critical. For example, hexavalent chromium is regarded as a potential health risk in some industries, e.g. chromium plating, while trivalent chromium has not been implicated as a health hazard. CCA-treated wood contains trivalent chromium compounds which are well fixed and insolubilized within the timber. Care should be taken when handling freshly treated, wet wood, since there may still be sufficient amounts of unreduced hexavalent chromium on the wood surface to cause dermatitic reactions in sensitive people. As suggested earlier, we recommend that at least three weeks elapse before CCA-treated timber is retailed to the public.

It is concluded that CCA-treated timber, properly produced and retailed is not a hazard to the health of people using it. Nor should it represent a health hazard in service, e.g. playground equipment, log cabins, etc. Where treated timber is found to have excessive surface deposits of efflorescent salts and unfixed preservative components, we suggest that they be washed off before use, although the relatively small amounts of chemicals present in these deposits are not in themselves likely to be hazardous.

SCRIMBER®



Log, crushed, processed into 'scrim' and finally turned into a piece of Scrimber.

SCRIMBER, a new timber product made from pine thinnings and small trees which matches the qualities of the best natural timber, is to be launched on to the Australian market. The Minister for Science, Mr Jones, announced on June 24 that SCRIMBER, invented by CSIRO and developed in collaboration with Repco, will be manufactured by the South Australian Timber Corporation (SATCO), the production and marketing arm of the Department of Woods and Forests in South Australia.

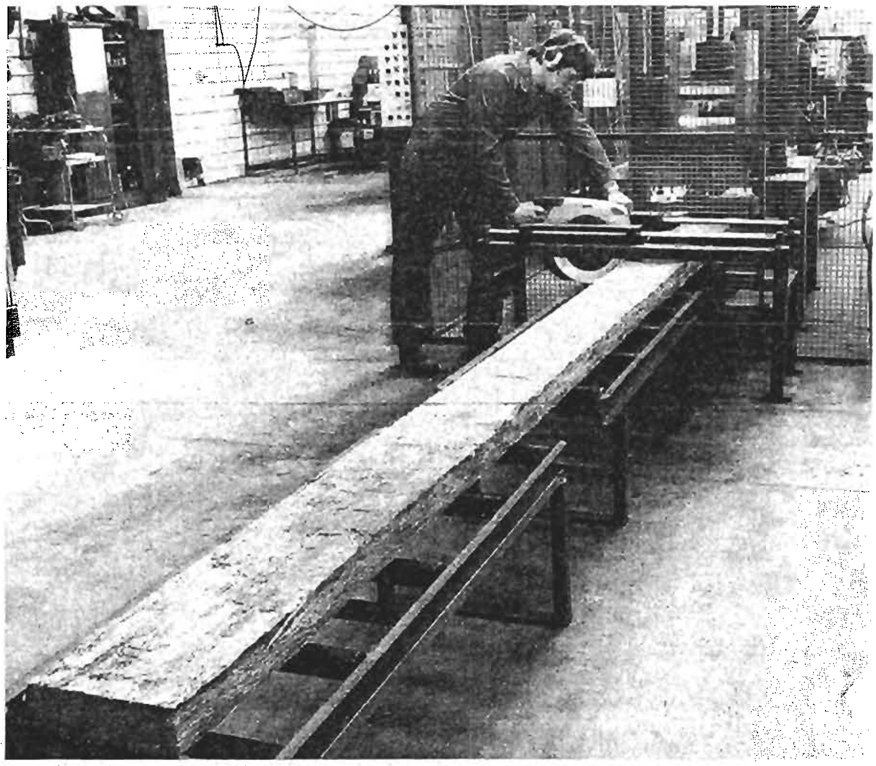
'The commercial agreement with SATCO is an early major success for CSIRO's new marketing company, SIROTECH, which was launched in March,' Mr Jones said.

Manufacture of SCRIMBER comes after eight years of research and development by the CSIRO's Division of Chemical and Wood Technology and Repco Research Pty Ltd, which established a pilot plant at Dandenong near Melbourne.

Mr Jones said SATCO had been selected to manufacture the high-quality reconstituted wood at a new plant to be built at Mount Gambier in the State's south-east. SATCO will use radiata pine from the extensive forests around Mount Gambier to produce SCRIMBER in market quantities.

Trees are a renewable resource. Nevertheless the supply is not limitless and sufficient wood, of construction size and quality, will not be readily available in the future. Reafforestation cannot keep up with the demand for quality timber. First quality timber requires between 60 and 200 years' tree growth. SCRIMBER has the potential to produce a prime product for this market from plantations which are as young as 8 years.

Present sawmilling techniques are inefficient because they are only able to utilize up to 40% of the volume of the original log. As well the industry is increasingly required to use small diameter logs. However, some material can be recovered by using offcuts, chips and sawdust in the manufacture of lower valued sheet products. In contrast to this, SCRIMBER is able to utilize more than 85% of the log.



Continuous beam emerging from the press.

SCRIMBER

It's a unique reconstituted wood product which has full structural properties. Therefore, it can be used in the same way as ordinary structural timber for building, exposed beams, etc. It can be machined, sawn, painted, nailed and moulded in the same way as timber, using conventional tools. The product can be made from young wood, and can convert small-diameter logs into high-grade building material. This means it can make use of fast-yielding forest plantations. The process has been designed to use radiata pine logs or pine thinnings. In the manufacture of SCRIMBER, the natural orientation of the wood fibres is preserved, and this gives it the strength which is lacking in reconstituted wood products such as particleboard and hardboard. Knots and other imperfections in the wood are eliminated, leading to a uniform, strong product which may be produced in a long structural lengths and deep sections.

Applications

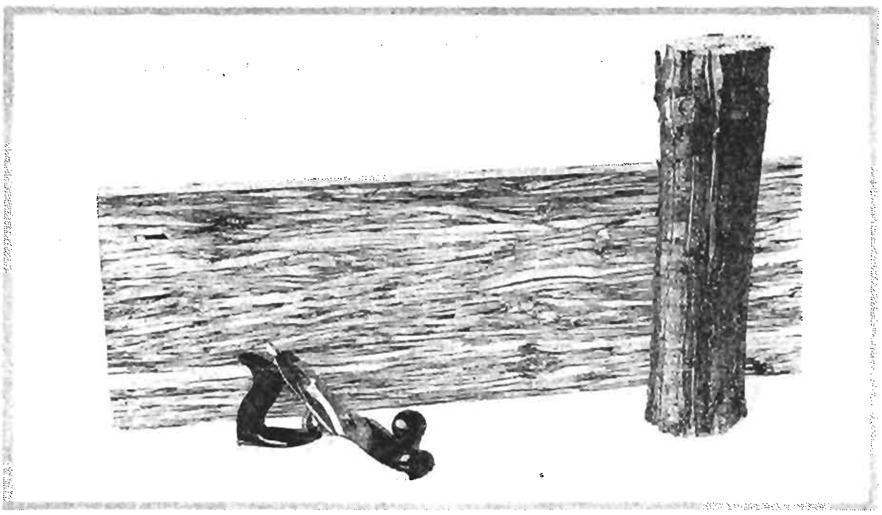
Unlike natural timber, SCRIMBER has little tendency to bow. It is ideal for building uses and is expected to be competitive with structural beams, including steel and concrete. Initial applications will be in the large cross-section beam market in roof trusses. It could also find use in indoor exposed beams, as it maintains the 'grain' of the wood, and can be stained or painted to suit the decor of the house. In appearance, it's similar to natural wood.

Production

In the past, attempts to reconstitute wood have been largely limited to the production of sheet materials. Apart from plywood, this has involved breakdown of the wood into particles or dispersed fibres which are then re-aligned into the desired form. Processes of this kind have resulted in products such as particleboard and hardboard, ideally suited to sheet applications but lacking in structural strength for engineering purposes. However, using purpose-built equipment designed by the joint CSIRO-Repco Research project team, the SCRIMBER process breaks down green logs in a way which hasn't been done before. After removal of the bark, tree stems are crushed in a series of rolls in the 'scrimming mill'. This forms bundles of interconnected and aligned strands which largely maintain the original orientation of the wood fibres. After drying, the bundles of strands are coated with a conventional water-resistant adhesive, assembled into the desired shape and hot pressed to set the adhesive. The pilot plant produces 200 mm by 80 mm rectangular SCRIMBER, but the general manager of Repco Research, Dr Jim Stobo, said eventually it may be possible to produce huge beams of SCRIMBER two metres wide by 500 mm thick.

Marketing

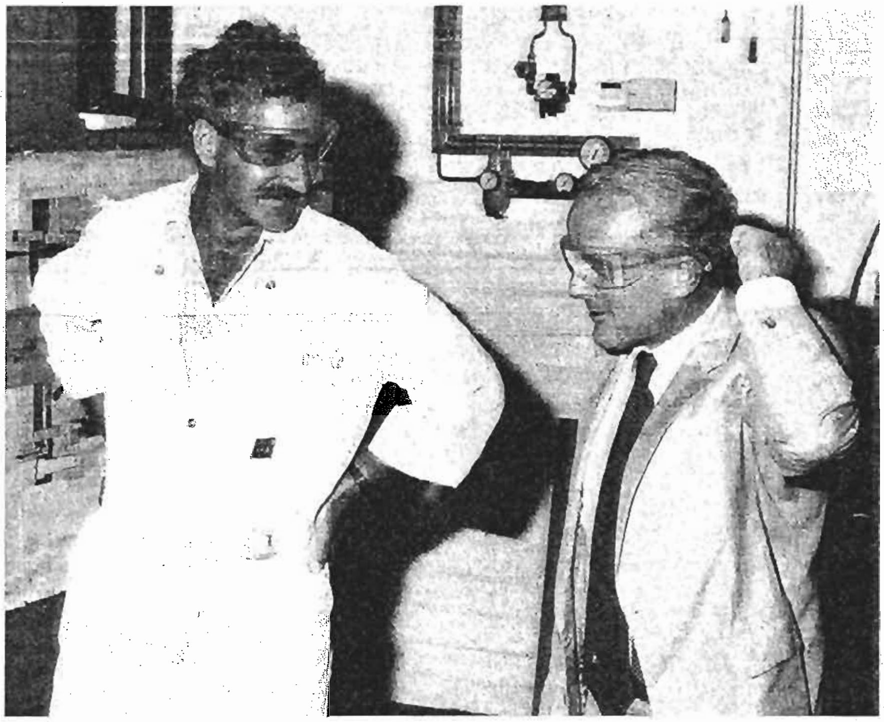
SIROTECH, the new company set up to market CSIRO (and outside) inventions, has been involved with the Division of Chemical and Wood Technology and Repco in the marketing negotiations with potential licencees. SIROTECH will also negotiate licences overseas where the SCRIMBER process has already gained recognition and is expected to attract considerable interest.



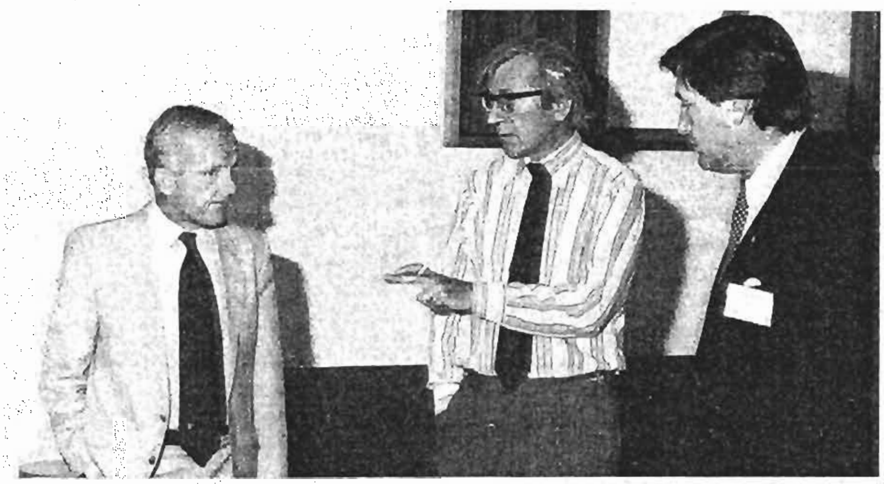
Scrimber can be worked with standard wood-working machines and tools, and will accept normal fastenings.

Senator Button visits our Clayton Laboratories

On the afternoon of May 1st, the Division played host to the Hon. Senator John Button, Minister for Industry, Technology and Commerce. In a crisp, effective schedule, the Minister's tour included selected presentations of many aspects of the Division's program demonstrating our real commitment to working with and for industry. Appropriate displays and models were also brought to Clayton highlighting aspects of our three forest products programmes based at Highett, namely Wood Science, Timber Conversion and Conservation and Biodegradation. In addition to a general introduction of our Wood Utilisation research effort by Dr Warren Hewertson, Senator Button attended special presentations concerning Scrimber® by John Coleman, wood fibre reinforcement by Dr Bob Coutts, pigment emulsified creosote by Dr Harry Greaves and mechanical pulping by Bill Balodis.



Senator Button chats with Max Williams at the Division's defibrator plant about pulping of Australian timbers.



Discussion in the foyer: L to R. Senator John Button, Dr Warren Hewertson, Doug Howick.

Forest Products Research International—achievements and the future

A well-organised and well-attended Symposium with the above title was held in Pretoria, South Africa on April 22–26, organized by the National Timber Research Institute of the South African Council for Scientific and Industrial Research. Chairman of the Organising Committee, Dr D.L. (Danie) Bosman, was well pleased that no less than 540 delegates from 26 different countries were in attendance.

In addition to a large number of research papers on a wide range of topics presented to the various working sessions, the two Keynote Addresses were considered to be highlights of this very successful conference. The first of these was prepared and delivered by Dr W. E. (Ted) Hillis, well-known Chief Research Scientist with this Division and Leader of our Wood Science research programme. The second was by Mr E. (Eugene) Van As, Group Managing Director of South African Pulp & Paper Industry Ltd. (SAPPI).

Other Australians in attendance included Drs Paul Fung, Kevin Harrington and Bob Leicester of CSIRO; Dr Alex Krilov of the Wood Technology & Forest Research Division, NSW Forestry Commission; Dennis Hanley of the Timber & Wood Products Centre, CIAE Rockhampton; Dr M. A. Connor of the University of Melbourne; Ed Sprengel and J. H. Ferguson of Bunnings, Perth and Richard Clennett of B. G. Clennett Pty Ltd, Tasmania.

In addition to the Symposium programme, a special meeting of the International Academy of Wood Science was held, at which Dr Ted Hillis was afforded the honour of presenting the 1985 Academy Lecture, for which his chosen title was 'Forever Amber—A Story of the Secondary Wood Components'.

CSIRO Contributions to AusTIS '85

Two invited papers by officers of the Division of Chemical and Wood Technology were presented at the recent AusTIS Conference held in

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Port Moresby, Papua New Guinea.

Prospects for PNG pulpwood by Frank Phillips and Alan Logan of the Division's Pulping and Pulpwood Resources Programme discussed the extent of pulpwood resources in PNG, both in natural forests and plantations. The known quality of pulpwoods from particular timber areas together with proven commercial utilisation indicates the suitability of fibre resources for extensive industry development. Recent activities in the pulp and paper industry in the Asian Region highlight apparent market possibilities and these are considered in conjunction with PNG development possibilities and constraints. Expansion of woodchip export operations and the establishment of export-oriented, chemical or semichemical pulp mills are the most feasible development options in the immediate future.

Research as an aid to marketing Forest Products by Doug Howick commenced with the premise that if marketing is the identification of a need and the setting out of those things necessary to satisfy that need—at a profit, then research and marketing should be interdependent. The paper gave several examples of Australian forest products research that has resulted in improvements for the industry in the marketplace. In discussing Industry/Research Liaison, the point was made that it is imperative that industry be involved in the development of ideas and innovations from their inception. This helps the researchers to participate in providing the appropriate products at the right time to satisfy the market demand. Research planning must therefore take into consideration the industry's perceived need for the work to be done and the researcher's considered assessment of its likely success.

Mr Hans Sabor (photo courtesy of Mrs G. Sabor).

The Hans E. Sabor Research Grant

Recently the Division was the recipient of a research grant of $35,000 from Mrs Gerda Sabor. This generous grant was provided by Mrs Sabor in memory of her late husband Mr Hans E. Sabor. Mr Sabor was a paper and cardboard expert and a paper importer who for many years had taken a keen interest in the Australian pulp and paper industry. The grant will be used to support research, and the purchase of equipment related to the production, use, economics or marketing of paper products utilizing Australian wood species.

In addition to the grant Mrs Sabor has also donated several pieces of paper testing equipment previously used by her late husband in the course of his business.

The Division is greatly enouraged by such timely financial support which will be of considerable benefit in helping us to further support the Australian pulp and paper industry.

Information Technology Fund Grant for CSIRO/Industry Collaborative Project

Twenty-five thousand dollars is to be spent on a collaborative project involving two Divisions of CSIRO and two industry organisations. Harris-Daishowa Aust. Pty Ltd and the Imlay Timber Contractors Association are collaborating with CSIRO's Division of Forest Research and Division of Chemical and Wood Technology on the development of computer software for analysing the economics of logging systems. Half of the funds have been provided by a special grant from CSIRO Division of Information Technology and the other half will be provided by HDA/Imlay Loggers.

Ian MacArthur of the Harvesting Research Group at the Division of Forest Research and Bill Rawlins of the Techno-Economic Programme of the Division of Chemical and Wood Technology are using the funds to adapt programmes written as part of the CSIRO/Victorian Forests Commission/MMBW Regrowth Eucalypt Project, to the requirements of HDA and the Imlay Loggers. Peter Mitchell and Frank Whitelaw of Harris-Daishowa and Gordon Barclay of the Imlay Timber Contractors Association are the industry people involved in the project.

The research is primarily aimed at seeing how far these programmes might assist in discussions involving the determination of harvesting contract rates, where it is anticipated that they can take over the calculation burden of what are often quite complex formulae. Part of the study will involve applying the programme to sixteen logging systems operating at Eden to ensure that the programme has sufficient flexibility to cover a wide variety of systems. It will incorporate the latest ideas on cost behaviour of the Harvesting Research Group of the Division of Forest Research. CSIRO considers that the work gives industrial exposure to an element in its new programme on the intensive management of eucalypt forests.

Forest Products Newsletter—Frequency and Distribution

It is intended that this new series of the Forest Products Newsletter will be issued quarterly. When the mailing list is being drawn up, it will be made available to as broad a spectrum of forest products industries personnel as possible. It is currently being supplied in bulk to industry associations, forest departments and research laboratories for distribution. If you wish to receive future copies, please write to the Editor giving your name, organisation, postal address and telephone number. Any comments and suggestions on content or format are also welcome.

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OCTOBER 1985 New Series No. 2

Forest Products NEWSLETTER

High temperature drying of hardwoods increases kiln throughput

by Frank Christensen
Timber Conversion Program

The increasing Australia-wide demand for dried hardwoods is straining the kiln-drying capacities of some timber producers and causing others to look closely at the benefits of installing kilns as a step towards increasing the added value of products. While their immediate objectives are different, both groups are keen to minimize capital expenditure on plant and drying costs.

Accelerating the drying rate of timber increases kiln throughput with little capital cost. Recent work has shown that drying time required with conventional schedules can easily be halved. When hardwoods below fibre saturation point (FSP) are dried at high temperatures. The result is at least a doubling of existing kiln drying capacity without having to install any more kilns.

In most cases, a changeover to high temperature operation can be achieved by merely increasing the output from the heating coils in a kiln either by increasing the steam pressure to them or by upgrading them. So instead of having to invest hundreds of thousands of dollars in new kilns, the productivity of existing kiln plants can be substantially increased by spending only thousands of dollars to upgrade each kiln to high temperature operation. For companies needing to install new drying plant, capital kiln costs are substantially reduced because kiln size need only be half that otherwise required.

Drying studies on 25–51 mm thick 'ash' type eucalypts have clearly demonstrated that the high temperature drying of such timbers, after preliminary drying to 25% moisture content (MC) or less, is a practical and profitable reality.

This result was obtained, first with short, end-coated boards dried in a laboratory kiln and then with hundreds of 3 m long boards in a pilot-scale kiln at the Division. Since then, the results have been regularly confirmed by a number of commercial companies in Tasmania which have adopted high temperature drying as standard practice. In that way they have been able to double their previous kiln drying capacity without installing any new driers.

Experimental results for high temperature drying

The results in Table 1 for 25 mm thick Tasmanian alpine ash show that drying times were 2, 5 and 9 hours at dry bulb temperatures (DBTs) of 130°C, 115°C and 90°C respectively for drying from 18% to 10–12% MC.

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CSIRO Division of Chemical and Wood Technology

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The latter increased by 1–2% after either steaming for 1 h or a high humidity treatment for 6–12 h. The final MC was 12%. Where drying was commenced at 24% MC, drying times were 8 and 12 h to 10 and 14% MC at 115°C and 90°C respectively. An estimated additional drying time of 6 h or a total of 18 h would have been required for a final figure of 10% at 90°C.

Drying results for 38 and 51 mm thick Victorian alpine ash are given in Table 2. For 38 mm thick timber, drying times were 9, 15 and 66 h at DBTs of 120°C, 100°C and 70°C respectively from 22–23% to 7–14% MC. A 14 h high humidity treatment increased the MC of the timber over-dried at 120°C from 7% to 13%. Comparable results were obtained for the 51 mm thick timber. Assuming that drying time is directly proportional to timber thickness and making allowances for the variations in the MC changes during drying at each of the different DBTs, then the drying rate of the 51 mm thick material is proportionately slightly faster than that of the 38 mm at 100°C and 120°C but appreciably slower at 70°C. Compared with drying at 70°C, the drying rate is about five times greater at 100°C and about eight times greater at 120°C, when adjusted for the differing MC changes during drying.

A number of large-scale studies on 3 m long boards, supplied by several commercial companies and dried in a pilot-scale kiln holding at least 2 m^3 of timber, has confirmed the excellent results obtained in the laboratory kiln. Both drying times, after allowing for the longer heating time to reach operating temperature, and the quality of drying were comparable under the two sets of experimental conditions. Among the Tasmanian alpine ash timber, there was a small proportion of boards which exhibited atypical drying behaviour of a refractory nature, irrespective of whether conventional or high temperature drying conditions were used. This comment has been included as a warning about the difficulty of drying this long-recognized class of material, which is slow to dry and prone to develop drying degrade. If recognizable, it should be segregated and dried under conventional drying conditions.

In contrast to conventional drying schedules, wet bulb temperatures (WBTs) are relatively unimportant with high temperature drying. Although certain of the WBTs given in Tables 1 and 2 may appear to be comparatively high, they are near the minimum attainable at the DBTs used. The correspondingly large wet bulb depressions are unlikely to cause any drying degrade in hardwoods already below FSP but they do point to the need to use a high humidity treatment at the end of drying. This puts moisture back into the outer layers of the timber and minimizes any drying stresses that may be present in the timber.

Vents should not be deliberately opened during high temperature drying unless the WBT rises about 75°C–80°C and thereby creates a risk of darkening the timber. There is usually sufficient leakage of air from most kilns to keep the WBT below this high limit. Unnecessary venting only increases heat losses, particularly for high temperature drying.

Collapse, recovery and normal shrinkage were not specifically measured for either the Tasmanian or Victorian material but they did not appear to present any particular problems after drying. Likewise for other drying degrade: none could be directly attributed to the effect of high temperature drying. However, until proved otherwise, high temperature drying of hardwoods should not commence until every part of the wood is below FSP. On average, this corresponds to a MC of about 25% but does vary from species to species.

Table 1. High temperature drying of 25 mm thick Tasmanian alpine ash boards

Drying			Conditioning			Moisture content %		
DBT °C	WBT °C	Time h	DBT °C	WBT °C	Time h	Before drying	After drying	After condition
90	50	9	90	86	12	17	12	13
115	70	5	90	86	6	18	10	12
130	70	2	100	100	1	17	10	12
90	45	12	90	88	6	24	14	16
115	55	8	90	85	14	24	10	12

Table 2. High temperature drying of 38 and 51 mm thick Victorian alpine ash boards

Drying			Conditioning			Moisture content %		
DBT °C	WBT °C	Time h	DBT °C	WBT °C	Time h	Before drying	After drying	After condition
				38 mm				
70	55	66	—	—	—	23	13	—
100	70	15	—	—	—	23	14	—
120	75	9	100	96	14	22	7	13
				51 mm				
70	55	90	—	—	—	21	13	—
100	70	19	—	—	—	22	13	—
120	75	9	100	96	14	20	8	12

Commercial experience of high temperature drying of hardwoods

There are several Tasmanian timber producers which have been using high temperature drying for periods of six months or more with the three principal species: mountain ash, alpine ash and messmate stringybark, as well as several other ones, ranging in thicknesses from 25–51 mm. In this way, they have been able to double their kiln throughput by merely increasing the drying temperature from 70°C to 90°C–100°C and have found that drying at the higher DBT does not increase the level of drying degrade, provided all parts of the timber are dried to 25% MC or below before reconditioning and drying at high DBT. Jarrah, a considerably denser timber than the 'ash' type eucalypts, can also be dried satisfactorily at up to 120°C after preliminary drying to below FSP (about 23% for that species).

Likely modifications needed to kilns and their operation for the high temperature drying of hardwoods

Structures: Most existing hardwood kilns are probably structurally

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suitable for high temperature operation. While there have been no reported structural problems with the limited number of hardwood kilns now operated at high DBT, troubles have been experienced from time to time with the cracking or crumbling of some brick-walled kilns used for high temperature drying of softwoods. This has been mainly due to the lack of expansion joints along the walls or to the relative movement between the walls and a reinforced concrete roof. Little or no structural problems arise with kilns of reinforced concrete, reinforced cement blocks, Mt Gambier stone, steel frame with calcium silicate sheathing and timber frame with cement sheet sheathing.

Air circulation: Because the timber is already at a comparatively low MC before high temperature drying commences, there is no advantage in increasing the air velocity above that normally used for hardwood drying, *i.e.*, 1·5–1·8 m/s, as distinct from the value of 5 m/s or more required when softwoods are dried at high DBT.

The important factor when drying from FSP or below is not the absolute value of air velocity through the stacks of timber in the kiln but its uniformity across their faces. Where air velocity in part of a stack is low, the rate of heat transfer to the timber there is also low and drying is retarded in that region.

Since drying time should be regulated by the wettest boards in a kiln charge, the result of uneven air circulation is overdrying of the charge as a whole. This effect is compounded by drying at high DBT, so special care should be taken to ensure that opportunities for the by-passing of air around the stacks of timber in the kiln are severely curtailed.

Heating: In some cases, the conversion of existing kilns to high temperature operation may involve no more than an increase in steam pressure to the heating coils or, at worst, an upgrading of the coils to achieve kiln operating DBTs of 100°C or more. The latter may involve the installation of additional heating coils or changing to finned coils if there is insufficient space to accommodate the required number of plain coils.

In addition to uniform air circulation, there is an equal need for uniform air temperature across the inlet face of all stacks in the kiln. This requires four important conditions:

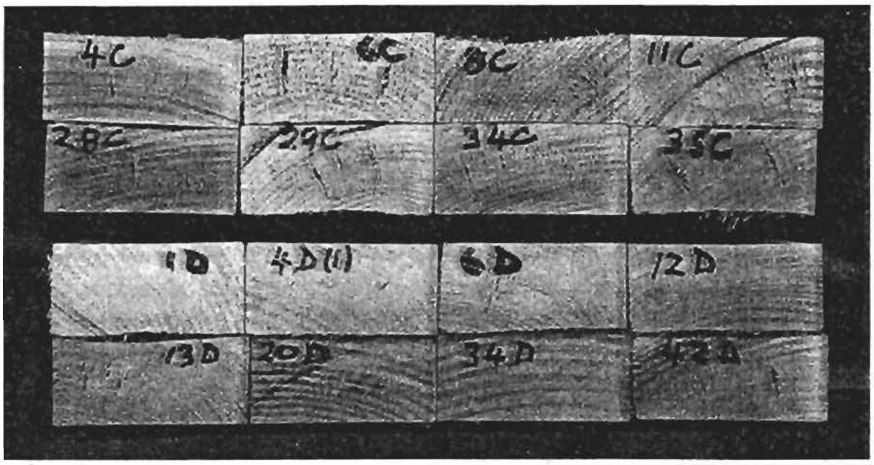
1. Uniform air velocity across the coils.
2. Banks of coils, both return bends and single runs, are fed with steam from each end of the kiln.
3. Equal numbers of coils, with steam fed to manifolds from alternate ends, are always used.
4. Steam traps on each bank of coils are of the right type and do not become waterlogged with the intermittent admission of steam to the coils.

Heat supply: The boiler or other type of heat source must be of sufficient capacity to meet the increased heat demand imposed by the higher throughput. To help in this regard, drying at high DBT requires less heat to dry the same volume of the same species to the same extent than drying at conventional temperature does. The heat demand can be reduced by 30% or so for drying at 120°C or by lesser amounts at somewhat lower DBTs.

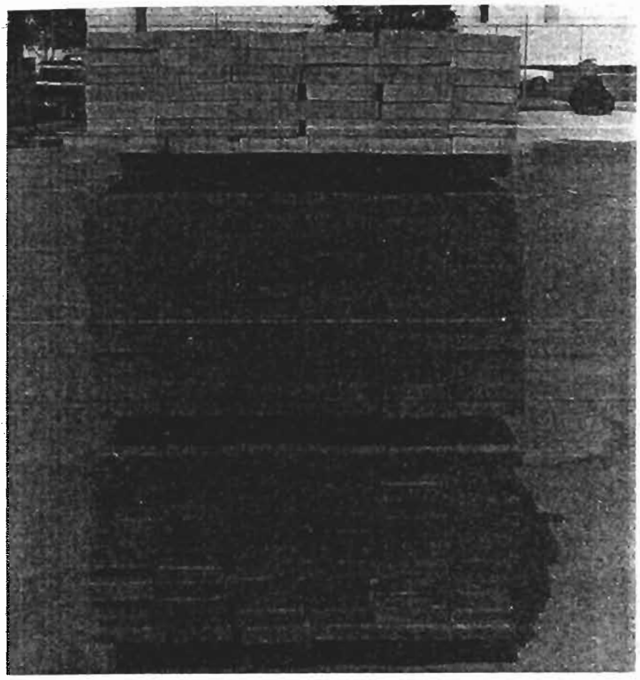
This saving in heat comes about from the lower heat loss through kiln venting which normally accounts for 75% or so of total heat losses during drying. Overall, the combination of markedly reduced drying time and rate of venting with high temperature drying makes it more thermally efficient than drying at conventional temperatures. Therefore, a smaller quantity of heat is required to meet a given evaporation load for the high rather than for the low temperature drying of timber.

Venting: For the high temperature drying of hardwoods below FSP, it is quite possible that vents will not

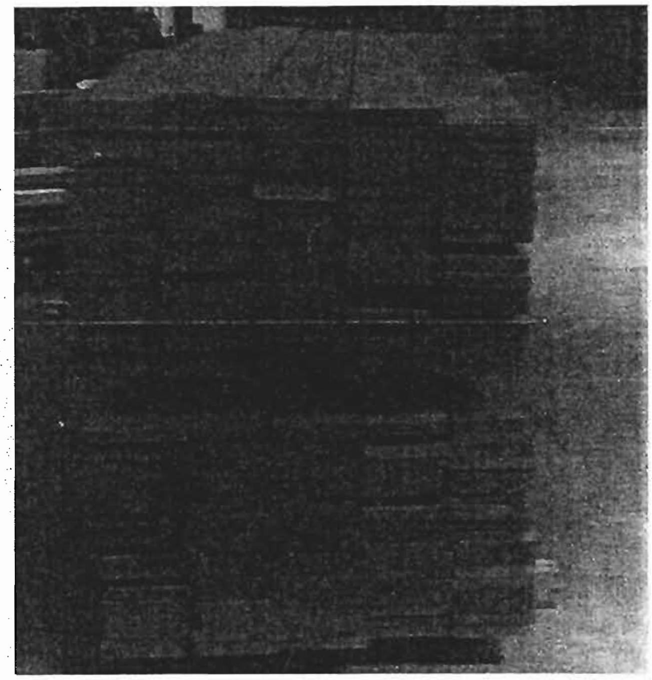
Absence of internal checking in Victorian ash when kiln drying is delayed until the core moisture content is below fibre saturation point. The two upper rows were dried at 120°C DBT/70°C WBT and the two lower ones at 70°C DBT/60°C WBT.



Internal checking in Victorian ash resulting from kiln drying when the core moisture content was still above fibre saturation point. The top group was dried at 120°C DBT/70°C WBT and the botton one at 70°C DBT/60°C WBT.



Good appearance of 32 mm thick boards of mixed Tasmanian hardwoods dried at high temperature in the Division's pilot-scale kiln after preliminary air drying. It took only 9 hours to dry them from 20 to 12% MC at 105°C DBT and 70°C WBT compared with 60 hours or more with the conventional drying schedule of 70°C DBT and 55°C WBT. The top pack shows the typical appearance of boards before reconditioning and high temperature drying.



Good appearance of 25 mm thick boards of mixed Tasmanian hardwoods dried at high temperature in the Division's pilot-scale kiln after preliminary air drying. It took only 7 hours to dry them from 20 to 12% MC at 105°C DBT and 70°C WBT compared with 48 hours or more with the conventional drying schedule of 70°C DBT and 55°C WBT. The top pack shows the typical appearance of boards before reconditioning and high temperature drying.

need to be opened at all or only to a very limited extent. Either way, both the venting losses and heat demand are reduced.

Fan reversals: Only one reversal of circulation should be necessary during the course of drying from about 25% initial MC downwards, in order to minimize any variations in drying rate across the width of the stack.

Energy considerations: For the drying of the same quantity of timber, both electrical and heat energy usage is less with high temperature than with conventional drying, because of the greatly reduced drying times and heat losses from the kiln.

Review of achievements and recommendations for the high temperature drying of hardwoods

The experimental work demonstrates that, at an average MC of 25% or less, 25–51 mm thick alpine ash boards can be rapidly dried at the relatively high DBTs of 115°C–130°C without causing any further degrade to occur during the process. At these DBTs, 25 mm thick mature timber from Tasmania will dry from 18 to 10% MC in 2–5 h. At 115°C, it will dry from 24 to 10% MC in 8 h compared with 2–5 days or more with conventional drying at 70°C DBT.

Similarly, boards from mature Victorian alpine ash will dry at 120°C DBT from 22 to 7% MC in 9 h for 38 mm thick stock and from 20 to 8% MC, also in 9 h, for 51 mm thick stock.

A high humidity treatment is recommended after high temperature drying in order to increase the MC in the outer layers of the timber and to relieve any drying stresses. This treatment is given in the kiln where the DBT is controlled at 100°C or less and the wet bulb depression at 4°C–5°C for about 12 h. These equilibrium MCs corresponding to these conditions is 12–14%.

These results have been confirmed with subsequent experimental work with 3 m long boards of mountain ash, messmate stringbark and other species together with feedback from commercial companies which have already adopted high temperature drying at 90°C–100°C. These commercial operators are enthusiastic about the benefits of high temperature drying and have generated considerable interest by others in the process.

Provided existing boiler or other heat supply capacity is adequate to cope with the increased heat demand of high temperature drying, then only very minimal changes to existing hardwood kilns are expected to be needed for their upgrading to high temperature operation.

On the heat side, this might include increasing the steam pressure or temperature of other heating media to the heat exchange coils, upgrading the performance of the coils, reconfiguring the heat supply to the coils and ensuring suitable types of steam traps are used.

No changes in the air circulation system are likely to be needed if the air velocity through the stack is at least 1·5 m/s and reasonably uniform. The latter may depend on limiting the by-passing of air around the stack by adequate baffling, particularly under the stack, and the building of square-ended stacks that completely fill the kiln.

Minor kiln operating changes may need to be made to present venting practice and the frequency of reversal of air circulation. The nett effect of the former in conjunction with radically reduced drying times is an overall reduction in total electrical and heat energy consumption when hardwoods are dried at high DBT from FSP or below.

CTETC: A stimulus for development of the timber industry

H. R. (Bob) Milner, Executive Director

The Chisholm Timber Engineering Technology Centre was established by the Timber Promotion Council in May of this year. At the function the centre's role as an instrument to promote the construction of engineered timber structures was explained by the Minister, who went on to show how this would be carried out through consulting, research and continuing eduction.

When approached to write the present article, I welcomed the opportunity and felt it would be best to concentrate on these developments which have taken place and those planned for the future as these illustrate the practical way in which the centre is going about its task.

Timber Industry Fellow

A major policy adopted in the management of of the centre has been to employ only the most highly qualified of staff to ensure that the advice provided was sound. Funding provided by the Timber Promotion Council has been used primarily to appoint a Timber Industry Fellow, and this position is to be filled by Mr. Dan Jepsen who has a wealth of knowledge and experience. Mr. Jepsen took his first degree at the Technical University of Copenhagen, Denmark, and later lectured there and in West Germany. He has subsequently had extensive industrial experience in the design and construction of timber structures as well as in the production of timber, especially glulam, beams.

Dan Jepsen will take up his new position in January 1986 and this will add considerable strength to the timber expertise available not only at Chisholm but within Melbourne generally. While he will be available for consulting, the early emphasis will be on his developing a technical library and preparing a series of lectures for engineering and architectural students.

Continuing Education

As stated a major role of the centre is to conduct a program of short courses for the continuing education of practising engineers. CTETC has already run two seminars on Timber

Executive Director, Dr Bob Milner at work in the CTETC Office. CTETC is able to offer clients a range of testing services and advice on timber structures.

CTETC Launching Function: The Hon. Ms Joan Kirner MP, Minister for Conservation, Forests and Lands, addressing architects, engineers and industry representatives at the launching held on 18th June 1985.

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Engineering. Each course attracted sixteen participants who were given considerable information on timber design. The seminars were introduced on each occasion using slides showing a selection of timber structures ranging from the spectacular to the more mundane, such as warehouses and factories. Subsequent topics covered basic timber properties, the use of the Timber Engineering Code AS1720, proprietary products, plywood, glulam, trusses, special beams, and fasteners, as well as design details and procedures. The material developed will form an excellent basis for future courses of this type.

The next seminar has been tentatively set for February 1986 and is being planned in conjunction with the support of the New Zealand Timber Industry Federation. It is expected that Prof. John Webster, Dean of Architecture at the Victoria University in Wellington will be the leading speaker who, in conjunction with CTETC, will subsequently assist local designers with their projects to ensure they are able to design effective timber structures. Further assistance is expected from the NZ timber industry in the form of subsidising the costs of products supplied for projects supplied through this initiative. I am shortly to have discussions with the Minister to determine whether any State Government assistance can be provided which will ensure a greater measure of success from this venture and hopefully more closely involve local industry.

Testing

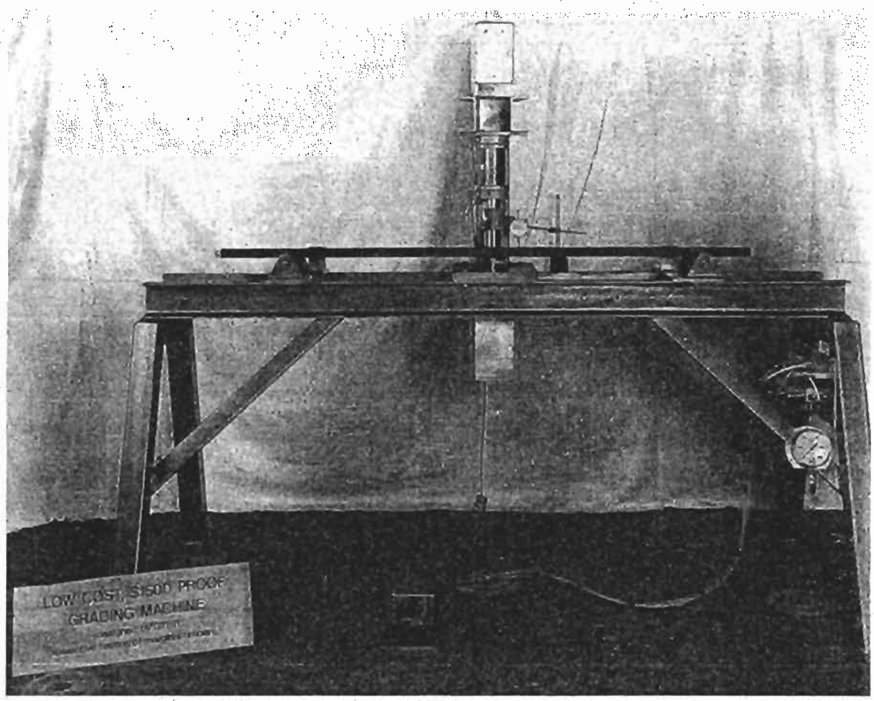
The centre is undertaking an expanding range of testing for industry. Recent testing has involved fabricated beams involving metal plates, proof grading, and a range of other products. The centre is prepared to assist the industry in conducting almost all tests it wishes to have done to the stage of either building special testing rigs, conducting tests off-site or taking other steps as necessary.

Research

Early R & D projects have led to considerable success in some instances.

The best example involves the development for the Radiata Pine Research Institute of a low cost proof-grader. The machine enables mills to spot check and grade pieces of timber which an inspector is unable to grade on the basis of visual criteria alone. The method involves spot testing the specimen in three-point loading with the worst defect or defects positioned under a loading head. A proof load is applied and the deflection is simultaneously measured using an electronic analyser which automatically adjusts for any initial bow in the timber. CTETC itself is constructing the deflection detector/analyser units and is prepared to build the completed device for mills at around $3500 or to simply supply detector/analyser units for $700. The device can also be constructed by mills which will need to purchase around $1700 worth of components. The prototype machine is already in use in South Australia and orders have been received for details from five other mills; both CTETC and RPRI are delighted with the result. Details may be obtained from RPRI in Adelaide.

CTETC is also about to forward a report to the Timber Promotion Council on *in situ* built house roof framing systems which do not rely on internal propping for support. The report has been somewhat slower in being finalised than CTETC would have wished but it is hoped its release will finally assist builders in roofing houses with open floor plans.



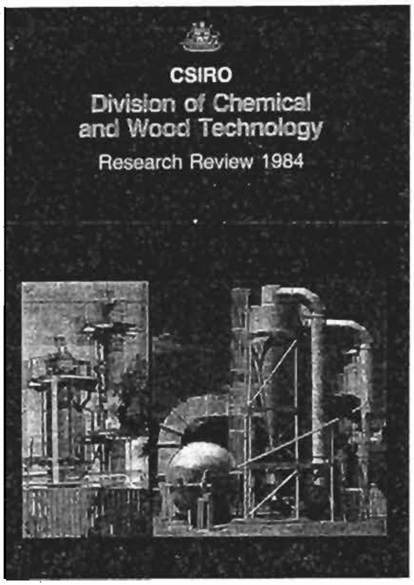
Low cost proof grading machine developed by CTETC for the selective testing of pieces of marginal timbers.

CTETC is at present negotiating a range of additional R & D projects which it expects will lead to similarly successful results.

and finally

CTETC was launched with somewhat of a fanfare and much hope that it would prove to be an important instrument in revitalising the timber industry in Victoria. It has now I believe established its credibility and can look forward to a very successful year in 1986 when it will be fully established. I believe the centre should be used as much as possible by the industry itself since the income derived would be used largely to expand its activities and become a major vehicle in the promotion of timber engineering.

DCWT Annual Report now available



The CSIRO Division of Chemical and Wood Technology has recently published its 1984 *Annual Research Review*. The Division's work covers a wide spectrum of interest and is primarily concerned with the efficient application of chemical and biochemical technology and engineering to the utilization of such resources as forests, agricultural products and water. The *Review* reports on the projects that the Division is currently engaged in as well as the relevant people to contact should you seek further information about certain projects or information that may assist you. Also the *Review* contains topical essays covering the Division's work. This year the essays cover the following topics.

1. Production of β-carotene from *Dunaliella salina*.
2. Wood rheology.
3. The development of the Alternating Aerobic/Anaerobic Completely Mixed Activated Sludge System (AAA-CMAS).
4. A solid-phase fermentation process for the production of ethanol.
5. On finding alternatives to rainforest species for veneer manufacture.
6. Recovery of alcohols—a novel approach.

Should you like to receive a copy of the *Research Review*, or copies of any of the essays, write to Mr David MacArthur, the Division's *Technical Secretary*, care of the Division's address.

Disposal of CCA-treated timber

A number of people greatly enjoyed our article concerning CCA-treated timber, however some also enquired about how CCA-treated timber should be handled and disposed of. In working with CCA-treated timber precautions should be taken to avoid inhaling dust and sawdust from the wood. The offcuts and waste material should not be used either for fuel inside the house or for barbecues. The unwanted CCA-treated wastes preferably should be buried, taking care to avoid proximity to watercourses. Large quantities of CCA-treated wood wastes may need to be buried at an approved tip or landfill, and local council permission should be sought. Where burial of the solid wood waste is not possible, we suggest disposal by burning, which should be carried out in the open and the resultant ash should be buried in such a way that it does not represent a potential source of contamination. We suggest that a good place to bury the ash is along a fenceline, say, near the posts.

First issue

We have been gratified—even flattered at the interest prompted by our first issue of the new series of the *Forest Products Newsletter*. We have received numerous requests from organisations and individuals to be included on our mailing list. It would seem that the industry has missed the contact and communication and is pleased to see it re-established. Here are a few extracts from the 'welcome back' mail:

'*...congratulations on the production, this is the type of communication the forest products industry at large has needed for quite a while...*'—NSW Forest Products Association, '*...we are delighted to receive New Series No. 1...*'—Victorian School of Forestry, '*...an excellent publication...*'—Forest Industries Association of Tasmania, '*...we gained valuable information from the old series and feel certain we would do likewise with the new publication...*'—Dr Michael Lenz.

We'll do our best to bring our readers the kind of Forest Products Newsletter that you want and we continue to welcome comments or suggestions on content or format.

Forest research assists Ethiopia

CSIRO is involved in an assistance scheme to reforest drought- and famine-stricken Ethiopia as part of an effort to put the country on the road to recovery. A tree seed supply project is being co-ordinated by the Division of Forest Research, using money from the Australian Development Assistance Bureau (ADAB). Extensive felling has decimated Ethiopia's forest resources, and despite the introduction of eucalypts late last century, the Australian trees—many of which are ideally suited to the conditions—have not been productively used.

In December 1984, the Ethiopian Government asked for Australian help in supplying seeds of about 40 species. It's hoped that an intensive campaign will more fully establish the faster-growing Australian tree varieties to provide much needed fuel, help retard further soil erosion and increase the productivity of the land.

Wood is the principal source of energy for cooking and heating in Ethiopia, but the supply of indigenous species is now reduced mainly to brushwood. Collection often involves a two-and-a-half hour walk each way.

ADAB has supplied \$8500 for seed supplies and \$500 for the provision of technical information about the species for use by Ethiopian authorities.

CSIRO is providing a range of seed types in both research and plantation quantities.

Species of acacia and casuarina are also being sent because of their nitrogen fixing qualities which will improve the soil.

Seed project member, Mr John Doran, said the eucalypts take well to the environment in the country and are fast-yielding and easily renewed.

Ethiopian native species often grow slowly and in the past little effort has been made to renew the resource.

An ADAB-sponsored mission to Ethiopia in May this year revealed only two species of Euclaypt extensively planted—'*a situation which provides little insurance about the effects of a future attack by pests and disease*' according to the resulting report.

Retirement of Dr J W P Nicholls

Jack Nicholls is retiring from CSIRO after many years' service in the Divisions of Forest Products, Applied Chemistry, Chemical Technology and Soils. After the war, in which he served as a pilot in the Air Force, he joined DFP and was attached to the Timber Physics Section, where he became an electronics expert in the days when everything was done with valves. Later he transferred to the Wood Structure Section and built an outstanding reputation for his work on the interface between forestry and wood properties. The effect of silvicultural régimes on wood quality was studied in great depth in collaboration with Australian and New Zealand foresters, and provided one of the few very strong links between forest products and forestry research. This work had a considerable influence on the development of pine plantations, in particular, and led to the conferring on him of the Degree of Doctor of Science in Forestry by the University of Melbourne.

Forest Products Newsletter—Frequency and Distribution

It is intended that this new series of the Forest Products Newsletter will be issued quarterly. When the mailing list is being drawn up, it will be made available to as broad a spectrum of forest products industries personel as possible. It is currently being supplied in bulk to industry associations, forest departments and research laboratories for distribution. If you wish to receive future copies, please write to the Editor giving your name, organisation, postal address and telephone number. Any comments and suggestions on content or format are also welcome.

Institute of Wood Science Wood Preservation Seminar

Earlier this month the Institute of Wood Science conducted a two-day seminar on the correct use of wood preservatives, the likely hazards that are likely to be encountered and how they may be overcome. The seminar was held at the Department of Conservation and Land Management's training centre at Como in Perth.

The panel of interstate and WA speakers was arranged so that each facet of the use of preservative treated timber was covered by a specialist in that field.

Speakers included:

- Dr Harry Greaves, Senior Principal Research Scientist with CSIRO DC&WT
- John Barnacle, Principal Experimental Scientist, CSIRO DC&WT
- Bob Barrett, Deputy Chief Electrical Engineer with Central West Country Council, Parkes, NSW
- Don Keene, Acting Manager, Timber Production Branch, W.A. Department of Conservation and Land Management
- Dan Price, Quality Control Manager, Radiata Pine Research Institute
- Dick Smith, Technical Committee of the Timber Preservers Association of Australia
- John Syers, Engineer with WA Railways.

It is envisaged that the Institute of Wood Science (Australian Branch) will produce a bound volume of all the papers presented at the seminar in the near future. This will be distributed to all those who participated in the seminar. Extra copies will be available for sale. The Institute is also running a three-day course in timber technology at the Australian National University in Canberra on 25–27 November. Anyone who would like copies of the seminar, or would like to attend the timber technology course should contact:

Mr J. Creffield
Branch Secretay
Institute of Wood Science
P.O. Box 56
Highett, Vic. 3190

TPC Annual Report presented to Minister

The 1984–85 Annual Report of the Timber Promotion Council of Victoria has just been presented to the Minister for Conservation, Forests and Lands. Apart from an overview of what has been happening in the timber market, the report is divided into three major sections; research activities, collaborative activities, and finally technical marketing and promotion.

The timber industry has been able to apply a wide range of timber products to support the still booming construction industy. Although supplies of imported timbers increased, these complemented rather than competed against Australian timber production. Our timber market is currently stable, however there is a possibility that it may decline. In fact, some areas of the timber market have been lost through the increasing use of concrete slabs, metal framing, plastics in the furniture industry, steel and fibre cement sheets in the fencing market and concrete and steel in commercial and industrial buildings. The report warns that the timber industry cannot be complacent and must actively encourage and support research product development and technology transfer if it is to not only maintain but also expand its market.

Some of the research projects that TPC has been involved in, and which reports will be available soon, are nail lamination, bolted joint testing, creep deformation of unseasoned regrowth ash and roof systems. The TPC has also been investigating its Technical Advisory Service which handled over 7000 enquiries last year. Most of the enquiries are on timber use, properties, construction methods, building regulations, preservation and finishes. This service has continued to grow steadily over the past few years.

In the area of technical marketing, the TPC has had contact with and distributed literature to over 250,000 people. If you would like to know more about the TPC's activities then write to the following address:

Timber Promotion Council
Victoria
184 Whitehorse Road
Blackburn, Vic. 3130
Telephone: 877 2666
Technical Advisory Service: 877 2766