

Timber Drying and the Dryspec™ System

A Scion Impact Statement 2009

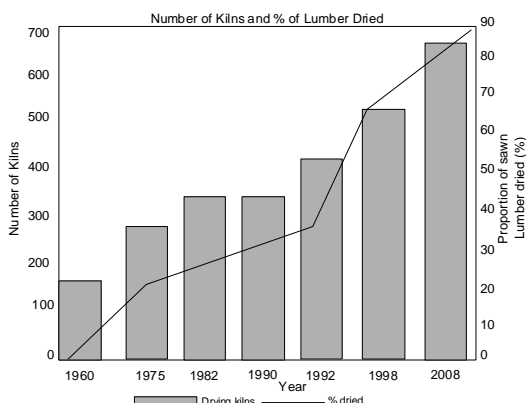
Every year the New Zealand wood processing industry spends about \$150 million drying timber. Drying is the first and most critical step in producing a high value material from timber and is the highest single cost processing step. It is the process step where substantial value is added to timber or where (if they get it wrong) the value of their timber product is destroyed. Successful drying of timber from 200% moisture content (dry basis) to about 13% moisture content (dry basis) is the platform upon which the \$2.5 billion value added wood processing industry in New Zealand has been built.

Scion has played the key role in the development of timber drying in New Zealand. BERL¹ in their 2004 review of the economic value obtained from timber drying research in New Zealand directly ascribed the rapid expansion of kiln drying in New Zealand as “primarily due to the work of Scion’s Wood Drying Group”. Scion was responsible for:

1. Building a wood drying platform in New Zealand to underpin the focus on high value wood processing.
2. Development of timber drying schedules, in particular High Temperature (HT) and Accelerated Conventional Drying (ACT) schedules, to reduce drying times.
3. Establishment of the New Zealand Timber Drying Multiclient for technology transfer and to facilitate national enhancement of timber drying skills and knowledge.
4. Development of the Dryspec™ system to enhance the timber drying process.

The benefits to New Zealand from the above are substantial. Quality dried timber, produced cost effectively, is essential to develop and sustain a viable high value wood products industry for products ranging from furniture through to building materials. Exports have grown from virtually nothing in the 1970’s to the current level of about \$700million per annum.

The BERL¹ report described timber drying as the “underpinning technology on which much subsequent wood processing is based.” They considered this “generic technology” to be responsible for “underpinning benefits, [to New Zealand] of gross outputs of \$2.4 billion per annum, value added GDP of \$890 million and employment of around 11,800 people.”



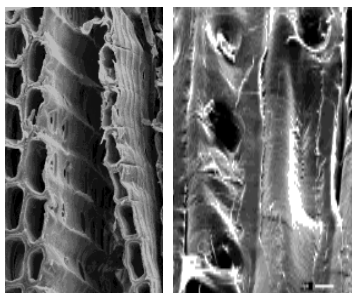
Development of timber drying schedules

The development of the HT and ACT drying schedules reduced drying times from the 1970’s best practice kiln drying of 4 to 6 days down to between 1 to 1.5 days. This represented substantial savings to the industry but, more importantly, created the platform to support the growth of the new generation wood processing industry in New Zealand.

¹ Economic Impact of Wood Drying Technology, June 2004 Report to MoRST, BERL

Radiata pine is New Zealand's dominant commercial species and represents virtually all of New Zealand's \$727 million of solid wood exports for last year². In its raw green state, Radiata pine has 2kg of water for every 1kg of dry matter. Removing this water in the first instance reduces weight for transport, and reduces damage caused by fungal attack or insects. Most importantly it prepares the timber for subsequent processing operations. Well managed drying:

- improves the stability of the wood;
- reduces its tendency to distort with changing environmental conditions;
- minimises post processing problems such as warping, checking and splitting; and
- creates the best material for other value adding steps (e.g. gluing, and machining).



Micrograph of the ultrastructure of wood

Drying a material such as Radiata pine is not easy. It is a complex, heterogeneous material. There are very few pathways for water to exit and what pathways there are can change shape and even collapse during the drying process. This means the permeability of wood changes during the drying process itself. It is not surprising therefore that for a long time wood drying was considered a 'black art' and mostly left to the sun and the seasons.

The need to export timber and the desire to promote timber into higher value applications necessitated a change in approach by the industry and a requirement to establish timber drying as a reliable and effective process. Consequently Scion established their wood drying group in the 1970's with the specific purpose of finding ways to reliably and predictably dry Radiata pine and to translate these findings into commercial practice.

"The knowledge platform in the generic technology of wood drying that [Scion] has developed over more than a 20 year period has been actively applied in a wide range of technology transfer to the forestry sector¹." The group's development of new drying schedules, in particular the high temperature schedules (ACT and HT) and the discovery that stress could be relieved post drying by steaming saw large increases in drying productivity.

"What the new [Scion] Schedules meant was that there could be a massive improvement in wood drying productivity without a loss of quality in the finished product. This proved a turning point for wood drying in New Zealand since it created the conditions which allowed for profitable investment by the industry in new ACT and HT kilns."¹

Establishment of the Drying Multiclient Research Group

The establishment of the Drying Multiclient Research Group by Scion – an early public/private partnership where all New Zealand timber drying companies worked in co-operation with researchers, accelerated uptake of technology and maximisation of benefits¹.

Kiln Type	Temperature dry bulb/wet bulb	Average Time
Conventional	70°C / -	4-6 days
Accelerated Conventional Temperature (ACT)	90°C / 60°C	1.5 days
High Temperature (HT)	120°C / -	< 1 day

Development of Dryspec™

In the 1970's very little wood was kiln dried in New Zealand; most was sold in the green (wet) state. These days most wood in New Zealand is sold as a kiln-dried product. The ability to make this dramatic change and the confidence that the New Zealand wood processing industry had in doing this was predominantly due to research by Scion's wood drying group and their invention of Dryspec™.

² New Zealand Forest Industry. Facts and figures 2008/9. www.nzfoa.org.nz

The Dryspec™ kiln control system, led the world in timber drying control and management. It led to optimal uses of resources for drying such as labour and energy, and also enabled the individual companies to better manage their drying processes and quality management systems.

Dryspec™ played an important role in supporting the growth of an innovative engineering company, Windsor Engineering Ltd, as it developed into a substantial international manufacturer of drying kilns. The company has made sales of over 530 kilns and related equipment, generating revenues of about \$20 million per year.

Scion developed the software-based control system for kilns in the mid 1980's, essentially codifying their years of knowledge in drying Radiata pine into an easy to use kiln software system. At that time converting such knowledge into a computer-based control system was visionary. Early adopters such as the New Zealand Forest Products mill at Putaruru and Tasman Forestry's mill at Kawerau took the risk and it was not long before the New Zealand industry followed their lead. By the mid 1990's Dryspec™ was the national benchmark drying system – today it is the *international* benchmark for drying control and is synonymous with quality drying.

The concept for Dryspec™ was to combine specialist knowledge of wood drying with local experiences and best practice process control systems. Previously kiln drying required the continuous presence of staff, a large number of routine and monotonous tasks and manual recording of conditions and events. The advent of kiln supervisory systems, pioneered by Dryspec™, finally provided stability and confidence for wood processing companies in this important processing step. The advantages of Dryspec™ were:

1. Providing the kiln operator with enhanced ability to set and manipulate the key parameters of the kiln in order to achieve strict quality control of the drying process;
2. Providing a major enhancement to kiln productivity because it allows wood throughput to be maximised without loss of quality; and
3. Improving energy efficiency and resource efficiency. For example one operator can check the state of a number of kilns from a central control point.

Very early in the development of Dryspec™, the product was licensed to Windsor Engineering Ltd. This relationship grew into a very strong mutually supportive alliance with Dryspec™ becoming an integral part of the Windsor Kiln system. Of the 530 kilns Windsor has sold, some 90% use the Dryspec™ control system. This represents over 80% of all the softwoods dried in New Zealand and Australia each year. Keith Robertson from Windsor Engineering sees the relationship between his company and Scion as very valuable.

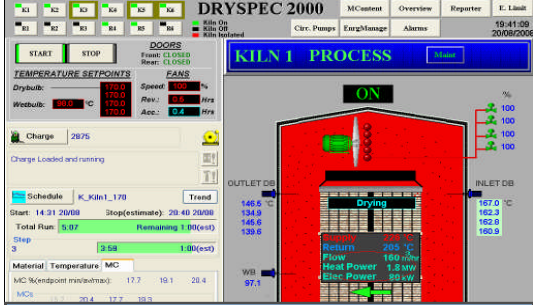
Established in the early 1980's, the "Drying Multiclient" would be one of the first public-private sector research partnerships. Almost every company in New Zealand who had an interest in drying participated by sending their technical people and kiln operators to the regular meetings of this group. The Multiclient was totally funded by private subscription. It focussed on finding solutions to immediate issues of common interest to the group. The main government programmes ran in parallel to the group who provided guidance and the ability to review outcomes. As a result uptake of research outcomes was extremely rapid.

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*Dryspec is an advanced software based timber drying management system. Embedded within it is some 20 plus years of accrued drying knowledge. It both controls and records the outcomes of a drying operation for both operational requirements and for on-going drying development and improvement. Dryspec:*

- Integrates any green mill, in kiln and dry mill moisture content measurement systems for tracking and QC purposes.
- Uses zonal temperature for management of moisture content.
- Smooths the load on the heat plant to improve energy management.

*Dryspec operates in a Windows environment and interfaces with industry standard programmable controllers.*



*Windsor Engineering Ltd was founded in 1975 by Bill Studd. Windsor is a privately owned company based in New Zealand with offices in Melbourne, Australia. It started with a range of fans and dust collecting equipment for the wood working industry; it expanded this into developing advanced drying kilns and is now the major producer of such equipment for the Australasian market. R&D plays a major role in the development of Windsor's business. [www.windsor.co.nz](http://www.windsor.co.nz)*

“Dryspect was key to the progress of drying technologies used in NZ and Australia and the strong linkages Windsor had with Scion wood drying scientists certainly helped with kiln sales. Windsor was able to demonstrate strong connectivity and linkages with leading edge researchers in softwood drying and this was a definite advantage.” Further, Dryspect™ has played an important role in helping Windsor Engineering grow from a \$10 to \$20 million business, employing 60 staff.

Dryspect™ has become synonymous with quality drying product. Tenon for example, one of New Zealand’s largest high value timber exporters supplying appearance grade lumber to US moulding and millwork manufacturers exclusively use Dryspect™ in their nine kilns to manage all their drying operations. Wayne Miller, technical manager at Tenon has no doubts about the value it adds to their operation. “Dryspect™ is a key component of Tenon’s world class drying operation. Dryspect™ databases and reporting systems are excellent for data capture and a great tool to assist with continuous improvement and refinement of kiln schedules to optimise quality and productivity.”

Similarly Kiwi Lumber which processes and dries about 75,000 m<sup>3</sup> of sawn timber per annum for the furniture, joinery, mouldings and building industry extensively use the Dryspect™ system. David Tilyard, Processing Manager at Kiwi Lumber, Dannevirke noted “Dryspect™ is a key part of monitoring our drying process, helping ensure we produce a consistent, high quality product – while maximising our throughput and productivity. Dryspect™ is a key tool for our kiln operators that enables them to make good decisions based on clear relevant data.”

## **THE FUTURE**

To date industry and the New Zealand Government have collectively invested about \$40million in wood drying research. This is a very small investment compared to the overall benefits that have accrued to the wood processing industry and to New Zealand.

Timber drying has of necessity, gone through a step change in New Zealand over the last 20 years, and Scion’s Wood Drying Group (WDG) has been part of creating and supporting this change. The timber drying industry is now on the cusp of another step change as external drivers intensify focus on enhancing wood quality from faster grown plantation forests in New Zealand and internationally (e.g. southern states of the USA) and reduction of operational costs associated with drying. The drying operation is typically the largest user of energy in wood processing. Accordingly any reductions in energy use improve productivity, reduce cost and the industry’s environmental footprint.

The future for timber drying is moving from batch processes to continuous drying processes. Windsor Kilns Ltd are at the international forefront in developing this new generation of drying kilns, specifically single track and double track continuous kilns. As part of this Dryspect™ is therefore in further development so that it too can support continuous operations.

The WDG continues to support Windsor Kilns Ltd as they seek to expand their operations into North America and create further export value to the benefit of New Zealand.

Providing benefit to the broader New Zealand drying industry also remains a priority for the WDG. The structure of this group’s relationship with the wood processing industry has evolved as the industry now works through the Solid Wood Initiative<sup>3</sup>, a wood processing industry consortium. This consortium has prioritised timber drying as one of the industry’s three priority areas for research. It seeks to continue to enhance wood quality from drying and increase international competitiveness by harnessing new innovations to increase productivity. The programme is specifically targeting energy reduction and water management as areas for process improvement.

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<sup>3</sup> [www.sqi.co.nz](http://www.sqi.co.nz)