Innovations in wool

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McKinsey's Richard N. Foster notes in his *Innovation: The Attackers Advantage*, 'But for me innovation was and still is … a battle in the marketplace between innovators or attackers trying to make money by changing the order of things, and defenders protecting their existing cash flows'.

Wool needs to ensure that its unique properties are fully utilised in the battle to maintain and grow its image as a highly desirable fibre and one that can make money for its stakeholders.

Wool fibre attributes and the world out there

It is useful to revise the special attributes of the wool fibre presented in the last session:

- water repellent
- ability to absorb water
- active heating
- breathability
- naturally elastic
- shape retentive
- temporarily and permanently settable
- flexible and imparting superb fabric drape
- naturally fire resistant.

And to this list must be added natural and heritable variability in fibre diameter between sheep.

The modern world where this wool fibre takes its place has its needs and wants, and these are conditioned by the kinds of lives we lead and the people we are. Here are some of the ways we in the developed world are commonly described:

- resource rich, yet time poor
- aspirational: wanting holidays, travel, adventure, home theatres, eating out, sporting culture, new technology such as mobile phones, iPods, digital cameras, computers and much, much, much more
- increasingly casual in clothing with emphasis on active performance and sports casual wear
- wanting value for money; investing or withdrawing trust in brands as they live up to or fail to meet expectations
- status conscious
- older on average
- environmentally aware even if not yet environmentally responsible
- more obese
- increasingly mobile
- increasingly aware of energy usage

- increasingly expectant, accepting of and even eager for the new in employment, fashion, consumer goods, technology, society and institutions
- increasingly employing and employed in the services sector
- living in climate controlled space.

There are clear, long-term signs, in the US, for example, of rising expenditure on services – medical, recreational and others, such as the hairdresser, beautician, vet, accountant, IT consultant, sports coach, personal trainer, chiropractor, psychiatrist and many, many more. However, relative expenditure on non-durable goods, which include food and textiles, has approximately halved.

It will not be surprising if the developing world tends to go in these directions too.

Textiles then have to compete with a host of other demands for the consumer dollar. Wool textiles face the same challenge, and there is robust competition within the textile market as well.

What then are the product and process areas in which innovation will ensure that the transformation of the unique wool fibre to product meets the needs and wants of the world? Here are my suggestions:

- lightweight, transeasonal, comfortable products
- sport and sport-casual garments
- easy-care garments with appearance retention
- a predictable, quality-managed, efficient and innovative pipeline from farm to product
- superior technical products
- environmentally friendly products and processes.

It goes without saying that the existing base of quality products with wool's unique properties of drape, handle and tailorability are the springboard for special efforts in these fields – and the addition of product differentiation, flair and uniqueness to appropriate fields is taken as a given. Each of these fields can be linked on one hand to one or more properties of the wool fibre, and on the other to one or more of the world's needs or wants.

In the following, each field will be examined to discover what innovations have contributed to wool's success in the past and what is being done to ensure wool's success in the future.

Lightweight, transeasonal, and comfortable products

Perhaps the greatest innovation here for wool has been the shift in the distribution of fibre diameter in the wool clip. The Australian Bureau of Economics estimates that the average micron of the mainline Merino fleece wool from broad-acre wool farms fell from 21.2 to 20.1 from 1992–3 to 2002–3 (ABARE, O'Donnell, Dickson and Wood, 'Sheep industry Outlook', 2010–11). This has been in response to market price signals, aided by the development of more precise and informative ways of measuring wool fibre diameter. Of particular note is the development of Fleecescan™ by the CSIRO Division of Textile and Fibre Technology (CTFT). This innovation provides direct measurement of the weight, mean fibre diameter and variation in fibre diameter of individual fleeces immediately after shearing, enabling the classer to class the fleece more reliably. The OFDA 2000 technology plays a similar role. These developments are likely to revolutionise the way fleeces are assembled for sale.

Finer wool means finer yarns can be spun, and finer fabrics can be made from those yarns. The finest yarn in tex or gm/km that can practically be spun from given wool is proportional to the square of the mean fibre diameter of the fibres. Reducing the fibre diameter by 10% will allow a 20% reduction in yarn linear density. Fabric weights can be that much lighter as a result.

There is another big bonus from the fining of the clip. Research at CTFT has shown that the prickle response experienced by the skin when wearing garments is caused by the presence of coarse fibres and not at all by allergic response. The force a fibre can exert on the skin increases as the fourth power of the fibre diameter, so coarser fibres can distort the skin and cause the pain receptors below the skin surface to fire. Fibres greater in diameter than 30 micron are a cause for concern and there should be fewer than 5% of these in wool destined for garments to be worn next to the skin. As the clip has gone finer there is significantly more wool available that meets this requirement. And the availability of instrumentation to provide the fibre diameter distribution in wool, and not just the mean, is of immense value. We shall look at this further.

In conjunction with young women's fashion label Kookai, Australian Wool Innovation Ltd (AWI) has developed a new softer wool knitwear fabric using finer wool (18.5 micron). Longer wool was selected, thus reducing the chance of pilling and allowing a reduction in twist. This in turn produces a softer feeling yarn. This is the kind of development that will move wool more into the next-to-the-skin garment market; for example, knitted tops and underwear.

AWI is developing partnerships to promote wool blends with other fibres such as linen, silk, Arcana (Optim), Viloft, microfibres and cotton. These cool-to-the-touch, lightweight, comfortable garments are part of the Summer in the City and Cool Merino initiatives.

Spinning developments at CTFT have also contributed to this area. Sirospun was originally conceived as a way of spinning a weavable worsted yarn in one operation without the extra step and expense associated with spinning finer singles yarns and then two-folding. It uses two rovings at each spinning position and a break-out detector is employed to disrupt the spinning process should one of the strands fail. The economic advantage of Sirospun together with the ability to make a slightly finer two-fold yarn than the normal two-fold counterpart facilitated the cost-effective spinning and fabrication of finer woven worsted fabrics. Sirospun significantly aided the Cool Wool initiative of the then International Wool Secretariat.

The success of Sirospun was aided considerably by a timely innovation at the winding stage. The Thermosplicer, invented at CTFT, enables almost invisible pneumatic splices to be made. This is important because, while conventional splices in singles yarns are hidden to a large degree in two-folding, this is not the case for Sirospun yarn.

Sirospun technology has also been adapted to spin a strand of monofilament together with a wool strand to create a blend yarn. This is Selfil, and even finer fabrics can be made in this way. If the monofilament is an elastic fibre the resulting fabrics can be endowed with stretch properties. Core spinning with monofilaments can also be used.

The CTFT successor to Sirospun, Solospun, also produces a 'weaveable singles' yarn. In this case the desirable yarn abrasion resistance is obtained with a simple clip-on roller, which rolls on the lower of the delivery rollers. It has the added advantage that only one roving package is required at each spinning position, unlike Sirospun, which requires two.

A current example of the use of these technologies is the development of the wool lightweight business shirt. Developed by AWI in conjunction with Canesis, the garment is targeted at the Chinese market. It uses pure wool lightweight yarns from 18.5-micron wool woven into a very light fabric. A special finishing routine is used, which does not involve chemical and polymer treatments. It is anticipated that the technology will be useful in lightweight trousers, jackets and skirts.

Optim^{TM} is a unique and exciting CTFT innovation that takes conventional wool fibres in top form, treats them with a reducing agent, twists and stretches the top, while applying steam and heat, and resets the fibres permanently in their stretched state. Diameter reductions of 2 to 3.5 microns can be obtained.

Optim Fine^{TM} is produced by permanently setting the fibres in their stretched state. They are stronger and finer than the parent fibres and have a soft, luxurious, silk-like feel and lustrous appearance, which is very well suited to innovation in the lightweight transeasonal area. The cost of Optim Fine^{TM} is very competitive with comparative fibres like cashmere. The fibre is whiter than normal wool and brighter pastel shades may be obtained in dyeing.

Innovative dyeing technology has been developed at CTFT to overcome problems in dyeing Optim Fine^{TM}. These arise because of the large decrease in fibre rigidity in hot aqueous media. This can lead to the collapse of top and yarn packages as the temperature of the dye bath is raised, and special care needs to be taken in piece dyeing. Details can be obtained from CTFT.

Optim Max^{TM} is produced by temporarily setting a stretch of about 20 to 30% into the fibres, which are then blended with normal wool and spun into yarn. When treated with hot water the temporary set is released and the fibres revert to their unstretched state. The normal fibres are forced to loop and buckle to accommodate the retraction, giving the yarn a bulky soft character. The yarns are typically 30 to 40% greater in volume and allow softer, bulkier, lighter-weight fabrics to be made.

New spinning technologies are available, which have very high production rates resulting in greatly reduced spinning costs. The Murata jet and vortex spinning processes (MJS and MVS) are good examples, and each MVS spinning position delivers yarn at about 400 m/min, compared to 20 m/min in conventional spinning. They are targeted at cotton and short staple spinning generally and as yet have found little application for wool. The economics of these processes present a real opportunity in the lightweight, transeasonal area for innovation using wool. Softer MVS spun knitwear is a particular target of CTFT research.

Chemical treatments can be used to impart greater softness to wool fibres. The Soft Lustre process uses a very rapid treatment to remove surface scales without significantly weakening the fibre. The fibre surface is then sealed with a hydrophobic silicone polymer. The result is a wool fibre that feels softer by 2 to 3 microns and has a greatly reduced likelihood of causing prickle. The fabrics made from these fibres are also suitably resistant to felting shrinkage during washing and can be worn next to the skin. They have been successful in the Chinese underwear market.

In the Basolan process, mild oxidation is applied to the interior of the fibre as well as the surface. The bending rigidity, and hence the prickle propensity, is significantly reduced, and the fires have a softer feel. A small amount of shrink resistance is obtained and the fibres are also whiter.

Technical advice on both Soft Lustre and Basolan Processes is available from AWI, and are discussed in presentations by Dr Brady.

Sport and sport casual

Long ago, football pullovers, cricketers' creams and pullovers, and even swimming trunks were all products that used wool. The sporting market has been revolutionised with the emphasis strongly placed on fitness for purpose, of course with appropriate and colourful styling. There is a very pronounced technical element in design, so that body temperature, moisture management, freedom of movement, garment weight, frictional resistance and even online monitoring of the athlete's performance can all be considerations. Witness the release of the Nike+iPod sports kit that enables 'Nike+ footwear to talk with your iPod nano to connect you to the ultimate personal running and workout experience'. See http://www.apple.com/pr/library/2006/may/23nike.html

In the 1990s, CTFT research led to the development of Sportwool™. This is a two-layer composite fabric with fine Merino wool next to the skin and an outer layer made from synthetic fibres. Vapour is removed from the space between the skin and the wool and then transported to the outer layer where it is evaporated. The athlete is kept drier as a result. The unique thermal and moisture absorbing properties of the wool fibres are enlisted to keep the athlete cool in the heat and warm in the cold.

Sportwool was adopted by the Australian team at the Sydney and Athens Olympics and is also worn by the Australian cricket team.

White and pastel shades are common in sports garments. Wool is not uniform in colour, nor is it white. Wool and wool treated with chlorine hercosett to impart shrink resistance can be bleached and the best available technology for doing so will be discussed in Dr Brady's presentations in this program. AWI market their Colourclear package, which provides information on bleaching and dye selection to produce clear, bright, reproducible shades.

However, the attribute that must accompany white and pastel shades is light fastness. Unfortunately wool, and bleached wool both yellow in sunlight and the rate of yellowing increases in the presence of moisture. This is a real problem in the sweaty, sunlit sporting fields. The rate of yellowing of dyed wool is also greater than for other dyed fibres.

Cibafast W absorbs UV at wavelengths that are damaging to wool. Its effectiveness for wool was discovered at a precursor Division of CTFT, and it will significantly slow down the rate of yellowing.

More effective treatments are, however, needed. One is being developed at CTFT, which further and very significantly retards the rate of yellowing in wet wool. This is one to be eagerly looked for in the future.

Of course, the innovations discussed in the lightweight, transeasonal and comfortable area will also be valuable in the sport and sport casual field.

It is important too to keep a watch on the smart and intelligent fabric and garment areas where wool's attributes can complement electronic sensing and computing functions.

Easy-care with appearance retention

Permanent press technology became available in the 1950s. This CSIRO innovation enables the setting of permanent creases in wool fabric and is valuable for trouser creases and the pleating of skirts.

In the 1960s, scientists at CSIRO developed a treatment that protects wool garments from felting shrinkage during washing. Shrinkage results from the surface scale structure of wool, which acts like a ratchet enabling a fibre to move easily in one direction into a group of fibres and preventing it from being released. The effect is greatly enhanced when the fibres are wet.

The Chlorine Hercosett treatment uses a mild chlorination to render the surface of the fibres suitable for coating with Hercosett resin. In water the resin swells, almost completely masking the scale structure and preventing the ratchet effect.

The Chlorine Hercosett process is used mainly to treat tops destined for knitwear. It is worth noting here that technical advice on the dyeing of shrink-proofed wool is also available from AWI and CTFT.

And while on knitwear, the approach previously discussed in the design of lightweight knitwear is also very apt in this area as pilling is particularly unwelcome with respect to appearance.

Launched in August 2003, the Machine Washable Wool Suit is a recent innovation whose development was managed by AWI in conjunction with CTFT and a large Australian suit manufacturer, Berkeley Apparel. The suit is made from a blend of 60%, 20 to 21 micron wool fibres, and 40% polyester. A wide range of fabrics, lining, interlining, and fusing materials were tested for suitability in its construction.

The suit has been shown capable of withstanding more than 50 machine wash cycles while still retaining its shape and appearance.

It is intended to introduce the suit to the Chinese market where the cost of dry cleaning is relatively high, and ultimately sales in the millions are anticipated. It is marketed by AWI in conjunction with Heilan. It is expected too that the suit will find ready acceptance in the defence force and uniform markets. It is also seen by AWI as a boon for the time-poor executive who is working longer hours, travelling more, whose partner is also working and where the time, delay and cost of dry-cleaning is increasingly unacceptable.

In the future, nano-technology shows promise of being valuable in this area with developments likely in water and stain repellence and ease of cleaning.

Predictable, efficient, quality production and transformation

To improve the quality, efficiency and predictability of any transformation it is necessary to be able to measure the properties of the input and output, and it is important to understand and monitor the transforming process. This is as true for the conversion of grass into wool as it is for making of fabric into garments.

An early example was the prevention of all kinds of pigmented material, from house paint to tar, appearing as defects in expensive wool fabrics. The cause was the application of marks on sheep for identification purposes on the farm. Many of the materials used for marking were not removed in scouring. The cure was to develop a marker that would wash off in early-stage processing.

Very like this problem is the still present contamination of wool with fibre-like materials such as medullated and dark fibres from the sheep, fibrillated hay bale twine, dog hairs, poultry feathers and bale pack material. The latter is solved in part by the introduction of nylon packs, and quality programs on-farm have significantly reduced the others. The new test procedure developed at CTFT to allow fibre-like contaminants to be assessed by immersing the sample in a liquid having the same refractive index as wool, and sealing it in a transparent pack for inspection is a welcome weapon.

You can imagine the quantum leap in efficiency when, as a result of work by the then AWC, the AWTA and CSIRO, means were introduced in the early 70s to reliably sample wool from sale lots and to present them in a form that could be conveniently inspected by buyers. Measures of VM content, average fibre diameter and yield were also provided. Prior to sale by sample, bales had to be available for appraisal.

Innovation gathered pace with the invention and introduction of length and strength testing. Together with objective means of fibre diameter and diameter distribution measurement, the scene was set for introduction of the TEAM prediction formula, which can be used as a benchmark for combing plants. Now, sale by description only (with no sample) has become a reality, if only in a minor way at present. Approximately 98% of the Australian wool clip is sampled and objectively measured before sale.

Siroscour is a CTFT development, which improves the cleanliness of scoured wool and achieves a high degree of grease recovery through the more rational removal of contaminant types. It is a three-stage process in which the suint or sweat is first removed, followed by grease removal in a detergent bowl. Then following rinsing, the most difficult-to-remove contaminants are removed in a final detergent bowl. It's a little like shampooing one's hair.

All scours commissioned in the last decade have been Siroscours.

The worsted card has been the object of significant innovation in the last decade or so. At ITMA 1999 Thibeau introduced the CA7 card developed in conjunction with CTFT. It has double doffers for efficient fibre removal at very high card speed, and a two burr beaters on each morel, which improves the removal of vegetable matter. A more compact version was released at ITMA 1999. Like all modern cards it is available in widths up to 3.5metres and it can operate at speeds up to twice that of conventional cards. Octir have followed suit with their Hercules card, which also has double doffers and operates at high speed.

High speed carding can be exploited to reduce cost or improve fibre length and reduce combing waste by reducing fibre density in the machine or a combination of both.

As a result of CTFT research more efficient worsted carding lubricants have been introduced by Henkel (now Cognis). These significantly improve fibre length and reduce waste in combing and now constitute 80% of the world market.

Combing is central to long staple wool processing, and innovations in the combing process itself have seen both NSC and Sant Andrea introduce combs, which can operate at speeds up to 260cpm, an increase of more than 30% on models of a decade or so ago. Important settings can now be continuously monitored to improve comb performance and sliver quality, and measures have been taken to significantly reduce the down time required for maintenance.

This is a good point to introduce innovations in measurement and instrumentation, which have significantly improved performance and quality management in early stage processing, and downstream in spinning.

Tribute must be paid to the Almeter, which was introduced in 1961. This innovation, developed at Centexbel in Belgium, measures the fibre length distribution in combed wool, or top, and was much more convenient and faster than previous methods. Originally incorporating an analogue computer, it was converted to digital operation in 1978. It is now manufactured by Peyer.

Since 2000, Laserscan is the international standard for the measurement of fibre diameter distribution. Like the Almeter, it drastically reduces the time required for measurement. This is a highly sophisticated instrument, which measures fibre snippets passing through a laser beam in a liquid stream. It is used on the cleaned sample prior to sale and on top. It is now manufactured by AWTA Ltd.

OFDA is an alternative technology for measuring the length distribution, also on snippets, but in this case spread on a microscope slide. The terms under which it can be used for commercial transactions have been defined by AWTA. In principle, both Laserscan and OFDA can give a measure of curvature of snippets, which may be related to fibre crimp. While crimp has been found to be of minor importance in processing, it plays a role in fabric quality and performance.

Together with measures of Vegetable Matter content and Yield on greasy wool, and solvent extractables and moisture content in top, the suite of measures required for commercial transactions from farm to combed wool stage is now complete.

Staple length and strength, coefficient of variation of length, percentage of mid-breaks, mean diameter, coefficient of variation of diameter and % vegetable matter content (VM) are the parameters used in the TEAM prediction formula referred to before. And there are commercially available decision support tools, which provide processing prediction for lot building. One of these is Sirolan Topspec from CTFT. This is a PC-based program which predicts the fibre length distribution, the noil or waste in combing, and the long and short fibre content of the top which would be produced from a greasy wool lot or a consignment of lots. Topmaker is a software package, which combines price and processing prediction with consignment building. It is available from Australian software for topmakers.

Sirolan Yarnspec is a PC based package, which predicts best-practice spinning performance for a given top, under specified spinning conditions. It is used to benchmark mill performance, much like TEAM, and to aid in the selection of top to meet customers' price and quality requirements. Yarnpsec clearly demonstrates that micron is the overwhelming determinant of spinning performance for a given yarn count, with length second in importance.

The wool input data to Yarnspec is that already discussed for top specification, together with a measure of fibre bundle strength. The latter can be conveniently and accurately provided by Sirolan Tensor, a CTFT-developed hardware and software package. The yarn count, twist, whether dyed and/or shrinkproofed, recombed or not, spinning speed, draft, ring size and traveller weight are entered, and Yarnspec will predict:

- yarn unevenness (CV%)
- thin and thick places per kilometre (50%)
- neps per kilometre (+200%)
- yarn tenacity (at test speeds from 0.1 to 500m/min)
- elongation of break (at test speeds from 0.1 to 500m/min)
- yarn hairiness
- ends-down per 1000 spindle hours.

Spinning innovations have already been discussed in the context of lightweight wool yarns and fabrics, but a notable, more recent innovation is so-called compact spinning. In this technology, the fibre strand emerging from the draft rollers is condensed or compacted laterally by carriage of the strand on a perforated surface to which suction is applied. It is claimed that this process improves yarn strength and elongation at break, reduce yarn hairiness, improves weaving efficiency and reduces fibre loss in knitting. It does not, however, produce a weavable single yarn, although Cognetex in its Com4 development at ITMA 2003 has introduced an extra fitting on a compact frame, which it claims does this (Oxenham W. Textile World Jan. 2004).

Siroclear, a CTFT innovation employs optical sensing to detect dark fibre or fibre-like contaminants in yarns being wound at high speed. It also performs the normal functions of a yarn clearer. It is marketed by Loepfe. Siroclear is of advantage to wool because of the importance of avoiding dark fibre contamination in light and pastel shade fabrics, and its use is facilitated by the pneumatic splicing technology discussed before. To date the penetration for wool has not been as rapid as for cotton.

Wool is damaged by dyeing and this can lead to fibre breakage in woollen carding, reduced spinning performance and yarn strength and elongation, reduced weaving efficiency and lower fabric breaking load and extensibility. Two recent developments are of considerable benefit here.

The Valsol LTA-N method, developed at CTFT and commercialised through ICI, reduces the degree of fibre damage by reducing the temperature of dyeing. It improves the quality of dyeing in other ways as well.

BASF has introduced the Basolan ASA method, which restricts the degree of permanent set during dyeing. The benefits are similar to those of low-temperature dyeing and there are other benefits as well. One of these is the protection provided to the wool fibres when dyed at 120 degrees, a necessary procedure when dyeing blends of wool and polyester.

Much like the systems developed to predict performance of wool in early stage processing, and spinning, SiroFAST was developed to measure aspects of fabric handle and to predict performance in garment manufacture. More recently it is being used to prescribe optimal finishing routines to maximise the quality of the finished fabric appropriate to its end use. Employing a series of five simple test rigs, FAST measures fabric surface thickness, bending rigidity, extensibility and relaxation shrinkage. These are then used to develop a chart or fingerprint of the fabric, which can be interpreted to indicate the desirable finishing route. The benefit of FAST can be well appreciated by considering the cost of the fabric before making-up to the price of the garment.

Technical markets

Perhaps the earliest use of wool in a technical product is the production of felt. Indeed, felt is still unsurpassed as the material of preference for the heads of piano hammers.

Wool has, however, found its way into many technical areas of modern life; home insulation, hospital blankets, continental quilts, drapes, upholstery, sheepskin covers for seating, uniforms, military greatcoats, wall and screen coverings and aircraft interiors, to name just a few.

CTFT is working with industry and other research bodies to seek opportunities for wool and wool-based textiles in injury prevention and wound healing products. This research takes advantage of wool's insulation and moisture transmission properties. It may also involve the incorporation of sensing devices and systems.

There will be opportunities too for wool in the physiological monitoring area.

With the exception of felts, non-woven textiles have up to now used relatively little wool, but in 2003 Macquarie Textiles announced the commissioning of a non-woven plant with a specific interest in Merino wool products. In partnership with AWI, and encouraged by a pilot project with Canesis, Macquarie intends to investigate stretch products as wool cotton blends, emergency blankets and footwear and protective clothing.

An Australian Design Award was given for the Annie Georgeson designed RELAXaMat^{R} series of exercise and yoga mats made by Macquarie from 60% wool and 40% polyester. Macquarie also manufactures a range of 90% wool screen covering fabrics, which takes advantage of wool's fire retardant properties. (See http://www.designawards.com.au/ADA/04-05/Materials%20and%20Textiles%20Innovation/061/061.htm.)

CTFT has a developmental non-woven plant with jet lacing and needle punching capabilities. Research is directed at blends of wool with synthetic fibres and microfibres.

Environmental friendliness

Wool has a good image as an environmentally friendly fibre. It is seen by many to be 'natural' and 'green'. This is an image worth preserving.

There are challenges to wool's image in at least three areas: effluent management in scouring, heavy metal presence in dyes commonly used for wool, and the increasing wariness of the presence of toxic chemicals in the environment and consumer products.

Raw wool fibre is ‘contaminated’ with wool wax in both oxidised and unoxidised form by about 10%, dirt, proteinaceous and organic, by about 10%, suint or water-soluble sweat salts by 5%, and vegetable matter (VM), by up to 5%. The latter is not removed from the wool in the scour but the rest is, and it must be managed. Very roughly, a scouring line has an effluent load equivalent to a town of 30,000 people.

CTFT has developed a modular system designed to maximise the removal of grease, dirt and suint from the effluent. It is called Scour Waste Integrated Modular System (SWIMS). The modules can be incorporated into a scouring line to suit the needs of the mill. The effluent, rather than being regarded as waste, is reusable – the wool grease as lanolin, the sweat salts as a potassium rich fertiliser, the dirt as a recyclable sludge or compost and clean waste-water for re-use in the scour. SWIMS is manufactured and marketed by ANDAR An excellent, detailed description of the process can be found at http://www.andar.co.nz/.

Chromium is a common element used in dyeing wool, either as a metal complex responsible for the colour or as a mordant designed to increase the fastness of the dye to water, perspiration and light. Chrome dyeing is particularly useful in very dark shades.

Heavy metals such as chromium are under close scrutiny and dye houses have had to adopt strategies to reduce the amount in their effluents to meet required standards.

The major dyestuff manufacturers have responded by promoting alternative metal-free dyes in both milling, and reactive dyes or combinations of reactive dyes. The latter make possible the attainment of bright shades with high wet-fastness and low pollution loads.

Pesticides are another class of chemicals under close scrutiny. These are used to control lice and fly-strike on sheep and are removed in processing. From 2007, stringent environmental regulations in the European Union will require wool processors to ensure that their effluents do not pollute waterways. Fortunately, by using appropriate lice and fly treatments, and by keeping accurate records of the details of application, Australian woolgrowers are able to provide wool that meets the standards. CTFT has an internationally accredited testing facility, which can assure the residue level of wool lots.

Summary

Innovation in the past has been necessary and successful in maintaining wool’s pre-eminent position as a quality fibre having unique and highly desirable textile and technical properties. But there is a continuing battle to be fought to maintain this position.

Product innovation is of paramount importance but it will need to be underpinned by continuing innovation in the process of transformation to keep wool at the forefront of product appeal, value for money, ease, comfort and convenience, image and environmental responsibility.

Useful web references

The AWI website is a fruitful place to find current news of recent innovations
http://www.wool.com.au/

For an excellent discussion of technical and processing innovations visit Wool on the Web
http://www.woolontheweb.com

CSIRO’s Division of Textile and Fibre Technology has an informative site at
http://www.tft.csiro.au/

Another research institute that has played a major role in innovation for wool is Canesis (formally WRONZ) at
http://www.canesis.com/home.shtm

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Exercises

1. Marketing is an important area for innovation. How would you rate the famous Woolmark symbol as a marketing innovation? Does it still have value for you, or does "wool" in conjunction with a brand name like Nike, Zegna, or Rip Curl carry more weight? How would you like to add to the way in which wool is marketed? You will find the AWI website a useful resource. Visit www.wool.com.au

2. Imagine you have a free hand to use any of the technologies discussed in this unit. What ideas would you like to try? What chance do you think they have of becoming innovations? How would you attack the commercialisation of each of your ideas?

3. What do you think are the major obstacles to opening up new markets for wool through innovation? How would you try to overcome them?