NATURAL FIBRES IN AUSTRALASIA

C. A. WILSON AND R. M. LAING (Editors)

COMBINED (NZ AND AUS) CONFERENCE OF THE TEXTILE INSTITUTE
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Forward

The United Nations FAO launched the International Year of Natural Fibres 2009 in Rome 22 January 2009. This launch event has been accessible worldwide through www.fao.org/webcast.

The conference 'Natural fibres in Australasia' provided a focus for delegates with diverse interests in natural fibres from this region to:

* recognise and celebrate the United Nations Year of natural fibres;
* examine current issues related to natural fibres in Australasia – production, processing, development of niche products, use, disposal – including use of natural fibres in cultural artefacts
* facilitate discussion among those working with textiles manufactured from natural fibres – members of The Textile Institute (TI New Zealand, TI New South Wales, TI Southern), other professionals (academics, technologists, industrialists, curators / collection managers / conservators), and students.

Welcome to the University of Otago and to Dunedin, New Zealand.
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Protein and cellulose fibres

Keynote: Recent research on natural fibres and textiles

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Research on a range of natural fibres and textiles will be presented. The focus will be on recent work carried out at Deakin University’s Centre for Material and Fibre Innovation, which is a multidisciplinary research centre with over 100 researchers. The work covered will include research on hemp fibres, wool, silk, and alpaca fibres. Research on yarns, fabrics, and fine powders made from these fibres will be briefly discussed also.

A relationship between hemp fibre fineness and residual gum content has been established, which provides a rapid means of assessing the residual gum content in the degummed hemp fibres (Beltran et al, 2002). Silk and wool fibres have been converted into ultra fine powders for advanced applications (Rajkhowa et al, 2008; Zhang et al, 2008). The resistance to compression (RtC) behaviour of wool and alpaca fibres has been closely examined (Liu et al, 2004), which challenges the belief that RtC is a good indicator of fibre softness.

Ways of reducing the hairiness of natural fibre yarns (Najar et al, 2006), predicting the pilling propensity of wool knits (Beltran et al, 2006), and functionalising fabrics for superhydrophobicity (Wang et al, 2008) and photochromic or colour changing effects (Cheng et al, 2008) will be discussed.

References


Croatian wool – high performance fibre instead of waste

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According to the State department for statistic there are 800 thousand native (domestic) sheep in Croatia, and approximately 900 tons of sheared wool per year. This wool is not used in Croatian textile industry as raw material since the overall perception is that it is too coarse for fine wool products, and that is why it is mostly disposed in the environment regardless of its limited capacity to accept such kind of waste (Vujasinovic and Soljacic, 2006). In order to avoid harmful influence of domestic wool on the land and to revive interest in this Croatian only one textile raw material, wide-ranging field and laboratory investigations were started at the Faculty of Textile Technology University of Zagreb.

Employing a systematic analysis of experimentally obtained data, especially fineness, medullation, bulkiness and sorption as well as the comparison with such data for the wool of similar characteristics (following the accepted standards of IWTO, WRONZ & AWTA), it is concluded that majority of Croatian domestic wool (e.g. wool of the predominant sheep breed, so called pramenka), with a proper clip preparations (Vujasinovic and Raffaelli, 1994) and environmentally friendly scouring (Vujasinovic, et al, 2007), can be used not only as replacement for some imported coarser carpet wool, but also as highly capable sorption material. Such suitability to be used in high added value product (technical textiles) can raise the interest in, and market value of Croatian domestic wool assuring it rightful place in Croatian economy and future sustainable development.

Acknowledgement

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References


An investigation on fleece characteristics of Arkharmerino × Ghezel and Arkharmerino × Moghani crossbreed sheep in third generation

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Sheep breeding has an important role in animal production in Iran. Sheep have the ability to transform poor grasslands, which are widespread in Iran, into valuable products like meat, milk, wool and skin. The greatest part of the wool produced by the indigenous sheep breeds in Iran is of coarse and mixed type of wool and most of it is used in the hand woven authentic carpet production. It is reported that there are 150 000 hand woven carpet production workbenches spread throughout Iran and about 3.5 million m² hand woven carpet is being produced annually. This is an important occupation particularly for the women living in rural areas (Mokhber, 2005). The authentic hand woven carpet type of wool is preferred to be coarse and mixed type as the thick fibre helps the thread to stand upright in the carpet but the coefficient of variation in fibre diameter is high and it should be improved through crossbreeding with exotic breeds. To reach this goal current study was conducted to investigate the wool characteristics of Arkharmerino × Moghani crossbreed sheep. Fibre samples of 187 crossbreed sheep were analysed with the image analyser (IA). The following traits were considered: staple length (SL), mean fibre diameter (MFD), standard deviation (S.D.), proportion fibre < 30 µm (%F < 30), proportion of kemp (PK) and proportion of medullated fibre (PMF) (Rafat, et al., 2007). The effects of type of birth, age, sex and generation were studied. The generation influenced all traits showing that second generation was better than first generation. With increasing age of the animal MFD, S.D., %F < 30 and PK increased whereas SL decreased. Comparing the two sexes, females showed better fibre quality.

In conclusion, the crossbreed population studied shows a high genetic potential for high quality fibre for woven authentic carpet production. The information available allows further steps towards the design of a breeding program.

Acknowledgement
The authors wish to thank the staff of the Khalat Poshan Research Station and Dr M. Dadpour for their help in the collection and measurement of the wool samples.

References
Proposed methods for reducing irregularity in worsted processing – with particular reference to Solospun™ yarns

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The significance of irregularity in processing is illustrated in a review of its influence on end breakage rates in spinning and weaving a range of Solospun™ yarns. Also reviewed is a simple mathematical model of the worsted drawing process, which identifies and quantifies the components of irregularity in slivers, rovings and yarns at every step in the drawing sequence. Three components of irregularity are identified, one due to the random distribution of fibres in the stream, a second due to variation in fibre diameter (both previously described and quantified by Martindale) and a third, comprised of processing irregularities due to imperfect fibre control during drafting. This third component comprises processing irregularities carried forward from one processing step to the next processing step, and further processing irregularities added during that step of processing. Three methods for reducing processing irregularities are described; the first using the mathematical model to optimize the design of the drawing sequence; the second and third aim to improve fibre control in the drafting zone, one by manipulating inter-fibre interference, and the second by improving the condition of the fibres prior to spinning.
Insect-resist treatment for wool and other animal fibres

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Wool and other animal fibres are susceptible to attack from the larvae of several insects which have evolved the ability to digest keratin despite it being strongly cross-linked.

Over the years a number of agents have been used to prevent attack but in the early 1980s the first use of the synthetic pyrethroid, permethrin began and this became the agent used in almost all applications.

However, in more recent years, permethrin has hit environmental, resistance and image problems.

This paper outlines the development of two replacement agents based on bifenthrin and chlorfenapyr which largely overcome these problems and ongoing work to develop a new environmentally friendly non-insecticidal agent.
Improving the skin comfort characteristics of wool fabrics

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Skin comfort or ‘prickle’ can be a significant issue for next-to-skin garments containing wool if inappropriate wools are used. As a result of research at CSIRO in the 1990’s the physical mechanism underlying this sensation is well understood and this has resulted in some quarters of the industry focusing on the percentage of fibres greater than 30 micrometers in the diameter distribution. Skin comfort is however a property of a finished fabric or garment and many parameters other than fibre diameter characteristics can influence the skin comfort of the final garment. The current paper will describe the results of recent work at CSIRO aimed at exploiting the role of other key fibre and fabric parameters to identify practical solutions for improving next-to-skin comfort.
Creating new opportunities for merino apparel using digital printing technology

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Statistics suggest that printing accounts for only a modest percentage of the wool fibre that finds its way into the global apparel market place. Less than one per cent of fabric printing is done on wool because it is expensive (Vijayan, 2008). On face value, it would follow that opportunities exist for growth in this product sector, particularly with the growing accessibility of digital fabric and garment printing technology. The integration of digital technologies into apparel forms allows designers to explore and visualise new creative possibilities (Campbell and Parsons, 2005). Limitless colours, design customisation, zero perceived impact on fabric/garment handle, rapid sampling, speed to market and reduced inventories are all benefits associated with digital printing.

The AUT Textile and Design Laboratory, based at the University’s Auckland City campus, has been working with industry partners for around two years. Awareness of the aforementioned technology and its benefits has started to percolate through to designers and product developers alike, which has resulted in a number of new niche products with the much sought after ‘value added’ tag.

Traditionally, printing and luxury fibre fabrics/garments have not been the best of bedfellows. One key reason for this is that the preferred colorant used by most printers has been pigment ink, which has a tendency to adversely affect the fabric/garment handle – we only have to consider the run of the mill printed T shirt to verify this. Digitally printing onto protein fibres with either acid or reactive dyes circumvents the issue of compromising garment handle as both these dyestuffs integrate chemically with the substrate, unlike pigments that ‘sit’ on the surface.

This paper will serve to demonstrate the above claims by looking at a number of case studies in which merino and other protein fibre fabrics and garments have been enhanced with the aid of digital printing carried out at the AUT University’s Textile and Design Laboratory.

References
Innovation for Australian wool

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Over time consumers expect progressively more from their products, in both performance and functionality and generally at a reduced price. Performance and functionality that were considered “top end” decades ago are no longer adequate even at the inexpensive end of the market. Easycare is a good example in the apparel market that was brought about by the development of new synthetic fibres, processes and the widespread adoption of domestic washing machines. Consumers expect garments to be durable but with soft handle, to be dyed in bright and vivid colours, or bright whites and pastels and to be worn next-to-skin without discomfort. The innovations that have driven these higher expectations have come about as a result of enormous investments in basic and applied fibre and textile research, particularly from the major producers of synthetic fibres. The wool industry must continue to innovate if it is to survive and remain a relevant fibre of choice for the modern consumer.

For many decades, CSIRO has taken on this challenge with the development of a wide range of technologies and processes e.g. the chlorine/Hercosett process for sliver shrink proofing, Siroset for wool setting, Sirospun™ for lightweight, cool wool fabrics, SiroLock™ card wire, Sportwool™ a new wool containing fabric for sportswear and objective measurement and instrumentation for raw wool specification and trading (micron, length and strength measurement, dark and medullated fibre). Examples of recent products that have been developed by CSIRO and that are now entering the commercialisation phase will be discussed.
Possum fibre — from pest to product

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The introduction to New Zealand of the Australian Brushtail Possum (Trichosurus vulpecula) is explained. From around 1900 to 1938 the possum was a protected species in New Zealand. Following collection of various forms of scientific evidence, the government acknowledged the destruction to New Zealand’s flora and fauna being caused by the possum. Thus, since the mid 20th century the New Zealand government has taken measures to control the number of animals.

Alternative ways to dealing with the animal were investigated. Around 15 years ago, the possum fibre was developed into a commercially viable yarn at Woolyarns factory in Lower Hutt. The possum fibre, combined with New Zealand merino wool, yielded yarns differentiated in the domestic market from more conventional merino wool yarns. When both yarns were manufactured to knit fabric structures and selected properties compared, fabrics from the possum/wool blend were superior in weight (lighter), in warmth, and with fewer pills evident. All the findings were from independent research performed by Clothing and Textile Sciences, University of Otago.

The presentation will further identify the impact the possum yarn has had on the domestic tourist market and now on an international scale.

Woolyarns also participates in conservation projects around New Zealand to help preserve the iconic Kiwi bird.

Acknowledgement

New Zealand Department of Conservation.
Liquid moisture transport performance of wool knitted fabrics for skin layer of active wear

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The factors that contribute to human performance are many and complex. Appropriate choice of clothing is important in maintaining the body's thermal balance and thermal regulation since it provides an interface between the human skin and the environment for those body parts covered, modifying human thermoregulatory responses (Li, 2001). The behaviour of the moisture absorbed at the fabric inner surface, transported between the two sides and evaporated at the outer surface significantly influences the wearer’s comfort sensation (Hu, et al., 2006).

The liquid moisture transfer responses of plain jersey fabrics constructed from 20 Tex extra fine Merino wool yarn were studied. Their liquid moisture transport properties were determined by Moisture Management Tester: wetting time of top (in contact with the skin) and bottom (exposed to the atmosphere) surfaces, maximum moisture absorption rates of top and bottom surfaces, maximum wetted radius of top and bottom surface, spreading speed of top and bottom surface, accumulative one way transport capacity and overall moisture management capacity (Hu, et al., 2005).

The fabrics were constructed with eleven different cover factors and their structural and physical properties were determined. The relationship between the cover factors and moisture management properties was established. The moisture management properties of the experimental fabrics were not influenced by their cover factors. Their liquid moisture transfer properties demonstrated that: almost all of the fabrics have low grade in top wetting time, but at the same time they have medium to very fast range of bottom wetting time; almost all are very slow in top absorption rate but they have fast to very fast range of bottom absorption rate. In maximum wetted radius, almost all the fabrics have low grade in both surfaces. In spreading speed, all the fabrics have very slow spreading speed in top surface, but have very slow to very fast range of spreading speed in bottom surface. All fabrics have the highest grade in accumulative one way transport index, thus it was concluded that wool fabrics have excellent one way liquid transport capacity from the inner (top) surface to the outer (bottom) surface. Their good to excellent range of overall moisture management capacity indicated that wool fabrics have high capability to manage the transport of liquid moisture and highly suitable as a skin layer for the active wear apparel.

References
Specialty protein fibres in the New Zealand outdoor apparel market

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The outdoor apparel market is an increasingly competitive one in which many companies use performance claims to differentiate products. At the same time, consumers are becoming more discerning about products that are marketed based on the physical properties of the fibre (often attributed to the fabric/garment). Protein fibre products are a popular choice for the New Zealand (NZ) performance apparel market. NZ’s importance as a sheep and wool producing country internationally and the dominance of wool in the NZ market means that NZ consumers are very familiar with the performance properties of wool garments. However, while wool – particularly Merino – dominates the NZ market, in recent years other protein fibre products such as those manufactured from silk and silk blends have been used for outdoor apparel.

Use of silk in the niche market of performance apparel shifts silk away from its more traditional use as a luxury fibre. Such a change in application presents challenges for manufacturers, retailers and consumers of silk products. Not only does there appear to be little published research regarding the properties of silk and silk blend fabrics used for production of niche performance apparel but there is also a lack of knowledge about the performance and care of silk knit garments cleaned using conventional laundering methods. In NZ and internationally apparel companies are legally required to substantiate product claims. In New Zealand the Fair Trading Act (1986) and the Consumer Guarantees Act (1993) require goods be safe, serviceable, and fit for the intended purpose. These legislative requirements enable consumers to seek a remedy, from either the supplier or the manufacturer (as appropriate) should obligations or guarantees under these Acts fail to be met. Such legal requirements and a quality focus provide an impetus for improving understanding of garment properties. Correct care, maintenance, and performance characteristics are of particular concern when manufacturing high quality niche products for the performance apparel market segment.

To meet legal and market needs an understanding of performance characteristics is needed. Research may be undertaken as part of a companies research and development programme or as sponsored co-operative research between independent research organisations such as universities and the industry. Such relationships can be beneficial to both parties. A collaborative study between Clothing and Textile Sciences, University of Otago, and a niche product provider, will be described.

Acknowledgement
We acknowledge the contribution of fabrics for this study from Paradox Products Co. Ltd.

References
Aho: Development and commercialisation of a unique cultural and technological concept

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Ngāi Tahu are an indigenous people of the South Island of New Zealand. Ngāi Tahu’s administrative wing, Te Rūnanga o Ngāi Tahu, manages a large base of cultural assets and delivers programmes and projects to promote the interests and aspirations of the people. One of these projects, Aho, which means thread, strand or line, is the first project to enjoy success under the banner of Ngāi Tahu Creative Products Development. This commercial project has involved the development of high quality wool products incorporating Māori rock art imagery. The textile technology behind Aho is a novel wool processing route developed by AgResearch’s Textile Science and Technology Section, and utilises the innovative ‘Fibreknit’ processing system.

Those involved with the venture believe it is setting a high benchmark in developing a tribal economy in a way that can turn profits as well as extending and informing the cultural tradition of Ngāi Tahu. The consultation process leading up to the development of the garments involved hui (meetings) between Ngāi Tahu artist Ross Hemera and representatives of the South Island Māori Rock Art Trust (also Ngāi Tahu). One outcome that emerged from the project is that a contribution is now made to the Rock Art Trust for each item sold.

The other important aspect of the project was the collaboration that developed between Ngāi Tahu and AgResearch. AgResearch’s Fibreknit system knits a fabric direct from sliver, without the need to first prepare a yarn. It differs from sliver-knitting in that the fibre is knitted into the fabric structure rather than protruding as a pile, allowing flat fabrics in multiple colours, and even ‘devoré’-style structures, both of which are featured in the Aho range. Technical challenges were in the areas of raw material specification, the knitting process itself and finishing routines that achieved an accurate reproduction of the design while maintaining durability and handle. Ensuring that the finished-fabric manifestation of the concept met all artistic, cultural and performance requirements was a particular feature of this textile development process.

The project has been a demanding and exciting process for the team, and its successful commercialisation has resulted from a unique development partnership between iwi, artist and research organisation. The collection was launched in March 2008 and can be viewed at www.ahocreations.com.

Acknowledgement
We would like to acknowledge the financial support of the Foundation for Research, Science and Technology during the initial stages of this development (contract WROX0303).
Including the consumer in garment quality evaluation

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Textile and fibre quality has traditionally been defined in terms of mechanical properties. To evaluate garment quality, this definition may be extended by inclusion of the dimension of consumer evaluation. This paper discusses the development and application of an extended methodology for defining garment quality in terms of consumer response.

Evaluation of consumer response requires accurate measurement of qualitative individual responses. However garment retailers are interested in a population rather than an individual response as well as quantitative specification of any change in consumer evaluation of quality.

In this context, a consumer-based methodology, developed to examine changes in consumer response to garment quality brought about by changing fibre properties, and relevant to both natural and synthetic fibres, is described. This four stage methodology (known as the Design For Comfort (DFC) garment methodology) extends traditional fabric evaluation methods to examine consumer response to fabric as garment in changing environments.

The DFC methodology utilises responses from screened untrained participants selected using a flexible screening process. This process has been designed to focus on responses in the particular market segment into which the garment would be sold. Results from the use of this methodology in testing a lightweight single jersey knitted long sleeved t-shirt made of different fibre types and properties are presented. Mapping and analysis of the comparative garment responses in terms of sensory response (tactile, moisture and thermal) and the ability of participants to detect differences between garments in changing environments is discussed. A Population Acceptance Rate (PAR) based on sensory score distributions is also estimated.

The ongoing research described establishes the basis for development of a multi-dimensional garment quality evaluation model.

Acknowledgement

We acknowledge the support of DAFWA for development of the garment test methodology, and the support of the Sheep CRC for testing of these garments.
Australia’s position in the global cotton industry

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Despite uncertainty regarding the consequences of the global financial crisis, tightening credit limits and increased competition from grains, oilseeds and man-made fibres the production and consumption of cotton remains resilient. World cotton production is estimated at 24.6 million tons during 2008/09, while consumption is estimated at 24.9 million tons (ICAC 2008).

The development and adoption of new technologies such as biotechnology, precision agriculture, better management of water and soil fertility, the use of integrated pest management and advances in plant breeding has led to improved yields and fibre quality. In comparison with major cotton producing countries such as China, India, the USA, Pakistan, Central Asia and Brazil, Australia is a small but significant producer of the world’s medium to high medium quality cotton.

Australian cotton is generally viewed worldwide as a quality fibre purchased for a premium with the intention of producing high quality fine count yarns, normally combed ringspun, for use in the woven and knitted apparel sectors. Nearly all of Australia’s cotton lint is exported for high quality end use in mills in South East Asia, with China, Indonesia, Thailand, South Korea and Japan being the main destinations. The strength of Australian cotton in these markets is primarily associated with the adoption of varieties with high inherent fibre characteristics, and with practices that attempt to preserve the quality at all stages of the cotton production pipeline.

The purpose of this paper is to give a brief history of the modern Australian cotton industry and the initiatives being taken by the industry to ensure that Australian cotton maintains its good position in the global cotton market.

References
Renewal of flax fibre production in Croatia

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Last 40 years of the past century was time when flax i.e. its production and culture was neglected in Croatia. Such circumstances resulted in the extermination of more than 20 different Croatian autochthonous flax cultivar. Having in mind that flax fibres were significant part of our cultural heritages and that natural fibres are in fashion again, a need for reviving flax production was pointed out (Raffaelli and Andressy, 1990). With the aim to revitalise flax fibre production based on principles of sustainable development research project financed by Croatian Ministry of Science, Technology and Sport was started few years ago.

Since there was no Croatian flax cultivars preserved the first part of research project was choosing the right foreign flax cultivars that can be grown in Croatia respecting her climate and geographic features and which can yield flax fibres of respected quality (Paskovic, 1957). According to the recommendation of agricultural specialists five different flax cultivars that might be suitable for growing were chosen for trials (Butorac, et al, 2006). They are: Jitka, Texa, Merkur and Bonet (originated in Czech Republic) and Viola (from Netherlands). Cultivars with the best agronomic traits (yields of stem, plant height and technical stem length, ratio of short and long fibre etc.) were subjected to biological maceration and flax fibres characterisation in order to determine the most appropriate one from textile-technology point of view. Respecting achieved agronomic and morphological characters of flax fibres that were isolated from foreign flax cultivars grown in Croatian conditions, Viola cultivar appear to be the right one.

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References
Bamboo fibre and its unique properties

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This research critically explores the scope of Bamboo fibre analysing its different properties. Extremely soft, comfortable and cool 100% eco fibre, Bamboo is a kind of regenerated cellulose with bright colour. Its fibre strength is better and steady. Jain, Kumar and Jindal (1992) indicate, the tensile, flexural and impact strengths of bamboo along the fibres are 200.5 MN m⁻², 230.09 MN m⁻² and 63.54 kJ m⁻², respectively. It has high elastic resilience, moisture absorption, good drapability, wearability and excellent spinnability.

Bamboo can grow as much as 3 feet (0.91m) over night. Its structure is designed to have uniform strength at all positions in both the radial direction on the transverse section and the lengthwise direction (Nogata and Takahashi, 1995). It is a natural cellulosic fibre, can naturally degrade in soil, pollution-free to environment after decomposing. It has in built anti bacterial agent named “Bamboo Kun”. Its natural antibiotic and bacteriostasis are due to Colon bacillus and golden staphylococcus (socksheaven.com, 2008).

It has a soft handle like any other viscose therefore, can be spun 100% and also can blend with such raw materials like Cotton, Hemp, artificial Silk, natural Silk, Modal, Silk ribbon, Dacron. It Passes Halo Test (JIS L1902), inhibits the proliferation of bacteria (Bacteria under testing: Staphylococcus aureus). Bamboo’s Deodorization rate is 80 %↑ (Deodorization for NH3) (ftc.com, 2008; kngfi.com, 2008; ftcamerica.com, 2008).

Bamboo yarns can be both woven and knitted in any design and pattern. Bamboo clothes can be made in bold, vibrant colours due to their affinity to dye stuffs. Bamboo has a thermal-regulating characteristic that keep cool when it’s hot and warm when it’s cold. Clothes made of bamboo are moisture absorbent and they have a unique wicking ability that prevents clinging under perspiration (hotfrog.com, 2008). Above all, Bamboo fibre can be an answer to the skin cancer of Australia due to its unique property of natural ultra violet protection (SPF 30+).

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The measurement of cotton fibre linear density and maturity and its potential value to textile processing

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A significant problem associated with cotton fibre quality is related to the control and management of cotton fibre maturity and linear density (fineness) from growing through to spinning. At the centre of the problem is the absence of rapid and accurate measures for cotton fibre linear density and maturity. The problem exists despite the very significant impact that fibre maturity and linear density can have in the spinning mill and on the quality of fabric. Confounding control of fibre maturity and linear density is the widely accepted and used micronaire test method, an airflow technique that measures a combination of fibre linear density and maturity. A consequence of using the micronaire is that cotton can be classified inappropriately. For example, fine mature cotton can have the same micronaire value as coarse immature cotton. Thus, there is a need for a new measurement technique to separate these. Recognition of fibre quality is of particular importance to the Australian cotton industry where varieties of fine, mature cotton have been wrongfully discounted because low micronaire values were taken as indicating immature cotton, or high micronaire cotton may be discounted where in some cases the cotton may be fine and mature and appropriate for producing fine count yarns. In this paper progress of two instruments developed by CSIRO in conjunction with the Australian cotton industry, which measure cotton fibre linear density and maturity directly and rapidly, will be presented. Further examples of the application and use of these new techniques during textile processing will be presented.

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The development and scale-up of electrospinning machines

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Electrostatic attraction of liquids was first observed by William Gilbert in 1628, and attempts were made to commercialise the process in the 1900s and 1930s (Stanger et al, 2009). In the late 1960s the physics of thread formation were described (Taylor, 1969). More recently electrospinning has emerged as a ready way to produce nanoscale polymer fibres (Doshi and Reneker, 1995). This paper describes the development of a laboratory scale electrospinning machine, some preliminary results concerning the manufacture of fibres from biodegradable and bio-origin materials, and some observations relating to scaling up for industrial scale production.

At the laboratory scale the typical machine uses a syringe pump to provide a constant volume flow rate feed with the whole apparatus housed inside a protective enclosure, whilst this setup is certainly effective, it only allows limited access to the apparatus during operation and is intrinsically a batch process. To produce significant quantities of material, it is necessary to devise a continuous process. If the machine is to be used in a research laboratory it is necessary to allow provision for modification to the machine. The machine described uses a constant head device to feed the spinning tip (a standard micropipette tip). The use of this type of constant pressure device allows the user to establish a stable meniscus for the formation of the Taylor cone, and the consequent drawing of fibre, the rate of meniscus replenishment is automatically matched to rate of fibre removal. The machine operates with dual polarity. This allows the user to explore the charge carrying ability of subject materials (Stanger et al 2009), and to charge the target rather than the spinning tip; a charged target may be required if spinning from a melt rather than a solution.

The commercial use of electrospun nanofibres has been held back by difficulties associated in making large quantities of fibre. This paper discusses the quantities required for certain industrial applications and proposes a method for commercial manufacture.

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References
Thermophysiological and thermal contact properties of wet knits made of non-traditional natural fibres

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In recent decade, various non-traditional natural fibres became systematically investigated, in order to replace at least partly oil–based man-made fibres. In this study, we have determined dry and wet thermal comfort properties of single jersey knits made of maize, soya and bamboo viscose fibres and compared with those of cotton fibres. The yarns always consisted of 2 components, either of other natural fibre of the group, or of polyester based fibres (Thermolite, Coolmax, and Drirelease). The objective of this research was to find the blend with the best (driest, warmest) thermal contact properties, the highest thermal resistance and the highest water vapour permeability. The natural component was believed to bring the better moisture transport, whereas the man-made fibres should add better thermal insulation. Square mass of all samples was around 200 ±10% g/m². The effect of moisture has been simulated by the sweating impulse principle, given by injection of 0.3 ml water into the middle of the sample, and by inserting the sample in the ALAMBETA computer controlled commercial tester after 1 minute. The ALAMBETA tester measures thermal conductivity $\lambda$, thermal resistance $R$, thermal absorbtivity (warm-cool feeling) $b$ and thickness of fabrics. The results are statistically treated and each measurement takes 3 minutes only. Thus, the instrument is very suitable for the wet measurements, as during the measurement the sample keeps the original moisture level.

As regards the results, for dry samples no significant differences in thermal conductivity and absorbtivity were found. Thermal conductivity values of wet samples were in the average 2,5 times higher than those of dry samples, and the lowest levels in wet state were obtained with knits containing maize and soya fibres. The same advantage was found for the maize and soya fibres, as regards thermal absorbtivity $b$ if knits in wet state – these samples offered the warmest (driest) contact feeling. However, none of these compositions showed relatively dry feeling in wet state like common double-layered polypropylene-cotton knits. These knits in wet state indicate $b$ around 250 Ws$^{1/2}$m$^{-2}$K, whereas thermal absorbtivity $b$ of the knits studied in this paper was always higher than 400 Ws$^{1/2}$m$^{-2}$K, which corresponds to quite cold (wet) feeling.

Water vapour permeability has been determined just for dry samples, by means of the computer evaluated non-destructive commercial PERMETEST instrument (by SENSORA). The highest water vapour permeability (lowest evaporation resistance $R_{et}$) exhibited the samples containing maize fibres in most cases, second best permeability being offered by soya samples.

Reference

Restoring New Zealand’s harakeke fibre industry

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New Zealand’s harakeke fibre industry has boomed and busted. However, with consumers increasingly looking for products made from natural and sustainable materials, the Biopolymer Network Ltd (BPN) is looking to restore this industry, albeit in a new guise. The BPN, a collaboration of three of New Zealand’s leading Crown Research Institutes - Scion, Plant and Food Research and AgResearch - is applying its collective capabilities to help New Zealand convert more of its plant fibre and resin resources into consumer attractive products. We have been exploring the use of natural resins and fibres in the plastic composites industry and have identified potential in our harakeke fibre resource. “Generation 1” biocomposite materials have been developed and recently we have begun a 5-year project which aims to develop “Generation 2 and Generation 3” materials. A further aim of this new programme is to enable the establishment and development of new enterprises, based on a harakeke fibre supply chain, from growing and harvesting, through fibre extraction and early-stage processing to composite manufacturing.

The BPN has explored the use of harakeke fibre as a replacement for glass fibre in “fibreglass” composites. At a technical level, our harakeke composites have demonstrated physical properties approaching those of fibreglass; however, harakeke fibre is five times the cost of glass fibre and so cannot compete on economics alone. To enter the composites market, harakeke has to offer something other than that offered by glass and, fortunately, it does. Unlike glass fibres and many other natural fibres that have been studied, harakeke has a very pleasing aesthetic appearance when it is set in a clear resin. This property allows us to place harakeke composites outside the technical (e.g. structural) and commodity composites market and into the decorative laminates market, where it has the potential to attract a higher price premium.

This paper introduces the BPN and then reviews the history of the harakeke rope, cordage and textile industries that operated in NZ from the 1860s right into the 1950s and 60s. The development of BPN’s “Generation 1” harakeke composite materials will be overviewed and illustrated with examples of our composite products. In conclusion, we will outline our 5-year plan to develop and modernise the growth, harvesting and processing of harakeke fibre, while creating demand for the fibre from new enterprises such as the manufacture of novel biocomposite materials and products.

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Templeton Flaxmilling Heritage Trust Mr Des Templeton
Reflex Products Ltd Mr Greg Simons
Natural fibre in cultural artefacts

Keynote: Cultural heritage: Exploration and discovery

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The examination of cultural heritage covers a range of continents, materials and cultures. Projects in which historical artefacts from cultures dating back to ca. 1500 have been analysed will be discussed. These reveal a dichotomy of civilisations and society as textiles and sacrificial mummies from South America are compared with exploration cartography from sixteenth century Europe. Materials and artefacts from separate continents show similarities in the consideration of traditional organic materials; a range of colorants, inks and dyes to record and store text, illustrations and weave patterns that expressed aspects of the contemporary life styles. Preservation projects discussed include ca 1500 Pre-Columbian textiles and sacrificial mummies, the Magna Carta (1297), the Waldseemüller 1507 World Map (the first map that used the term “America”), the Star Spangled Banner (the original 30 x 42 foot American Flag flown during the War of 1812), other flags from the War of 1812; and artefacts in the 2001 World Trade Center Archive.

Using advanced modern technologies can reveal hidden text, unknown and lost information, allowing us to explore and revisit the past. The preservation of cultures for future generations is imperative for continuing to understand our past, and preserving as much as possible is a critical way to balance preservation and access. Access is an integral component for indigenous cultures, as items are repatriated to their tribes and rightful locations, and issues of treatments that could impact human health are assessed.

Preventive conservation is an extremely important component for the ongoing preservation of collections, particularly organic traditional materials such as cellulose and protein. The incorporation and importance of collaboration between preservation professionals (preservation scientists, conservators, curators), engineers, architects, and management is imperative to the future of successful cultural heritage preservation.
Muka taonga (treasures) in the Museum of New Zealand Te Papa Tongarewa

A. TAMARAPA

The Museum of New Zealand Te Papa Tongarewa has a rich and diverse collection of Māori material that includes natural fibre. This presentation is a glimpse into the variety of uses for muka—the processed inner fibre from leaves of the harakeke plant, Phormium tenax.

All aspects of Māori life featured the indispensable muka. Its significance is encapsulated in metaphorical terms. Muka is sometimes referred to as the intangible, spiritual link between generations across time. The aho (weft threads) can refer to an umbilical cord, the whenu (warp threads) the womb, and Papatūānuku, the earth mother. Connections are integral to Māori. All things are interrelated, and have a mauri, a living life force.

The practical attributes of muka are evident in the extent of its use. Cloaks, maro (waist garments for women), pāraea (shoes), kete muka (bags), tauri (woven collars) for taiaha, or long handled weapons, cordage and binding for building construction, fishing and hunting, weaponry, recreational items such as kites, poi, musical instruments, transitional period items such as muka tea cosies, letter holders, placemats, feather muffš, mantle drapes, an alter cloth and a baby wrap are among the many types of items produced that reside in the collections of Te Papa.

This is an opportunity to reveal some of the unique and interesting items that demonstrate the importance, value and versatility of muka. It is also an occasion to share in the range of material in our collection and be able to discuss taonga that are rarely exhibited in this context.
Identifying harakeke (Phormium tenax) cultivars using whītau (fibre aggregate) properties

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Harakeke (Phormium tenax) is a monocotyledonous plant endemic to Aotearoa (New Zealand) and Norfolk Island. Harakeke is an icon of contemporary New Zealand culture with the status of taonga (treasure) under Article II of the Treaty of Waitangi and the Ngāi Tahu Claims Settlement Act (1998). Māori have a long history of utilising whenu (strips of harakeke leaf) and whītau (fibre aggregate) to manufacture objects required for daily life e.g. ropes, nets, sails, containers, furnishings, clothing and artwork, both traditional and contemporary. Although there are only two species of Phormium (P. tenax, P. cookianum), Māori weavers recognise more than 60 different cultivars. Experienced weavers recognise different cultivars by assessing the appearance of the harakeke bush and leaf, and the behaviour and feel of the leaf and fibre as they are prepared for use.

Recent studies have attempted to characterise differences among harakeke cultivars recognised by weavers, by investigating properties of leaf and fibre collected from the cultivars. These studies have either investigated the properties of leaf and fibre using materials or textile science techniques, or else worked with weavers to carry out ethnobotanical assessments. In the work reported here, we have combined both approaches in order to discriminate among cultivars. Qualitative assessments of fibre properties by weavers have been compared with quantitative assessments provided by tensile testing. The work aims to contribute to both Mātauranga Māori (Māori knowledge) and textile science, by exploring the common ground between the two knowledge paradigms. The scope and relevance of this approach is discussed. The work reported also aims to provide information that will contribute to a broader study investigating the provenance and whakapapa (lineage) of a collection of harakeke cultivars growing in the Dunedin Botanic Garden.

Acknowledgements
This project is funded by the New Zealand Foundation for Research, Science and Technology. We acknowledge the Treaty of Waitangi, the Ngāi Tahu Settlement Act 1998, the Convention on Biological Diversity, and the Mataatua Declaration on Cultural and Intellectual Property Rights of Indigenous Peoples. We also acknowledge the Kaimahi Harakeke, the Dunedin Botanic Garden and the University of Otago.
Plant material used in New Zealand archaeological textiles

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Māori settled New Zealand Aotearoa from Eastern Polynesia in the thirteenth century AD (Wilmhurst, Anderson, Higham, and Worthy, 2008). This change in climate from tropical to temperate meant settlers had to develop new forms of dress, and to adapt traditional methods of textile production to a new array of plant material and fibre sources (Buck, 1924; Pendergrast, 1987). Numerous forms of evidence (e.g. the testimony of early European visitors, depictions of Māori dress, ethnographic study, waita) testify to the use by Māori of a broad range of New Zealand indigenous and endemic plant materials. A recent survey of archaeological textiles held in New Zealand cultural institutions has also confirmed the diversity of plant materials used to construct textiles and textile objects during the pre-contact period. However, difficulties have been encountered when attempting to:

1 identify the aged and deteriorated plant materials used in these artefacts; and
2 connect the artefacts substantively with other forms of evidence.

This paper discusses a selection of artefacts encountered as part of a broader study, and some common methods for identification of plant materials used to construct cultural artefacts including assessments of their efficacy.

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References

Changing usage of kiekie (*Freycinetia banksii*) and challenges to sustainability

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Kiekie (*Freycinetia banksii*) is a coastal and montane epiphyte found widely throughout Aotearoa/New Zealand. Māori names of indigenous plants reflect the recognition by their eastern Polynesian ancestors - perhaps 1000 years ago - of a range of semi-familiar botanical species. Different resources found in New Zealand required these early settlers to both adapt their existing range of technologies and develop new ones, in order to meet the challenges of surviving in their new homelands.

Prior to European contact, Māori were able to access considerable and sustainable supplies of kiekie to fulfil a variety of end uses. This included an important class of rain-capes, prized for the superior durability and strength of their fibre. Once common, these rain-capes are now evident only as comparatively rare artefacts found in museum collections; nonetheless, recovery of indigenous technology demonstrates the customary importance of this resource, and testifies to a complex traditional practice developed to extract the fibre. However, during nearly 200 years since colonial settlement began, end uses have changed significantly, and challenges to sustainability of traditional practice continue to increase.

This paper discusses Māori traditional use of kiekie, and addresses problems that face indigenous weavers today.
The identification and use of birds in Te Papa’s Māori feather cloak collection

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In 2007 over 100 of Te Papa’s Māori feather cloaks or kākahu were identified using a feather image identification key and microscopic analyses of downy feather nodules. This information gave an insight into the wide range of native and introduced birds utilised by Māori, and an understanding of the knowledge and production surrounding the museum’s kākahu not fully recorded until now.

The feather structure of New Zealand birds has been largely unstudied. Previous work identifying birds from feather down (Chandler, 1916; Day, 1966) and more recently the identification of bird strike remains at the Smithsonian Museum (Laybourne and Dove, 1994) enabled classification of New Zealand birds based on the characteristic structures of feather down between bird order and family groups.

Finally, comparing museum bird skins with cloak feathers resulted in the positive identification of at least 18 native and 8 introduced bird species in Te Papa’s kākahu. This research has given the museum knowledge on the bird species and feather types and their use within cloaks i.e. only one species covering a cloak, or a single feather hidden amongst feathers of another species.

The identification of hidden feathers in Māori feather cloaks warrants further research and in conjunction with DNA and isotopic analyses of feathers and flax in cloaks, Te Papa hopes to connect these kākahu back to an area, iwi or hapu, and possibly even a weaver.

References


Unpicking the past – dress artefacts held by The Nelson Provincial Museum

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This material culture study, the first of its kind undertaken at The Nelson Provincial Museum, focussed on dress artefacts to provide evidence of a particular period in the history of the settlement of Nelson, New Zealand.

The Nelson Provincial Museum is the oldest museum in New Zealand, being established in 1841, the year the first British immigrants landed in the Nelson region. Many garments in this study were worn by some of these early settlers. Prior to this study these garments were in storage, isolated from the history of those people who made, and those who wore them, and from those who donated them to the museum. The sample of eighteen artefacts was made up of dresses, bodices and skirts, all made from natural fibres and ranging in date from c1830 to 1910.

Not only does the museum hold a collection of garments, but also holdings of archives and published material of the period, and a nationally significant collection of photographs, including many images of the early settlers. Extensive use was made of this rich source of archival and documentary material. A multi-faceted approach was taken: the garments were examined visually to describe in detail the object (physical properties, fabric and trim detail, construction methods, alterations and physical condition), documentary sources were analysed, and donors and donor's families interviewed.

Through this analysis of settlement-phase women's European dress from a clothing and textile sciences viewpoint, and the investigation and interpretation of cultural and social history information, a picture of life in the colony of Nelson during the settlement period was developed. The garments in the study were found to be similar in style, made of similar fabrics, and were constructed using the same methods as those made and worn through the period 1830 to 1910, as identified in previous studies. The lives of those people involved in the history of the garments were explored; each object has been placed in an historical setting. The developments of the textile and garment industry have also been investigated.

The research approach taken increased the level of academic scholarship, enhanced both the interpretation and preservation of the artefacts, established the artefacts as direct a direct link to Nelson's past, and facilitated public understanding and enjoyment of the collection through an exhibition at the museum.

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I acknowledge the support of the University of Otago's School of Consumer and Applied Sciences through the Carnegie Corporation Award for Adult Education, and staff, staff of The Nelson Provincial Museum, donors and donor's families.
The indigenous Māori people of New Zealand traditionally wove garments from the fibres and leaves of *Phormium tenax* (New Zealand Flax). One of the dyes used to decorate these garments was a black iron-tannate complex which degrades and embrittles the *P. tenax* substrate to which it is applied. As a result, various elements of the dyed garments are subject to loss of mechanical integrity and fracture. The treatment of a *piupiu* waist garment of traditional Māori costume using a novel consolidant, zinc alginate, on degraded fibres that have been traditionally dyed with the black iron-tannate dye (an iron-containing mud known as *paru* and tannin treated substrate), *P. tenax* is presented. A “once only” approach is taken with limited handling, support, consolidation and attachment of broken waist garment lengths.