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THE CHANGING PERCEPTION OF POLYESTER

BY

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INTRODUCTION:

In finding my way to a suitable topic for my thesis, I found myself being drawn towards innovative designers and the fibers that they used. While researching I realised that I was more interested in the fabric and the fibers used than the designers who used them.

This thesis will look at and explore the publics changing perception of polyester. Its introduction, its rejection and subsequent rebirth within the commercial world of fiber and fabric production.

Polyester as a fiber is analysed through the context of its scientific advancement, its cultural nonacceptability and its ultimate acceptability as a premium synthetic fiber.

While researching information numerous obstacles had to be overcome. Finding adequate literature which did not primarily deal with technological and scientific aspects of polyester was difficult. Many technical handbooks were available, these included 'Textiles Fiber to Fabric' by B. Corbman and 'New Fibers' by Tatsuya Hongu. Information based on the social implications of polyester were mostly found in various source books on the fifties and sixties. One of those being 'Fifties Source Book' by

Christopher Pearce. Periodicals such as Textile Horizons and International Textiles helped me explore the changing markets and current perception of polyester. Very little information is available or being written about the latest developments within polyester. Most of the up-to-date information I have gathered is due to direct interviewing of those involved in the fiber industry and access to many of their intercompany publications and files.

Chapter one covers a brief history of the invention of polyester and the subsequent production of fiber and fabrics. Chapter two charts the rise, fall and eventual acceptability of polyester as a useful fiber and fabric over the past fifty years, dealing with the influences which had the potential to change the perception of polyester. Invention and innovation in polyester is the theme of Chapter three using examples of new fabric innovations within modern fiber producing companies. Finally in Chapter four environmental issues are discussed and the relationship between textiles and the environment are closely observed. The use of polyester within the new environmentally aware society and its advantages are also illustrated.

The objective of this thesis is to gather information pertaining to polyester and to show that polyester has moved and developed with time. It does not attempt to tout polyester as the best fiber ever developed. Hopefully the thesis will show that polyester is no longer the plastic fiber used for shirting in the 1950s but rather that it is finally being recognised as an indispensable fiber in this technological and demanding world.

CHAPTER 1

This chapter intends to chart briefly the development of polyester through to the present day. It deals with a number of aspects of the evolvement of polyester. This involves a brief history, a technical description of the production of polyester and some fo the immediate advantages and disadvantages of the fiber and in some cases the finished fabric. It is not however an argument promoting polyester as the ultimate fiber. Instead it is an observation of a fiber created for various uses and primarily for the mass market.

In analysing the evolution of synthetic fibers one can break down this evolution into three stages. The first generation was that of invention. During this time chemists invented the basic technology for fibers made by man to supplement and simulate those grown by nature. In this phase of development each of the fibers, Rayon, Nylon, Acrylic and Polyester were first made in only one form. During the second generation diversification was the fiber manufacturers main objective, each of the generic fibers underwent some modification to improve both performance and aesthetics. It was a time of problem solving and the exploration of design for end uses. Now most generic fibers are being made in

many different versions each engineered to suit particular products. Today we have entered a new phase of development, that of the third generations, in which the fibers are being custom tailored for specialized markets. Predetermined aesthetics and performance are now being built into the fibers at the production level and it seems as though each generic fiber can be changed in so many ways that we may be on the road to one universal fiber modified for all purposes.

For the consumer the versatility of the polyester fiber has provided its base for the penetration into almost every aspect of our modern life, in everything from the clothing we wear at work or play, to fabrics for furnishing within homes and corporations, as well as multiple uses within industries from a hospital theatre to highly technical laboratories in spacecrafts.

Many Fiber textbooks inform us that polyester was neither the first man-made fiber, that distinction was given to viscose. Nor was it the first synthetic fiber, Nylon 6.6 which was first commercially produced in 1938. The cornerstone for the development of synthetic fiber was the discovery in 1927 by Staudinger of Germany, who proved that natural fibers were formed by giant linear

molecules. Wallace Carothers joined Dupont in 1927 and was responsible for the development of polyamide, which as commercialised as Nylon 6.6. In 1938 a subtle change in chemistry was all that was needed to lead Winfield and Dickson to Polyehylene Terephalate or P.E.T. hereafter.

In the 1940s as the second world war encompassed the world few were aware that in the midst of the great Lancashire cotton manufacturing industry, the final touches were being put on a patent application for an important new synthetic polymar. Fewer still would have thought it would have replaced cottons as the cheap general purpose fiber of the industrial world. Decades of polyester history provides us with a fascinating commentary on commercial development in the 20th century. When polyester was first introduced in the 1940s it was lauded as a new fiber highly valued for its properties within a limited market. As society changed within the 50s and 60s polyester became more widely available and was hailed as a new wonder fiber in a society where 'new' meant better. In an age dominated by consumerism and the future this was an accessible fiber which encompassed these futuristic ideals. In the late 1960s and 70s however society started to reject all things modern, synthetic and throwaway.

It adopted instead the Hippy ethic of embracing nature and all things natural. Allied to the fact that the polyester produced at this time was not of a high quality.

Peoples sensitivity to their environs and to the clothes they wore were being finely honed. No more would the general public settle for a fabric that may have once been radical and forward looking but was now regarded as an uncomfortable and plastic fabric. It seemed that polyester producers were not observing the changing society and the new needs and demands for their fibers. Thus failing to evolve the fibers appropriately. The 1980s disowned outwardly synthetics and as a global awareness dawned so too did the demand for all things natural. At this point a transformation began to occur within polyester producers as modifications made to fibers for high tech applications filtered into mainstream production of fibers for the mass markets. The swings in the popularity and subsequent decline oF polyesters act as a barometer to the publics awareness and taste, and as to the reactions of society in general to the world around it.

Nylon and polyester owed part of their early success to their toughness which gave improved durability. The big advantage polyester had over the other

fibers was its versatility. In the early days of man-made fibre development the main objective was to make man-made, synthetic fibers with some added easycare properties. Polyester had properties and advantages which made it the preferred fiber to blend with. It gave a crisper handle, it worked better for wash and wear performance and it showed a better abrasion resistance. According to J. Hearle the first public announcements of the new fiber following the war were made in the Manchester Guardian of the 5th May 1945. [J. Hearle, Textile Horizons, June 1992, Pg. No.22]. The name Terylene had been given to this new fiber and an exclusive licence negotiated with I.C.I. Ltd. for world manufacturing rights, except in the U.S.A. were Dupont were licensed with the name Dacron.

Today there are many companies producing polyester under various different registered trademarks. There are many polyester yarns, produced by numerous manufacturers most of them manufacturing several types. Each manufacturer has its own labels and registered trademarks for its product. Within the group of variants the types of polyesters and their properties are essentially the same but with modification for specific characteristics see Figures 1 to 3 showing charts of the various

different types of polyester producers and the trademarks they use. At the time of Terylenes release I.C.I. Ltd. recognised it as a new, premium, high value fiber and priced it accordingly. Seeing its applications as suitable for demanding industrial uses and for blending with expensive natural fibers. It was priced accordingly so that in 1955 Terylene staple fiber was five times the price of cotton. Once the fibers potential was established the required volumes followed. As a result it was not long before the once rare and highly valuable fiber had flooded the market and had already started its decline into social unacceptability.

The basic chemicals from which the polyester fiber is made are coal, air, water and petroleum. These chemicals are 'cooled' in a vacuum at very high temperatures until they combine to form a hard porcelain like substance. This material is then melted down to a honeylike liquid which is forced through a spinneret. As the stream of molten liquid emerge down from the spinneret they are cooled and solidified into long slender hairlike strands or filaments. These filaments are then stretched out to many times their original length. This stretching process imparts great strength to

TRADEMARK	MANUFACTURER	TYPE	SPECIAL CHARACTERISTICS	USES
A.C.E.	Allied Corp.	Multifilament		Industrial fabrics, tire cord, rope
Avlin (Fiber 200)	Avtex Fibers Inc.	Multifilament		Apparel, home furnishings
Crepesoft	American Enka Co.	Multifilament		Apparel
Dacron	E.I. du Pont de Nemours & Co.	Multifilament, staple, tow	Types vary according to desired purpose	Apparel, home furnishings, industrial fabrics
Dacron 900F	E.I. du Pont de Nemours & Co.	Staple	Flame-retardant	Apparel, home furnishings, industrial fabrics
Dacron Hollofil	E.I. du Pont de Nemours & Co.	Staple	Hollow	Apparel, home furnishings
Encron	American Enka Co.	Multifilament	Types vary according to desired purpose	Apparel, home furnishings, industrial fabrics
Encron 8	American Enka Co.	Multifilament	Multilobal cross section	Apparel
Encron Golden Glow	American Enka Co.	Multifilament	Trilobal; bright	Apparel, home furnishings
Encron Golden Touch	American Enka Co.	Multifilament	Fine denier	Apparel
Encron Plyloc	American Enka Co.	Multifilament	Producer-textured; two ply stretch yarn	Apparel
Encron Strialine	American Enka Co.	Multifilament	Thick and thin; color contrast dyeing	Apparel, home furnishings
Enka Polyester	American Enka Co.	Multifilament	Types vary according to desired purpose	Apparel, home furnishings, industrial fabrics
Firestone Polyester	Firestone Synthetic Fibers Co.	Multifilament		Industrial fabrics, tire cord
Fortrel	Celanese Fibers Marketing Co.	Multifilament, staple, tow	Types vary according to desired purpose	Apparel, home furnishings, industrial fabrics, tire cord
Fortrel PCP	Celanese Fibers Marketing Co.	Staple	Producer-colored	Home furnishings

Figure 1 : Chart of Polyester fiber Producers and Trademarks.

TRADEMARK	MANUFACTURER	TYPE	SPECIAL CHARACTERISTICS	USES
Golden Touch	American Enka Co.	Multifilament	Fine denier	Apparel, home furnishings
Golden Glow	American Enka Co.	Multifilament	Trilobal; bright	Apparel, home furnishings
Goodyear Polyester	Goodyear Tire & Rubber Co.	Multifilament		Tire cord
Hanover Polyester	Hanover Mills, Inc.	Monofilament, multifilament		Apparel, home furnishings, industrial fabrics
Hoechst Polyester	Hoechst Fibers Industries	Multifilament, staple	High- or mid-tenacity, carrierless dyeable, cationic dyeable	Apparel, home furnishings, industrial fabrics
Hydrolease	Johnson Filaments	Multifilament	Superior heat resistance	Industrial fabrics
Kodel 200	Eastman Chemical Products, Inc.	Multifilament, staple	Types vary according to desired purpose; PCDT variety	Apparel, home furnishings, industrial fabrics
Kodel 400	Eastman Chemical Products, Inc.	Staple	Types vary according to desired purpose	Apparel, home furnishings
KodOfill	Eastman Chemical Products, Inc.	Staple	Hollow	Apparel, home furnishings
KodOsoff	Eastman Chemical Products, Inc.	Staple	Hollow	Apparel, home furnishings
Lambda	Celanese Fibers Marketing Co.	Multifilament	Spunlike characteristics	Apparel
Loftguard	Celanese Fibers Marketing Co.	Staple	Hollow	Apparel, home furnishings
Matte Touch	American Enka Co.	Multifilament	Octolobal	Apparel, home furnishings
Meyers Polyester	Meyers Fibers	Multifilament		Apparel, industrial fabrics
MX6020	Shakespeare Co.	Monofilament	Round; regular, medium, and low shrinkage	Industrial fabrics

Figure 2 : Continuation of Polyester Fiber Producers and their Trademarks.

TRADEMARK	MANUFACTURER	TYPE	SPECIAL CHARACTERISTICS	USES
MX6020H	Shakespeare Co.	Monofilament	Round; heat-resistant; regular, medium, and low shrinkage	Industrial fabrics
Newton Polyester	Newton Filaments, Inc.	Multifilament		Industrial fabrics
PE 3100	Monofilaments, Inc.	Monofilament	Clear, melt-dyed	Apparel, home furnishings, industrial fabrics
Pentron	Hoechst Fibers Industries	Staple	Carrierless dyeable, soil- and stain-resistant	Home furnishings
PolarGuard	Celanese Fibers Marketing Co.	Multifilament, tow		Apparel, industrial fabrics
Polyester by Albany	Albany International Monofilament Plant	Monofilament		Industrial fabrics
Polyester by Ametek	Ametek Inc.	Monofilament	Round	Industrial fabrics
Polyester by IRC	IRC Fibers Co.	Multifilament		Tire cord
Polyextra	American Enka Co.	Multifilament		Home furnishings
Polyfyre	Johnson Filaments	Monofilament	Flame retardant	Industrial fabrics
Shakespeare Polyester	Shakespeare Co.	Monofilament		Industrial fabrics
Shanton	American Enka Co.	Monofilament	Slub/nub yarn	Apparel, home furnishings
Silky Touch	American Enka Co.	Multifilament	Bright, trilobal	Apparel, home furnishings
Spectran	Monsanto Textiles Co.	Staple		Apparel
Trevira	Hoechst Fibers Industries	Multifilament, staple	Types vary according to desired purpose	Apparel, home furnishings, industrial fabrics
Trevira for FR	Hoechst Fibers Industries	Multifilament, staple	Flame resistant	Apparel, home furnishings

Figure 3 : Continuation of Polyester Fiber Producers and Trademarks.

each filament. See Figure 4 for an illustration of the production process of polyester. With regards to the further processing of the finished product into fabrics many factors have to be taken into consideration, such as the denier *, the length of the fiber and the finishes that are applied to the fiber itself in the processing. According to Mike Dyer, Head of Product Development in Klopman International a polyester fabric manufacturer based in Ireland, this has allied companies such as DuPont, I.C.I. and Hoecht, the producers of the polyester fibers, with those companies who create the fabrics. This is to ensure that any changes in the finishes applied to the fiber, designed to ease the production process, do not mitigate against the producers final fabric and the standards set for that fabric.

While working and researching within the product development and production area of Klopman International I was informed that the most common problem encountered with the processing of polyester fiber was normally the resultant finishing oils on the spinning and weaving equipment from the original polyester filament or the anti-static interference particularly relevant in the ring spinning process.

* Here one denier is defined as the weight of a filament of 9,000 meters in length.

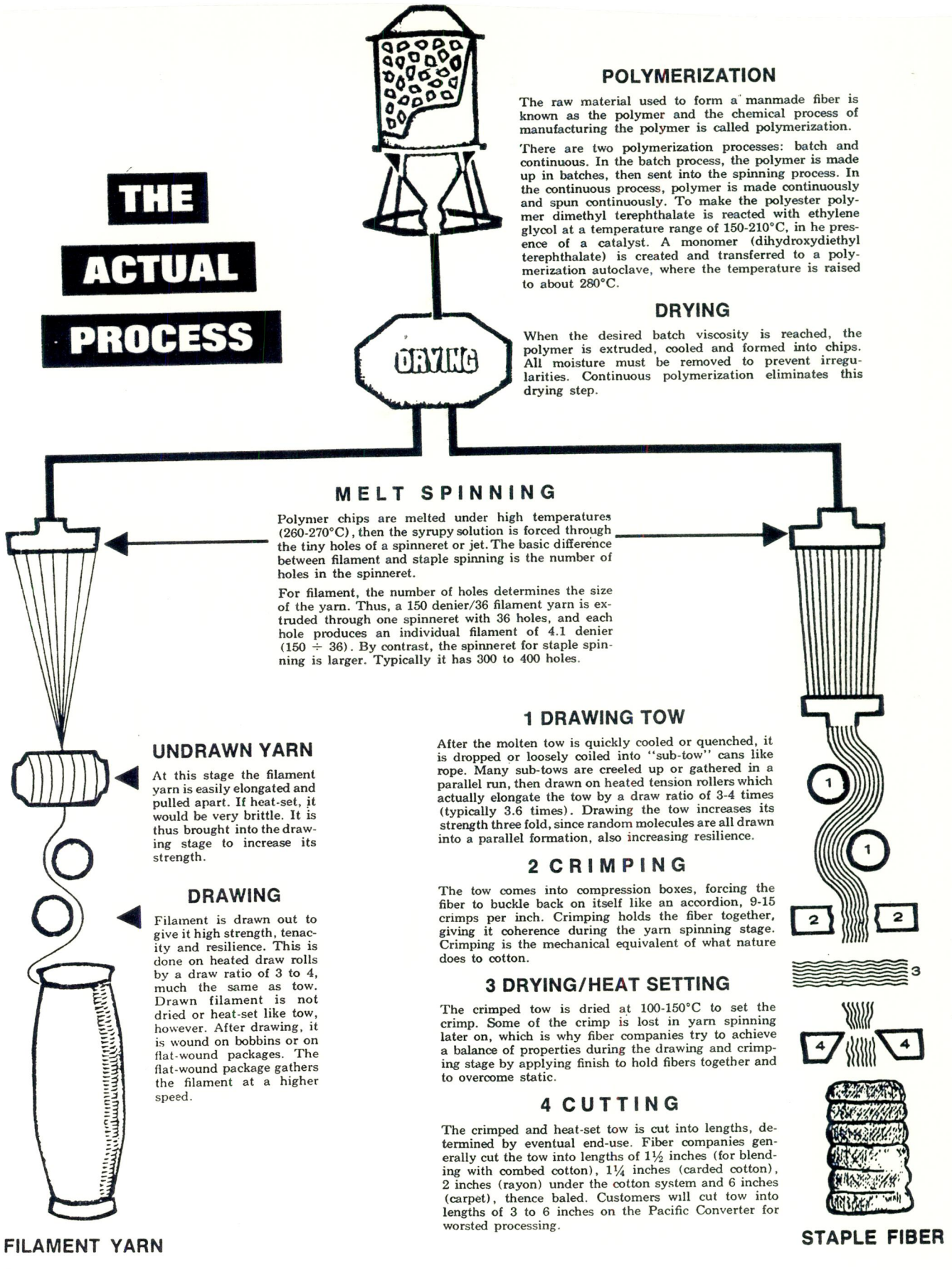

Figure 4 : Process of Production of Polyester.

This normally manifests itself with the build-up of fibers on the steel rolls causing "lapping" and the subsequent breakdown of processes which causes uneven fiber and therefore poor quality fabric. Any changes between the producers of the fiber and the end uses are normally procluded by some small processing trials and subsequent close monitoring of initial production. This is normally referred to as merging.

There are four basic forms of polyester fiber produced and marketed. A filament, which is an individual strand that is one continuous length. A staple, which is a fiber in short controlled lengths cut from continuous filament. A tow, a continuous loose rope of filaments drawn together without a twist and fiberfill, a lofty assembly of fibers used for quilting. Polyester is also produced by DuPont in the form of film under the trade names of 'Mylar' and 'Celanar'. Its chief textile use is in metallic yarns laminations. Its other uses include computer and recording tapes, electrical and electronic insulation and packaging.

Polyester is an extremely resilient and springy fiber with the ability to return to its original shape either wet or dry regardless of the twisting or crushing it may undergo. It is a smooth crisp

fiber which will keep its shape even in damp muggy weather. Fabrics of all polyester fibers do not wilt or droop. It is virtually insensitive to moisture. Water does not permeate its slick surface and does not effect the shape, the size or the resilience of the fiber itself. According to Mike Dyer of Klopman International 'polyester is a thermoplastic fiber'. This means that once the fiber is set to a shape by the application of heat it stays that way. This trait makes it possible to control shrinking and sagging and in the final fabric to heat-set pleats and creases that stay put through many washings and wearings, ideal for all those who demand perfection. Polyester is a lightweight strong fiber that resists abrasions and it is not damaged by sunlight or weather. Moreover it is not appetizing for moths nor is it harmed by mildew and its flammability is low in fabrics when properly selected by the manufacturer and finishes are used in conjunction with the fiber producer.

As mentioned earlier stabilized fabrics made of polyester filament yarn have excellent resistance and recovery from wrinkling. Permanent creases can be set on fabric at low to medium temperatures and still retain sharpness after washing. After heat setting the polyester cloth may be given a controlled

caustic soda treatment to improve its handle and drape by passing it in a relaxed state through an alkaline bath, which dissolves away a small amount of the fiber surface and sets the yarn crimp of the weave construction.

Again According to Mike Dyer singeing has been found to be an effective method for reducing the piling on yarn spun fabrics. While some types of polyester yarns are inherently pile resistant singeing however does yield a better or finer handle. Calendering does improve the piling resistance by flattening the fiber ends and smoothing the surface, it also provides an increased lustre. Fabrics made from entirely polyester based filament yarn, can be preshrunk in finishing by as much as 20%. As a result such fabrics will not shrink significantly in later handling and processes, which gives it ease of care to those who have more to do than worry about what temperature to wash their clothes at. When polyester staple is blended with another fiber such as cotton, fabrics with such mixes can be given a water and oil repellant finish, for example Scotsguard, as polyester properties means it does not absorb water yet may absorb and retain oil permanently. As result new treatments are being developed to increase the moisture absorption and

oil repellancy giving workwear clothes for example easy care and comfort wear, ultimately giving a long working lifespan to a garment.

Fabrics of polyester fibers are better conductors of heat than fabrics made of acrylic fibers. The basic polyester filament fiber is cylindrical. See Figure 5. This results in a smoother yarn when woven into fabrics with fewer air spaces and less insulation, when the filaments are textured as shown in Figure 6. There is an increase in loft and therefore some amount of insulation. Polyester Staple fiber is crimped and this does provide greater insulation in the yarns and the fabrics, but a fabric of polyester-spun yarns would not retain heat as well as fabric made of acrylic, silks or wool, it would be warmer though than if made of cotton, linen or rayon.

One of the reasons for the apparent greater warmth of polyester is its low absorbency. Fabrics of a low absorbency generally have the disadvantage of being clammy and uncomfortable in humid weather, as they will not absorb perspiration or atmospheric moisture. As a result an absorbent fiber such as cotton is often blended with a polyester staple. A deciding factor in the decline of polyesters popularity was the 'unnatural' feeling of

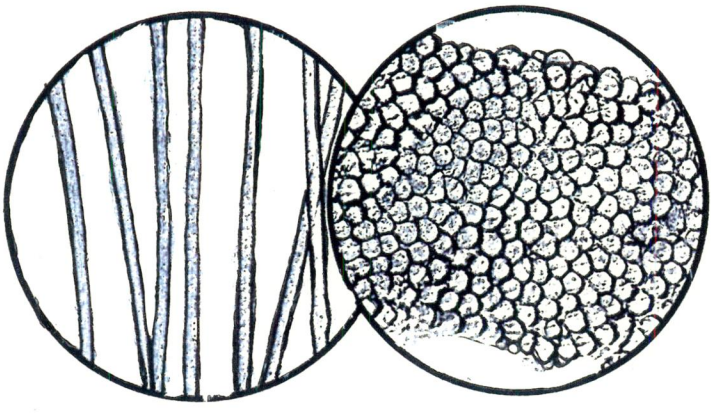

Figure 5 : Original Round Polyester Filament.

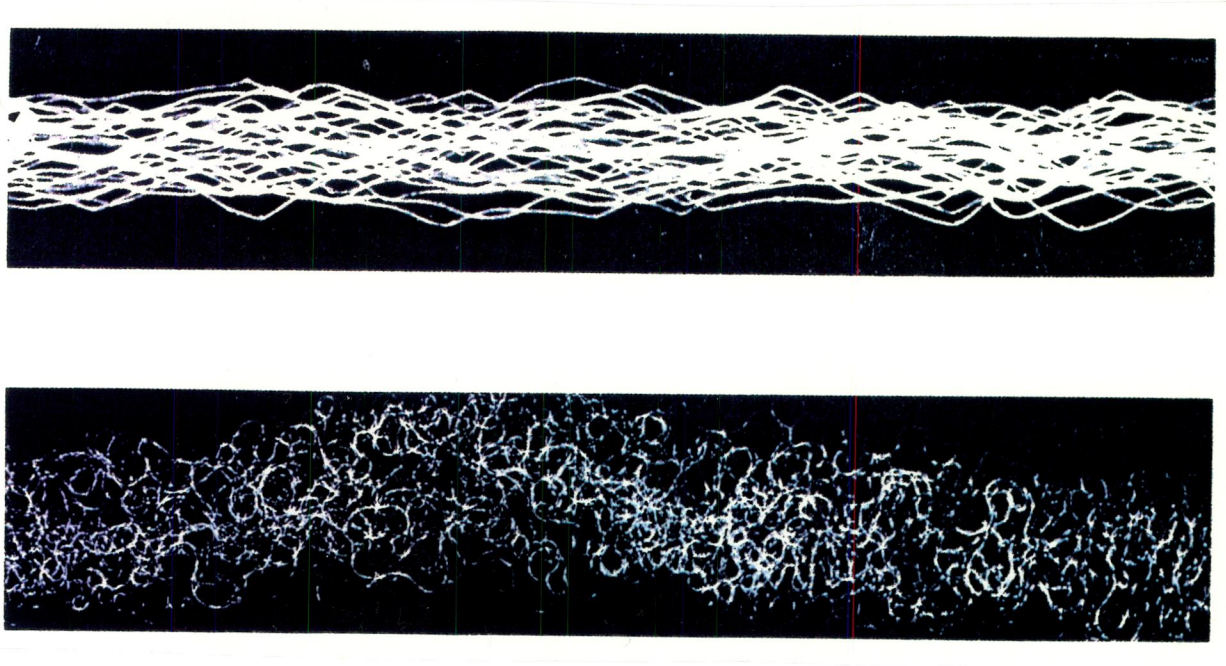

Figure 6 : Textured Filaments

the synthetic fiber or fabric which held all the properties of polyester, i.e. ease of care, with the added ease of wear associated with natural fibers.

Among other disadvantages related to polyester fibers is the accumulation of static electricity. Klopman International who produce fabric for use within various industries have stated that static electricity would be objectionable were highly charged static clothing could disrupt work schedules or most importantly endanger lives, for example, hospital clean rooms or controlled laboratories. The electrostatic properties of these polyester fabrics also attract such elements as lint and dust particles, hair and similar substances which would not be favoured in sealed clinically clean areas such as operation theatres. Nor would the general consumer wish to wear clothing which is difficult to keep presentable thus defeating the whole purpose of polyester and polyester mixed fabrics. Such fabrics also cling to the body if static electricity builds up. Consequently several anti-static finishes have been developed, some provide temporary protection while others are more durable.

Presently various polyester producing companies have developed anti-static fabric for industrial uses. According to Mike Dyer Klopmans anti-static fabric

is not a regular polyester cloth with an anti-static treatment but rather a high technology fabric developed specifically for use in industry with an inbuilt anti-static property in the original fiber. [Klopman Interview, Mike Dyer, April 14th, 1993].

The simple base for their product is running small wires within the cloth thus changing the conductive properties of the finished garment. As yet these ideas have not been developed to the extent that they could be used on the High Street in ordinary polyester products, but we can be guaranteed that with time the new concepts will be modified and used in everyday production of polyester. As once the high tech microfibers coveted for athletes suits are now used for producing artificial silk on the commercial market.

The two major forms of polyester are P.E.T. and Poly-1, 4 cy - Clohexylene -dimethylene terephthalate hereafter P.C.D.T. They have certain differences between them, principally in the mechanical attributes rather than chemical. In general the consumer may assume that the polyester being used is P.E.T. unless the fiber is identified otherwise. All care instructions must be followed if consumers wish to maintain the qualities of the purchased fabric. This requirement of strict

observation of the care instructions are aimed more at corporations using special polyester apparel with which certain specifications have been made for fabric care to assure durability. If adhered to, the life span of the fabric can be monitored and improved on with constructive communication between the fiber producers, the fabric manufacturers, the purchasers and the industrial cleaning companies normally employed to treat the garments. The ultimate user, i.e. those whose job it is to produce and use specific specialised polyester, maybe able to determine the particular variant of polyester needed in order to anticipate the precise performance of a finished fabric.

Polyester maybe defined as a relatively strong and durable fiber. High tenacity P.E.T. polyester filament yarns are used for tyres and industrial purposes as they are extremely strong in their make up. In general P.E.T. polyester staple fiber ranges from a high tenacity, which is stronger than nylon staple, to a regular tenacity which is about equal to or slightly weaker than nylon staple. The abrasion resistance of polyester is exceptionally good being exceeded only by nylon. The strength abrasion resistance and stability of polyester makes it extremely suitable for sewing thread. Such thread

will not shrink or cause fabrics to pucker. The fabrics of polyester filament yarn only have satisfactory draping qualities. The drapeability of fabrics blended with polyester staple will depend upon the type and proportion of blend in the yarn as well as the fabric construction. What is highly important is the length, the denier and the staple of polyester within the production and another important factor is as mentioned previously the fiber manufacturers working closely with the fabric producers and the end users to ensure that any changes are designed to ease the process of production.

The resultant factor is that over the last several decades, a great deal of effort has been concentrated in the area of improving the performance, the handle and the appearance of polyester filaments, as its physical properties were and are still considered the most suitable for the production of many of todays hardwearing fabrics.

This chapter has dealt briefly with the development of polyester from its inception to today. It observes the dependence that the various stages of polyester production have on each other, right from the inventor of the fiber through to the end user. The next chapter intends to analyse a changing

society and how over a fifty year period polyester fiber evolved and grew to mirror those changes.

CHAPTER 2:

The main objective of this chapter is to analyse and discuss the effect that polyester had as a new fiber on a growing and changing society from its discovery in the 1950s to the present day, while also observing how society reacted to the fiber and fabric. This discussion will look at the fact that over approximately four and a half decades polyester essentially has travelled a full 360^{o} degrees in regards to its popularity and acceptability. Polyesters image metamorphised from that of a unique fiber in the 50s and early 60s, to a fiber held in disdain throughout the 70s and 80s. In the 1990s however it is being recognised one again as a highly potential fiber within the textile world, with uses in both the industrial and commercial textile markets.

Polyester had an enormous impact on the general publics lifestyle as a new fabric and had a strong influence on the industry that produced it as a fiber. Man-made fibers of the 1950s were all part of the manifestations and fascinations with new space age technology, following the second world war and their novelty made them luxury goods for a short while at least. For example polyesters luxury status guaranteed that its prices were above that of

cotton [J. Hearle Textile Horizons, 1992, pg.22]. Americans lifestyles of the 1950s set a standard, a precedent for the other advancing western countries to emulate a lifestyle which revolved around conspicuous consumption, leisure activities and the new space age technology. The ideal was to become a throwaway society, a society of consumers, a society where new and evermore advancing products were to be constantly available. By the late 1950s there were more than four million women working in Britain bringing in to many households a second income and along with that higher living standards and new priorities. Many of the consumer goods we now take for granted were first marketed in the growing technically advanced and status conscious western world of the 1950s.

The advent of synthetic fibers had a conspicuous effect. They became a major fashion influence. Polyester was a fiber created to simulate natural fibers such as silk and to have added ease of care properties. This meant that working class men and women could have garments of a high fashion effect without very high fashion prices. Clothes could be produced more economically and were easier to keep and take care of. For the first time the working and middle classes could buy fashions for each

season, to have clothes for important occasions and garments for leisure wear.

The increased durability and ease of care of everyday wear was the most notable effect of the introduction of synthetic fibers, but they also enabled special clothing such as bridal gowns to be produced economically [C. Pearce 50s Source Book, 1990, Pg. No. 158]. Synthetics were central to the 50s fashion scene. They were in line with the general image of less domestic drudgery. The acceptance of the artificiality of these fabrics paralled the increased use of plastics in general. In an age that naively believed that 'New' automatically meant better the basic material was promoted to almost the same degree as the final product. Such as a suit, if it was made from polyester it was considered 'modern and new' with all the added easy care values associated with the fiber, a much more up to date product than the 'old' and expensive pure new wool suit. The most popular features of the synthetics were the fact that they could be made to simulate traditional fabric albeit in a very crude manner. As an example of the effect the synthetics had on a natural fiber producing industry, genuine cotton moved upmarket and the cotton industry declined as it's role was taken over

by man-made synthetics which, superficially at least replicated the real thing.

As mentioned in Chapter one, the first public announcement of the new fiber 'Polyester' was in 1945. According to Serena Sinclair who was a fashion writer on London's 'Daily Telegraph' through the 50s and 60s, the general public were not to see the new polyester fiber until a number of years after the first public announcements. She comments in an article that in 1952 I.C.I. Ltd. brought Terylene to the general publics attention with a flourish [The name Terylene was exclusive to I.C.I. for world manufacturing rights] [Sinclair, Textiles Horizons, 1992, pg.32].

Terylene was seen by I.C.I. as a premium high value fiber suitable for demanding industrial applications and for bending with expensive natural fibers. It was priced accordingly and as a result in 1955 Terylene staple fiber was five times the price of cotton and once the fabrics and its potential were established the necessary prices and volumes of production followed. [Hearle, Textile Horizons, 1992, pg.22]

I.C.I. Ltd. promoted polyester as a wonder fabric with a magic ingredient which eliminated the ironing

of mens shirts, of sheets and table cloths plus much, much more, forever. This could be seen as a sharp marketing ploy of great significance. If one looks at the 50s evolving lifestyle you become aware of the high amount of advertising and products on the market, consumerism was growing rapidly. See Figure 7 and Figure 8. Products were all fighting for a slice of the market. The marketing people observed that with the higher standard of living, the new time saving appliances such as washing machines and food processors and the growing appreciation of leisure time called for a marketing ploy aimed towards the new proportion of the consumer market, women. Polyester was now seen as vital, women wanted this dramatic fabric which would fit in nicely with the new image of technology, life was supposedly getting easier so why not aspire to rid the world of the drudgery of the iron and the ironing board.

In 1956 British presswomen were shown skirts in a Terylene and wool mix for the first time at the Savoy Hotel in London according to Serena Sinclair. She recalls that an element in the fashion show for the introduction of this new fiber, mirrored a classic scene of a 1950s film staring Cary Grant and Audrey Hepburn. The scene in the film showed Cary

Figure 7 : Polyester Shirts, Socks, Trousers encapsulates the Essence of the Era.

Figure 8 : Advertising for Terylene

Grant showering in his suit. The fashion show hosted by I.C.I. featured a male model stepping out of a shower dripping wet but immaculate and uncreased. In a suit made of terylene [Sinclair, Textile Horizons, June 1992, pg.32]. Using such a popular image, made the message wonderfully clear, that Terylene was uncreasable even after wetting. DuPont in America with their trademark 'Dacron' also employed this marketing strategy and demonstrated its high qualities by putting the suit through a shower [See Figure 9], then a washing machine followed by an immersion in a swimming pool before it was finally worn for sixty seven days without pressing. Judging by recorded reactions of the public of the 1950s to polyester in various textile historical journals the market was ripe to accept without question non crease, drip dry fabrics [Kenna - Somethin' else, 50s life and style, 1989, Pg. No. 56].

Though DuPont brought the American rights to produce polyester in 1946 they did not actually start producing fibers until 1951 under the trade name 'Dacron'. Now polyester is produced and marketed in America under 20 trade names, and DuPont under the label 'Dacron' have over 70 types of fiber variants

Figure 9 : I.C.I. and DuPont's Advertising Ploy.

Man Stepping out of Shower in Polyester Suit, Date: 1956.

alone [Sinclair, Textile Horizons, June 1992, Pg. No. 32]

As the 60s progressed consumers could not help but become more and more confused by polyesters produced by the American companies Enka [Everon], Hoechts [Treviva], Philips [Quintess] and Eastman [Kodel]. Most consumers just wanted to know 'Do I Iron it?' or 'Am I liberated?'. Both I.C.I. and DuPont were seasoned promoters fo fabrics and fibers but the introduction of the miracle fiber polyester became the key to easily accessible leisure time and easy care glamour clothes. Through I.C.I. and DuPont's successful promotions, the fashion world had been won over. Admittedly at first there were various problems associated with the colouring of polyester and most other synthetics. In the early days producers of polyester were stuck to a limited colour palette. Disperse dyes were developed to give a wide colour choice and a high colour fastness to light, washing and rubbing. According to Ian Holme in the late 1950s and 1960s demands for dyes with a higher colour fastness to heat had to be developed. In the 1970s and 1980s demands for higher colour fastness to washing were introduced as a result of changes in wash test procedures [Holme, Textile Horizons, June 1992, Pg. No.29].

Soon polyester was everywhere and there was 'electricity' quite literally "in the air" [Pearce, Fifties Source Book, 1990, Pg. No.144]. Most people in the last years of the 1950s and early 1960s were sporting garments made with polyester or polyester mixed with cotton or wool, everything from blouses, dresses, trousers to sports wear and underwear. The uses of polyester was not limited only to fabric for apparel but was used for furnishings and interiors as people became more interested in their living quarters and had more disposable capital to spend on their surroundings. In an era where plastics were everywhere as chairs, tables and fabrics, people were moving away from the cluttered remains of the Victorian and Edwardian room with dark dusty colours. Those who could afford it could dramatically change rooms with the people and could if they wished even alter the interior of their cars, as many synthetic covers were made for the seats.

The fairy tale story of the wonder fiber polyester was not destined to continue indefinitely. By the end of the 1960s due to the change in social opinion, values once again had started to move on. The huge consumerism of the 50s was dead. The world was becoming a smaller place. Young men of America

were being sent to fight in Vietnam, many never to return and viewers could watch the war on their television in their own front room. The hippy ethetics which denoted peace, love and nature were starting to filter through from these radicals down to the people who just agreed with the principal of naturalism and peace. However even if social factors changed dramatically polyester did not. Physically early polyester fabrics were plastic, were essentially uncomfortable and the once new and modern fabric was now being regarded as unhealthy, dated and not moving with the times. Polyester fiber manufacturers did not seem to change and develop polyester from its original stage, thus it was seen as a cheap and unattractive fabric whose uses seemed limited to that of production of low quality clothing.

From the beginning of the 1970s through to the 1980s polyester was not viewed as a versatile fiber but rather a cheap and uncomfortable one, which would not sell. The fiber producers recognised that they had to develop polyester further. Stan Davies writes that behind the scenes many producers were working on the fine tuning of their synthetics. In America they produced a cotton like polyester substitute and in Japan due to their inability to

produce the masses of silk fibers needed they started to develop silk like polyester fibers [Davies, Textile Horizons, June 1992, Pg. No.25].

Polyester did not fall from favour in all textile markets. Within the scope of workwear fabrics polyester was the fiber employed because of its strengths and versatility. This also lead to its image being one of a cheap and tacky fabric used in clothing from waitress uniforms to uniforms for oil rig workers. Throughout the years of general consumers disdain for polyester, apparel manufacturers still appreciated the value of polyester. Taking into consideration its inherent strengths and weaknesses and addressing these by blending the polyester with various natural fibers and by producing this blend properly they could provide the workwear apparel market with a high quality fabric. As an example, marketing of garments even today is biased towards natural fibers. A garment made of 55% cotton and 45% polyester will always be marketed on the basis of being cotton rich, the slight excess of cotton allows for this. It seems that polyester producers have allowed such a poor market image of an excellent prodcut. This could be because for the past 15 years polyesters producers main market was

workwear apparel. The publics perceptions of polyester was until recent fiber developments such as microfibers, very poor. without a 'new' and 'improved' product, why market a fabric that was not attractive to consumers.

All too often polyester seems to slip into the small print or is used as a derogatory term associated with the cheapest and worst designed textiles made from this versatile fiber. Many peoples recollections of polyester are of non-iron shirts or blouses which irritated and made them feel hot, sweaty and clammy while wearing them. Today many people would not even realise they were wearing a polyester based fabric unless they specifically read the label as both marketing and the finished products have changed so dramatically. Polyester unfortunately has become a synonym for unfashionable. As a comment in a travel article stated:

> "In Benidorm theres nothing to see, and its certainly no fashion parade. The moment you step onto the promenade you breath a sigh of relief, whatever you've packed its going to be alright. This is Bri-Nylon and polyesters spiritual home; A conservation area for cerise tiger skin. Here you don't just physically relax you culturally freefall."
>
> [A.A. Gill, Sunday Times, 10th October 1993, pg.16]

Society is littered with images which represent the 'trendy', 'fashionable' and 'cool' people and things. Music Television or as it is more commonly known 'M.T.V.' is a popular youth culture music channel. It is broadcast around the world 24 hours a day and is the 'Guru' of style and ideas influencing the largest growing consumer market today. That is the age group of the 16-27 year olds, the baby boomers. For example 50% of Ireland's population is under the age of 25 [Byrne, Sunday Independent, February 20, 1994, pg.8]. This music channel promotes itself between music videos and fashion shows, through various forms of short films and photo montages. The medium is television. One cannot touch or smell what you see, yet it conveys an image so well. In one short advertisement feature we are shown on screen a man in his mid fifties, his hair is greased back, he wears a 3 piece pale blue suit and a dress shirt with flounces on the front. He struts towards the screen to a very outdated piece of music. Layered on top of that music and more importantly that image is a series of comments, "Some people tune into M.T.V., some don't, some people see the newest fashions 'Oh I love that polyester feel'. Some don't. Some people hear the latest music, some don't" - At that point the picture fades leaving us

in no doubt that polyester is not trendy or modern and this is an image that polyester producers and closet polyester wearers have to contend with.

Obviously polyester is not seen as part of the modern world or at least it is frowned upon and regarded as tasteless. It is ironic really because polyester as a fiber is utilized in more ways than creating a fabric. Chapters three and four will discuss the depth of which polyester is now to be found in fabrics, geotextiles, and solid fiber constructions.

Polyester producers do appear in my opinion to be starting to fight back against the image still adhering to the very word polyester, and are following the example of the natural fiber producers who enhanced, protected and promoted the quality and image of their products against the competition from the miracle fibers of the 1950s. They are backed up by the new generation of polyester fibers now being produced by the Japanese resulting in their Shingosen fabrics. The term is not much more than a nickname for new polyester fabrics of quality but it works as the appeal in the Japanese market has proven effective.

This chapter observed the changing faces of polyester through the decades. The producers never really ignored the fiber but took their time developing it to its full potential. It did as a fiber in the synthetic field suffer in the late 60s and 70s a backlash as a result of growing ideas such as a return to nature and a natural way of life. The 80s saw polyester take a back seat in the promotion of blends of fibers, where cotton percentages in a garment were held in higher esteem. However in the 1990s polyester has once again been seen by the consumer as well as industry as an innovative and versatile fiber and at last really living up to its promise of the 50s of being a 'new' 'modern' and ease of care fiber or fabric.

The next chapter will trace briefly the new developments in polyester innovation and their application. These developments have taken place in the last number of years which show the length of time a fiber can stay in a dormant position, until it is re-examined and re-invented.

CHAPTER 3:

This chapter is a short commentary on polyester innovations within the textile and fiber manufacturing industry. These innovations are very recent most having been developed within the last six years. Considering that polyester has been with us for almost 50 years, only within the past 10 years have the greatest innovations occurred. Their development did not happen suddenly, rather polyesters development was the merging of fundamental, scientific and technical knowledge. This discussion will comment on four polyester producing companies currently creating and marketing new fibers.

The interaction of textile design and technology has played a major part in the development of polyester, since textile manufacture acts as a service and is often a crucial factor in the emergence of new and innovative fibers and fabrics for end uses in everything from industry to High Fashion.

The first generation of fibers were produced from the mid 1940s because of their new found qualities in contrast to the previously available fibers. The second generation occurred where the chemist copied natural fibers in order to replace them to some extent then succeeded in this purpose. However the

fibers with high performance being produced today provide the potential for developing a new technology. Fibers of high strength can now be further produced from synthetic polymers of light weights and are currently widely employed in Space Technology, as for example fibers of polyester and polyethylene.

Therefore synthetic fibers of the third generation are not simply alternatives to natural fibers, as were the synthetic fibers of the second generation. The need for ultra light fibers of high strength is increasing as high technology responds to changes in the social environment, for example the demands of energy conservation. Such fibers are also needed in various sports, leisure, transportation, ocean, air space developments in effect leading out from earth to space. In future decades, metals are expected to be replaced by newly developed synthetic fibers of the third generation, which maybe superior to metals with respect to their strength. Already some synthetic fibers are being employed as strengthening materials as composites in wings and body parts of aircrafts and space shuttles [Hongu, New fibers, 1990, pg.3].

Fibers before the 1980s were either identified as general purpose fibers or designated as speciality

fibers. High value added products of polyester fiber were first developed in Japan in the 1980s. It might not always be appreciated that it is technically difficult to spin fine polyester filament, i.e. that which is finer than human hair or spun silk. In fact the spinning technique for forming synthetic fiber becomes more difficult with shrinking denier, since the process requires three established technologies to spin uniform synthetic fibers as fine as human hair.

Those being:

(1) Fine Spinning

(2) Fine Processing

(3) A highly reliable production technology to combine the previous two technologies without producing any defect

Engineers established technologies as a result of constant and intensive efforts over a considerable period of time. Synthetic fiber companies have accepted the challenge to spin finer and finer yarns. As a result of the competition many new products are referred to as high value added or speciality products.

According to Mr. Yoshikazu Yamasaki, of Japan Chemical Fibers Association, the recently developed Japanese polyester fabrics have been given the name

'Shingosen' which in literal translation means New Synthetic Fiber. In Japan where despite a high demand for silk, its high price and unreliability of supply led the Japanese manufacturers to concentrate on producing commercially viable products or alternatives. Due largely to the progress made during the 1980s Shingosen has been receiving rave reviews due mainly to the following:

(1) Following a lengthy period of time wherein natural fiber fabrics had been used for casual apparel, polyester fibers with new excellent drapability are becoming increasingly more popular as more of this fabric is used in todays stylish fashions.

(2) Japanese polyester fiber makers have expended a great deal of energy in their efforts to develop new fabrics. Because these newly developed fabrics have a fresh and different feeling from that which is found in existing natural or synthetic fabrics, they are being accepted by consumers who want high quality made goods. [Yamasaki International Textiles,, May 1993, pg. 54] [Nishida International Manmade Fiber Congress, pg.5]

The definition of Shingosen has not been clearly defined in the marketing literature of various fiber

and fabric producers however it has best been described roughly in this way. In an effort not to copy natural fibers, Shingosen was developed for the consumer who wanted a new value and feeling. It was produced by combining newly developed yarn with the advanced technology of weaving, dyeing and finishing. Shingosen was developed from the standpoint of giving priority to creating a quality fabric rather than being concerned solely with production aspects which requires efficiency and rationality. This resulted in a wide range and variety of appearances structure and handle in the fabric. Critical to Shingosen fabric development is the organisation of a very high tech production system which encompasses everything from initial fiber production right through to the finished product. Each technique results in fibers with different shapes, properties and deniers and the choice of methods dependent on what the final applications will be.

Microfibers within textiles are an area of much ongoing research and development and they have a highly perceived value. There are huge rewards for manufactures to combine innovation, creativity and technology ensuring that the drive for the future developments of Shingosen concept remains strong.

A Japanese based company Toray Industry Incorporated is a producer of synthetic fibers and fabrics and has been involved in synthetic fiber development as part of an ongoing search for new fabric to respond to new needs of challenging lifestyle in a dramatically changing world. The company now produces plastics for a number of different industries - from fibers and textiles through to plastics, chemicals, medical equipment and pharmaceuticals.

The company's aim which it clearly states in promotional data is to create fibers that "Captures the mysteries of nature through the power of technology". [Yamasaki International Textiles, May 1993, pg.58] The company's forward thinking has provided not only constantly updated fashion fabrics but also fabric which can be applied to high performance and speciality comfort cloths as well as embracing a much wider field of industrial material from construction to ocean exploration.

The Toray company believes that by challenging the limits of technology it is also recreating the hidden secrets of nature. The company for example has developed the Toray form of dust free working clothes. This form of fabric and clothing has

become important for cleanrooms * as cleanrooms are indispensable for the maintaining of many of todays micro technology and scientific developments. the degree of required cleanliness is continually increasing. Indeed no high technology can develop to its extreme height without stricter cleanliness. The production yield in a cleanroom falls due to the presence of dust, of which nearly 50% comes from workers in the room. Man pollutes the clean room air by dropping dandruff, old skin and dust from underwear. Now developments are being made to create dust free working clothes which will envelope a man completely and ensure there is no leak of dust from the seams or neck ares.

The main criteria for working clothes suitable for the clean rooms are:

(i) The dust generated from working underwear must not leak through the working clothes.

(ii) No dust must escape from the clothing matter itself.

(iii) The clothes must be antistatic and dust proof.

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* A cleanroom is a sealed, sterile laboratory in which everything from humidity to dust particles are monitored. Ideally a cleanroom would have no type of waste products in the air.

(iv) The fabric should be breathable or moisture permeable and comfortable.

(v) The clothing should be durable against washing. Washing of cleanroom clothing is normally contracted to industrial cleaners with the knowledge of the fibers and fabrics inherent qualities.

Polyester is probably the best synthetic material available for cleanroom working clothes. Polyester and carbon are mixed to make it electrically conductive. These conductive fibers can be woven into high density fabrics and eliminate static electricity induced by the low humidity atmosphere of the cleanroom. Natural fibers such as cotton or synthetics such as nylon are unsuitable for this purpose because of the dust they generate.

Toray have also developed an electrically charged non woven fabric 'Toray Micron'. This is used for the high efficiency fitters needed for cleanrooms, masks and machine filters, as charged microparticles of dusts can be caught electrically as well as physically in a filtration system [Hongu, New Fibers, 1990, pg.176]. As a textile company Toray is striving to show the world that technological innovations are virtually limitless. Its belief that synthetics will surpass natural fibers grows stronger. Their ongoing quest for information,

allied to a strong marketing strategy has created a company whose formidable success was rewarded in 1992 when Toray won first place in 'Fortune' Global 500 for the Textile Sector.

Kuraray Company Ltd. are also a Japanese based company who according to one article written on them are 'A good corporate citizen making efforts to conserve energy and protect the environment' [Yamasaki, International Textiles, May, 1993, pg.61]. The company have chosen to specialise in the fields of polymer and synthetic chemistry and chemical engineering. The move towards the 21st century and the search for advanced knowledge has kept Kuraray at the 'Sharp end of pioneering work in Textiles' [Yamasaki, International Textiles, May 1992, pg.60]. At Kuraray special importance has been placed on products which meet the future needs of society. As part of this concept, researchers have been able to work on advanced technology polyester fabrics which absorb ultra violet light to protect the skin from harmful rays. This is of growing importance in the present day to all people, when we are constantly showered with reports of the thinning of the ozone layer and the subsequent danger of skin cancer from exposure to strong direct sunlight. This is in keeping with Kuraray's

observation of society and its needs. This series of ultra violet reflective fabric is marketed under the trade name 'Esmo' and is based on a polyester fiber blended with a high technology ceramic in the polymer stage resulting in a fabric which can either absorb or reflect rays according to the lengths of the fibers. As polyester has become the mainstay of Kuraray's textile business it is also natural that the company has become one of the leaders of Shingosen.

Wramp which is one of the Shingosen fabrics produced by Kuraray, is made of 67% polyester and 44% nylon fibers. Ultrafine microfibers of 0.28 denier per filament is used which gives the fabric a silky touch [Yamasaki-International Textiles, May 1993, pg.61] One of the most successful combinations of using a variety of fiber wefts to create new possibilities is in using wramp for the weft and a polyester filament yarn for the wramp. when this is knitted in a 3 way layered form it produces a cloth with a capillary action, causing perspiration to be drawn away from the body and dispersed on the outer surface of the fabric where it evaporates. [See Figure 10 for illustration of Wramp fiber]. These fabrics are suited to active sportswear and when they become available on the general fabric market

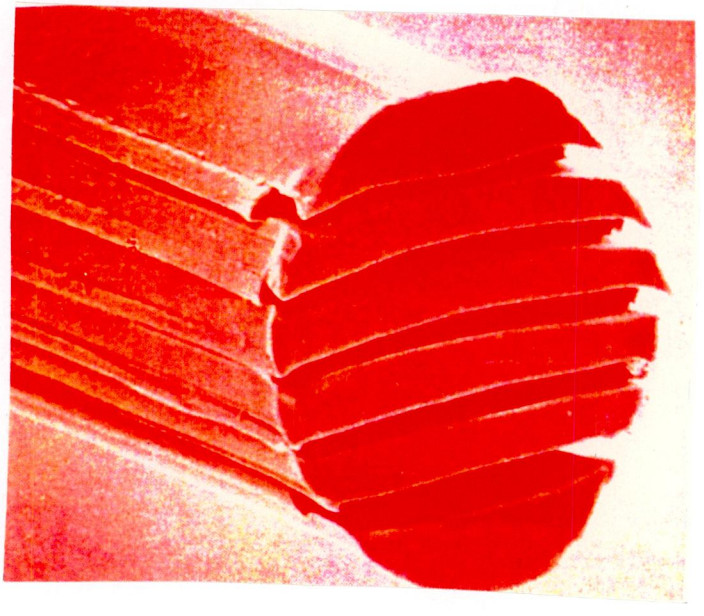

Figure 10: Kuraray's wramp yarn with unusual flat cross section. combined with polyester yarn in knitted fabric it has its capillary properties

it may go someway to change the view that polyester based fabrics are uncomfortable and clammy to wear.

Apart from the development of polyester fabric for apparel Kuraray have also developed a very high strength aromatic polyester filament fiber whose tradename is 'Vectran'. According to Kuraray the valuable property of Vectran is that it absorbs no water and undergoes no physical change when in the wet stage. For example Vectran when used as a reinforcing fiber for fiber reinforced plastics it will not deteriorate while utilized for its bonding strengths under the influence of moisture. High durability represented by high wear resistance and high heat and age resistance and secondly a high chemical stability especially against acids are characteristics of fully aromatic polyester which guarantees a long life for Vectran products such as ropes, gloves, protective clothes and acid resistance filters [Hongu, New Fibers, 1990, pg.32]. Unbeknown to most people polyester is in use all around us, being applied industrially, in tyre cords, rubber materials such as belts etc., ropes, tension members for optical fibers, friction materials, fenders and composites.

Kuraray's awareness of the environment around us and the new and specialised fields in which polyester

can be utilized, have promoted the fiber as one whose life span will go far into the future.

Teijin Ltd. is currently offering a range of micro fibers. The main ones coming under the trade names 'Sildoll', 'Sorela', 'Asty' and 'Altex'. In 1987 'The Technology prize of the Society of Fiber Science and Technology Japan' was awarded to the Tijin company for their development of fabric with a high water repellancy. Their 'Super Microft' was designed by emulating the structure of a lotus leaf. Water rolls off the lotus leaf like mercury. The leafs surface is microscopically rough and covered with a wax like substance with low surface tension. Shown in Figure 11 is the resistance of the fabric to water. When water is dropped onto the surface of a lotus leaf, air is trapped in the dents and forms a boundary with water. The contact angle of the water is large because of the wax like substance. Super Microft is a high water repellant fabric made of polyester fibers, harnessing the water repellant mechanism of the lotus leaves.

The technology of Super Microft production consists of:

(1) The design of the original filament to allow air are trapped with high durability, partial

crimping, and the potential to give a high bulk filament.

(2) The textile design to give high density textile with a natural cotton hand feeling and good size stability.

(3) A new dyeing process. Dyeing in such a way as to produce homogeneous microscopic dents on the surface.

(4) A new finishing process to reduce the surface tension by combining water repellant and wash and wear resistance processing.

[Hongu, New Fibers, 1990, pg.65,66]

Super Microft exhibits good water repellancy, durability and a high wear resistance. Therefore it is suitable for use in clothing, for example cleanroom garments, coats, working clothes as well as industrial fabric. So far I have only dealt with water repellancy which relates to the waterproof abilities of this fabric. However the repellancy of water can also be utilised to evaporate moisture coming from the human body, the new water repellant fabric described is both moisture permeable and waterproof, therefore is not uncomfortable to wear for long periods of time.

As Figure 12 shows the handle of the 'Microft' exhibits a soft almost natural effect. Therefore

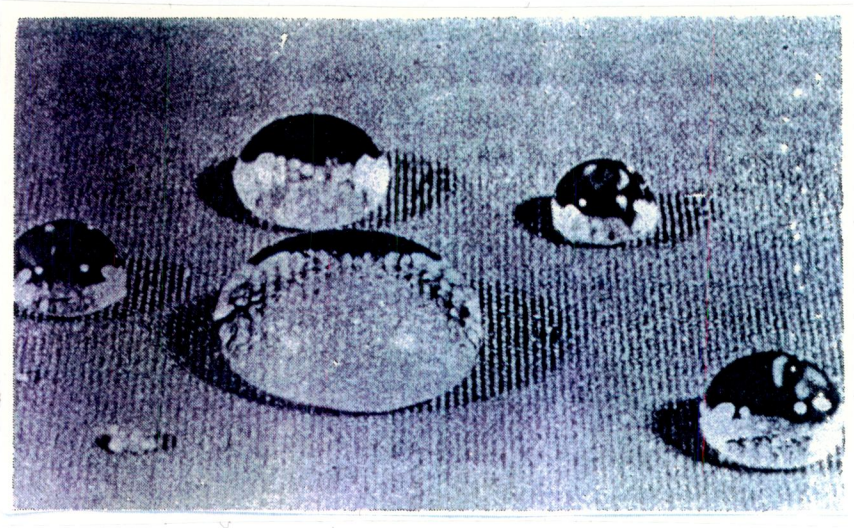

Figure 11 : Resistance of 'Super Microft' to Water

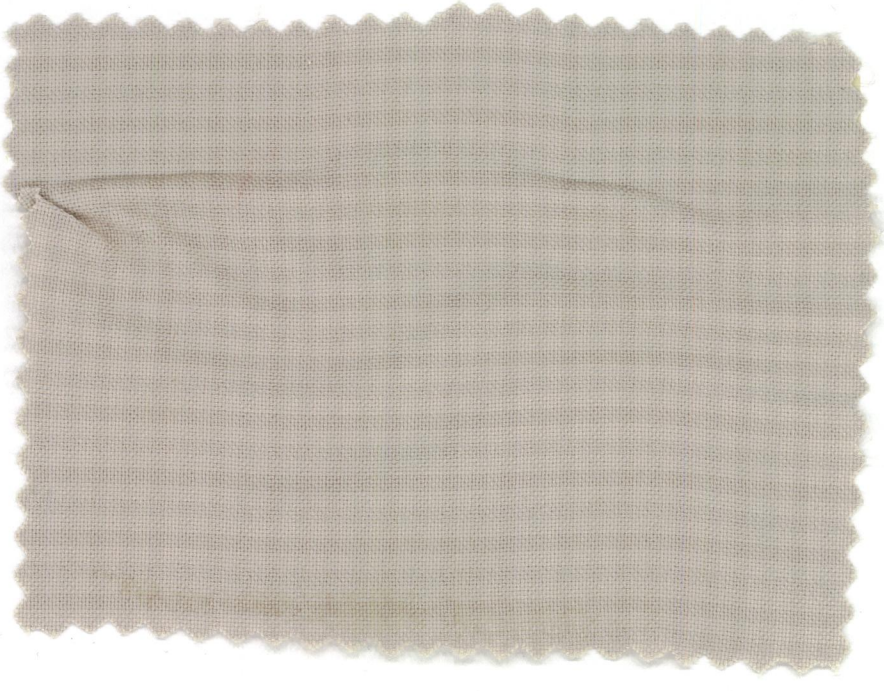

Figure 12 : The almost 'natural; handle of Super Microft

to the ordinary man on the street the eventual use of this 'Microft' fiber will improve the comfort value of various garments such as raincoats, fishing gear, and other waterproof garments without having to have a true 'plastic' mac or an uncomfortable sweaty garment.

The final company I will discuss in relation to improved polyester fibers is Unikita Ltd. Unikita Ltd. have developed a solar energy absorbing and retaining fabric they call 'Solar a' [its European trade name being 'Accusol'] [Yagihara - International Manmade Fibers Congress, 1990, Austria, pg.2]. Their observation of the market needs for apparel fiber especially for sportswear and particularly for winter sportswear led them to develop a fabric which would be required for the following functions:

(1) Exercise; functionality, elasticity, fitness, lightness etc.

(2) Safety; resistance to impact, abrasion and heat, lubrication.

(3) Durability; a variety of colour fastness and shape stability.

(4) Physiological comfort; heat retention, sweat absorption, breathability, waterproofness, clothing pressure.

(5) Aesthetic appeal; colour, patterns, lustre, uniqueness, powerfulness and visibility.

Winter sportswear must have two functions. One is to protect the wearer form the cold weather and rain. The other is to maximise physiological comfort within the mini climate that exists within the clothing by controlling the heat and perspiration generated by the body and by the strenuous action of the wearer. To meet these needs, several moisture permeable and waterproof fabrics have been developed by the worlds major fiber producers. This has evolved into 2 basic types of heat retention fiber and fabrics, one is passive heat retention which traps heat off the body of the wearer and prevents its escape to the outside, the other is the positive type which uses electrical or chemical material to heat up. [Yagihara, International Manmade Fiber Congress, 1990, pg.5].

According to Yagihara on the aforementioned International Manmade Fiber Congress of 1990 'Unitika Ltd' embarked in 1987 on the development of a better heat retention fabric using a chemical called Zra and developed solar energy absorbing and heat retaining fabric called 'Solar a'. It absorbs and converts into heat the visible infra red rays in solar

energy. It also reflects and traps the heat given from the body to maximise heat accumulation within the clothing.

Zra had both the function of heat absorption and heat retention. That is to say it absorbs a major part of solar energy and converts it to heat but reflects and retains within the clothing the heat given off the body. The core part of the fiber is a polyester polymer containing particles of Zra. In the fabric mixed yarns and cationic dyeable polyester yarn is used, thereby causing a gun metallic or bright, deep colour variation. Figure 13 shows a collection of 'Solar a' 'Accusal' fabrics featuring the 'metallic' look fabric plus the thicker felted fabric. In addition to its high function, its original and distinctive colours tones and overall aesthetic appeal have resulted in a highly favourable consumer response.

Solar-α Fabrics

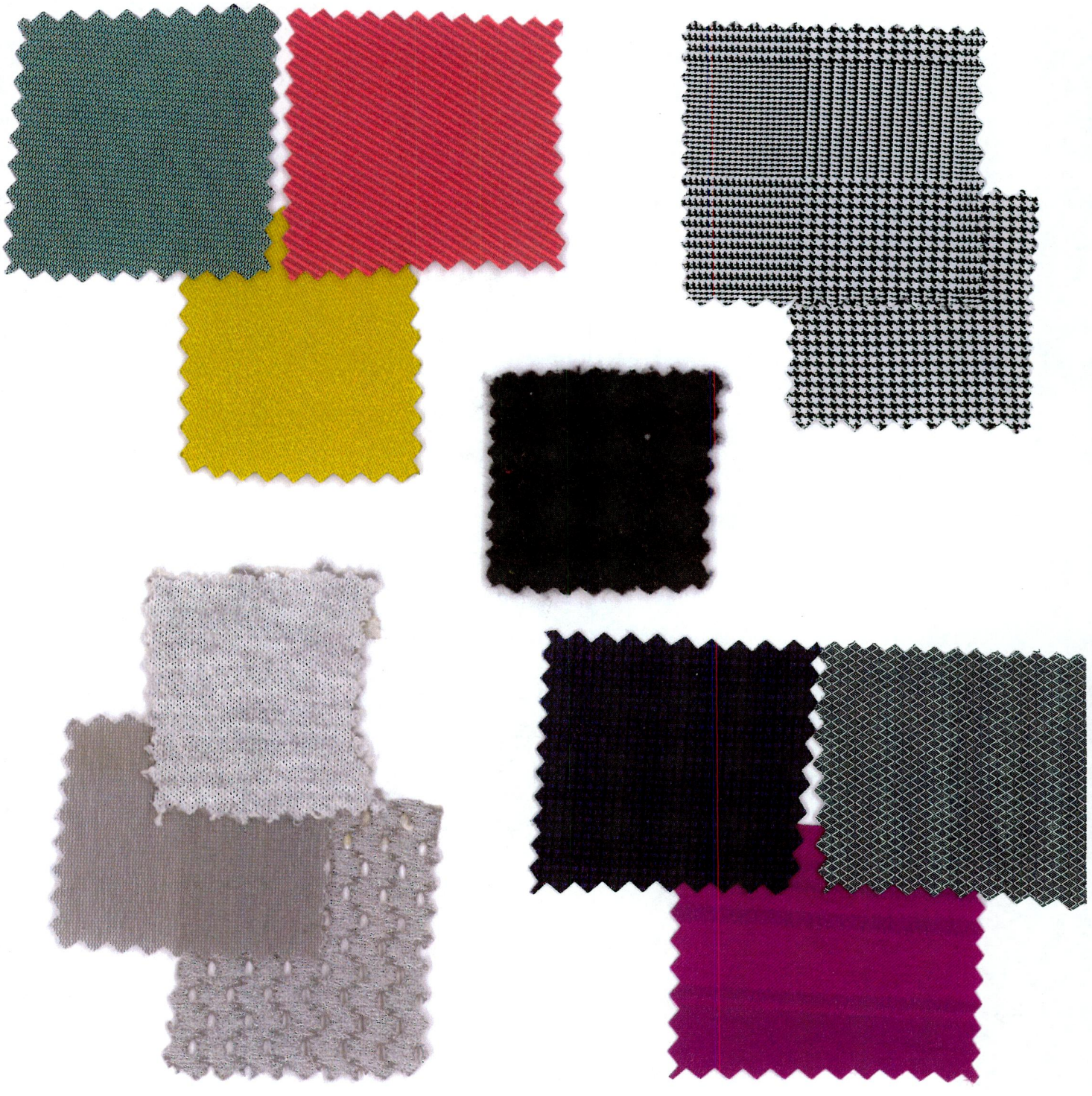

Figure 13: Selection of 'Solar a' Fabrics

The uses and potential for 'Solar a' range from, skinwear, athletic wear, workwear, golf wear, bathing suits, futons etc. In the future, applications are expected in the field of Agri culture, architecture and interior decor. 'Solar a' currently is used in coats, slacks, workwear, gloves and hats for cold weather, it serves a wide range of applications which require a heat retaining function.

'Solar a' was launched in 1987. One year after its launch the uniforms of seven national ski teams which participated at the Winter Olympic Games in Calgary, Canada had 'solar a' suits. The uniforms earned a high reputation as a revolutionary functional fabric on the world market [Yagihara, International Manmade Fiber Congress, 1990, pg.14].

Apart from the specialised fields in which the previously described new polyester fabrics are marketed and used, there is of yet no recorded general public perception of the new fabrics to my knowledge. The high tech fabrics are observed and appreciated by the industries which use them. With regards to the Shingosen fabrics the fashion industry in Japan has welcomes these new fabrics and promotes them greatly. See Figure 14 which illustrates in a very demonstrative way a microfiber

Figure 14 : Various Advertisements for Shingosen Fabric.

fabric. The pictures show us the high degree of drapebility, texture and quality of materials that are first and foremost polyester. The European fashion industry have yet to totally remove itself from the 'natural' is best ethic and it will I'm sure take time before the American and European fashion producers openly use Shingosen fabric.

The future of the fiber innovators can only improve. Polyester in particular as we can see has many and varied uses. The development of polyester can only improve both the company's sales and profits, and complement and improve dramatically the polyester products available to us on the market. Also the environment surrounding us must benefit from the industrial breakthroughs with regards to scientific improvements and the use of fibers in geotextiles.

The next chapter will deal with effect of polyester and synthetic fibers in general on the environment and how the general publics reactions to this new movement has pressured polyester into moving with the times. Also how various manufacturers and processors of polyester have had to evolve a new cultural awareness to market demands with regards to the society we live in and the environs that surround us.

CHAPTER 4

The previous chapter looked at new high technological developments relating to polyester. While these new innovations are taking place there is much debate on the effect of such fibers and their products on our environment. Within this chapter the effect that polyester and man made fibers have on the environment will be discussed. It will observe the reaction of the general public to synthetics and the results of the publics opinion on the image of unnatural fibers. It will cover the various misconceptions held by the public and how those misconceptions were cultivated. Also this chapter will explore the new polyester derivatives used in the maintaining and improvement of the environment.

The natural versus man made fiber and fabric debate has figured predominantly since the late 1960s backlash against the new plastic fibers of the era. Along with this argument is the contradictory views as to which fiber is better for the environment. The public was made aware of the different aspects of natural and man made fibers during the mid to late 60s. However it was in the 70s that attitudes started to favour natural fibers. The 1980s brought the publics concern for the environment to an all

time high, as an ever increasing number of reports from scientific organisations coupled with wide media coverage brought depictions of the depleciation of the worlds life support systems to the publics attention and motivated the general public to think about the products they bought and used and more importantly what they were made from.

Without a doubt the later half of the 1990s will be a period of considerable change with strong implications for the textile industries. The textiles products themselves will be altered as consumers preferences are affected by their increasing processes such as, deying and finishing and in the case of natural fibers cleaning.

A sudden focus in the late 1980s on the environmental issues produced a different response from the textile industry than that from the clothing and fashion industry. The textile industry addressed the environmental problems caused by the processing of textiles. Most companies had no option as legislation demanded stringent action [Watson, Textiles and the Environment, April 1991, pg.31]. The clothing industries concerns for the environment focused on the product itself, a far cry form the 50s marketing ploy of calling an item of clothing a 'polyester T-Shirt' and not just a T-

Shirt. There was a spate of 'green fashion' carried by the fashion magazine editors of the day. Some claimed their fashions were better for the environment because of the new processes involved. Most just adopted the ecology look as a point of style. In the short term they focused attention upon some of the problems such as polluted rivers and acid rain but few made significant contributions.

In addition, the media especially fashion, womens and environmental pages of newspapers and consumers magazines took up the cause, informing the consumer of the problems associated with textile production. Articles were often based on prejudice rather than fact, for example supporting this misconception that natural fibers are better for the environment, the result of this approach has led to the division between the producers of textiles on the one hand and the clothing industry on the other [Watson, Textile and the Environment, April 1990, pg.4].

The response of the clothing and fashion industry to environemntal awareness made the synthetic fiber producers out to be villains, in that it was the producers of textiles who did the polluting. This was partly true in that the processes did have an effect on the environment, fashion however specifies the end product, if non crease products are required

then those finishes are applied if thermoplastic properties of synthetics are needed for pleated designs then the fabrics are made available. Obviously a greater dialogue between clothing and textile industries are required to resolve these important environmental issues.

The ecology look of the mid 1980s came at an important time for the clothing industry, as the public became disillusioned with the overt consumerism of the early 1980s. The new colours were natural, undyed unbleached cottons and linens and the fabric handle was 'Natural'. The fabric had to look unprocessed. Changes within fashion and textiles often as stated in chapters 1 and 2 mirror changes within society. This was however transient, and immediate style interpretations were to be replaced by a style successor each demanding different fiber products from the textile producers. Although this rapidly changing trend is ultimately good for the retailer it provides no support for the textile producers who have to contend with the real issues of environmental control.

Due to expert marketing over the past decade consumers believe that natural fibers are best for the environment. Natural fibers biograde and are produced by agricultural processes which despite the

use of pesticides and fertilisers appear to be more environmentally friendly than the image of factories producing synthetics.

In pursuit of a neat answer to the question "which is the most environmentally friendly fiber?" the entire textile processs must be taken into account. Understandably, consumers do not have sufficient knowledge about the textile processes involved, therefore their judgements are based upon narrow and incomplete information, they have concluded that the best must be natural fibers. The industry knows that these conclusions are incorrect. Each producer within the textile industry defends its environmental creditability. Each group be it Natural, Synthetic or Man made fibre producers realise that they have to contend with environmentally damaging processes and when weighed no one fiber could be clearly stated as the ultimate environmentally friendly fiber.

Within the natural versus the synthetic debate the acceptance by consumers of natural fiber products as the environments most friendly fiber has been further enhanced by marketing which is fiber specific. Natural fiber especially wool, cotton and linen are marketed by international organisations. These organisations promotional campaigns usually

emphasise the inherent 'natural' qualities of the fibre. The following are two examples:

> "Wool is naturally soft when you need a gentle touch ... love from woolmark"
>
> [International Wool Secretariat Campaign 1990]
>
> "How to start the day, First rays from the sun,
> Juice from the Tropics, Cotton from America"
>
> [Cotton Council International Campaign 1990]

A corporate wholesomeness becomes associated with natural fiber groups. Often the assumption is that because these fibers are comfortable to wear, and natural they must be better for the environment. Conversely the marketing for man made fibers is brand specific, undertaken by individual fiber producers. The qualities which man made fibers now impart may not be fully realised by the public even though the term 'polyester' and nylon are familiar as they are clearly stated on clothing labels.

Synthetic Fiber brands have become associated with particular chemical companies, for example I.C.I. Ltd. and DuPont. With the current environmental concerns with the negative associations of chemical

companies in terms of their impact on the environment this has a knock on effect for their fiber products. It is assumed therefore that synthetics i.e. polyester must be bad for the environment. Yet no matter how strong the debate between natural and synthetic fibers the fact remains that life as we know it today could not exist without man made fibers. The use of textiles extends far beyond those for apparel and home furnishing markets. Over 21% of synthetic fiber production in the U.S.A. is for industrial end uses and 17% in Europe. As Figure 15 shows industrial polyester fiber encompasses a wide range of applications including tyres, safety belts, geotextiles and medical uses.

To question the uses of resources within the scope of man made fibers is paramount. Oil is one of the main substances in the manufacturing of polyester yet as shown in Figure 16 only 2 to 9 percent of oil is used in the production of synthetic fibres that includes polyester, polamides and acrylics. The biggest use of oil is for transport accounting for 45% of total world consumption. Another feature is that oil used for fiber production results in end products whereas most oil is burnt to produce energy, contributing significantly to the level of

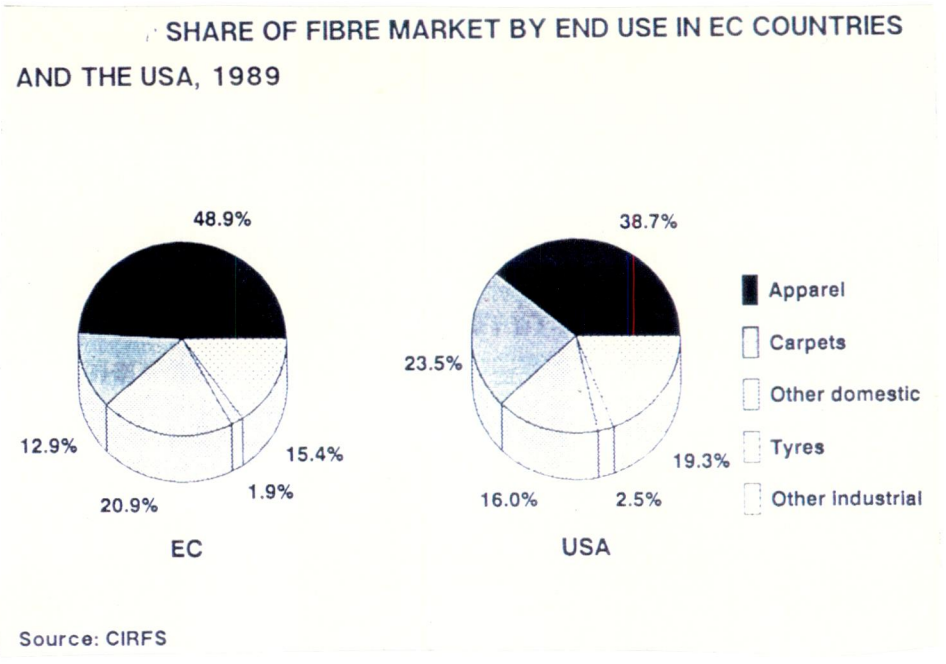

Figure 15 Share of Fiber Market by end use in E.E.C. Countries and the U.S.A. 1989

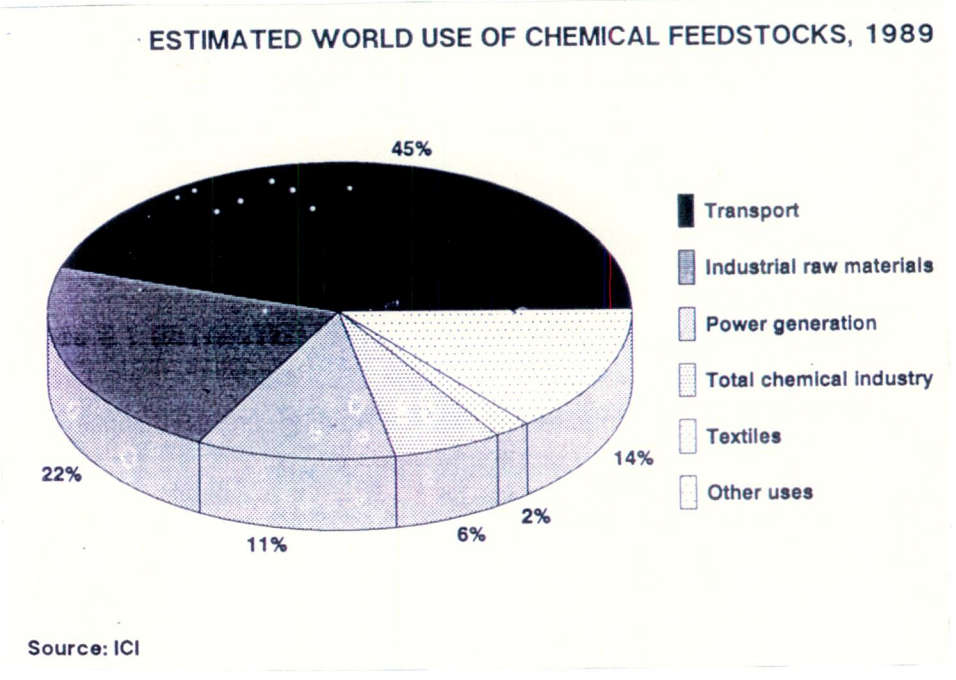

Figure 16 Estimated world use of Chemical Feedstocks 1989

carbon dioxide in the atmosphere, [Watson, Textiles and the Environment, April 1991, pg.17]

Natural fibers cotton, wool, linen and cellulose fibers all require large amounts of land for their production and two stages are involved prior to yarn production. Firstly the transportation of raw materials to processing plants and secondly the huge amounts of water in the cleaning and carding processes of raw materials. In the case of synthetic fiber for example polyester, polymer chips are melted down and subsequently extracted to form filaments. These can be wound as yarns or cut into staple fibers reading for carding without further processing. Natural fibers have to be processed from their natural raw state. Wool must be cleaned and degreased. Cotton has to be wasted, flax stems have to be retted to yield linen and the natural gum has to be removed from raw silk. In addition production of natural fibers and fiber processing are often conducted in separate locations. Processing is often undertaken outside of the fibers country of origin and in the case of wool processing may be on the other side of the world, adding to the amount of oil burnt in transport. Man made fibers tend to invoke negative associations but in most cases their production is relatively clean.

Polyester and polyamide fibers are melt spun and there is no effluent arising from their production.

Apart from the problems associated with the production of both natural and synthetic fibers neither of them are fully environmentally friendly. Observation of the life-span and relative waste disposal of these fiber shows that natural fibers biodegrade as do cellulosic man made fibers but the majority of man made synthetics do not. The association performance and characteristics of synthetics such as strength and durability are inherent in the product and remain so after their useful purpose is over, resulting in solid waste which is present for generations to come.

The book 'New Fibers' by Tatsuya Hongu speaks of the discovery of bacteria which produce polyester. This is no new thing as bacteria have produced polyester for several hundred million years. More than a hundred bacterial species are known to produce polyester and store it to use as an energy source in case of starvation. Scientists have discovered a way to cultivate these bacteria and extract the natural polyester. The polyester stored in the bacteria body can be extracted using organic solvents. Natural Polymers such as cellulose do not melt but natural polyester is exceptionally

thermoplastic and melts at about 180^{o}C. Therefore it can be moulded into any shape like any other synthetic polyester. The polyester producing bacteria also contains the 'polymerase enzyme' controlling polymerisation, thus bacterial polyester is biodegradable. It could be an important material in establishing a well balanced ecosystem since biopolyesters are biocompatible they find applications also in medicine. the surgical suture, gauze bandage or the material used to repair bone fractures or deficiencies made from bacterial polyester and causes no inflammation in the organs or tissues where they are applied. Since these bioplastics are optically active further applications may be anticipated in the field of optics and electronics. Bioplastic and Bacterial Polyester and Biodegradable and these materials can be decomposed by bacteria in sludge and soil [Hongu, New Fibers, pg.134]

Natural fibers are not wonder fibers at decomposing. It takes time for complete degradation as they require optimum conditions of moisture and warmth. Another drawback to natural fibers is that large quantities of wool in a landfill site will give off ammonia fume while decomposing.

Other recycling possibilities exists within the synthetic textile industry, for example, the plastic used in making bottles for soft drinks, mineral water etc. is P.E.T. By recycling these plastic bottles the P.E.T. is converted into chips which are remelted and spun into polyester. The resulting fibers are suitable for fillings in pillows and duvets, clothing and for manufacturing geotextiles. 170,000 tons a year of polyester is used in Western Europe to make plastic bottles. This compares with 450,000 tons of polyester staple fiber produced. If all the plastic bottles were recycled it would account for 30% of total polyester staple production. Converting plastic bottles for polyester fiber is currently undertaken by only a few companies. One such company is Wellman International based in Navan, Co. Meath, Ireland. They convert P.E.T. industrial waste and P.E.T. bottle scrap into polyester fibers. The company now processes over 50,000 tons per year 20% more than 10 years ago according to figures published in Textiles Horizons of June 1992 [Hearle, Textile Horizons, 1992, pg.27].

Wellman have developed special polyester fibers for use in upholstery to replace polyurethane from blocks. These specially developed fibers avoid the

flammability problems associated with polyurethane. They can also at the end of their life be recycled which is not possible with polyurethane. It is Wellman's opinion shown in promotional literature that polyester has the ideal opportunity to become the single fiber type for automative interior trim such as carpets, door panels, seat panels and boot linings. If such products were made from 100% polyester it would be readily recycled and this would go a long way towards activating the automotive industries objective of the totally recycleable car, [Hearle, Textile Horizons, 1992, pg.27]

Since the Tokyo Dome Stadium in Japan first used synthetic materials for its football ground, the artificial lawn is gradually replacing natural grass in football and baseball grounds in Japan. These artificial surfaces are made of nylon planted on to polyester mesh. Such applications of fibers fall into the category of geotextiles which includes fiber processed materials used in construction and building. The International Geotextile Society was established in 1982 to promote new applications of geotextiles, and in Japan the Geotextile Research Group started its activity in 1985 within The Society of Science and Technology. Most geotextile

materials are light, strong but cheap and mainly fabricated polyolefins, polyprophylene and polyester P.E.T.

Enka Co. Holland developed a railway sleeper bed using high modulus and good ultra violet resistant polyester fabrics. Enka claims that the use of this sleeper bed reduces the long-term deformation of rails. Woven knitted fabrics are commonly employed for draining. A polyester fabric bag filled with sand is used to drain water and so reclaim soft wet ground [Hongu, New Fibers, pg.196].

Hoechst AG, Germany have developed a polyester P.E.T. fabric wall, which costs only 30-40 percent of that of a conventional concrete wall. A cylindrical or pillow shaped knitted bag has been developed for bank protection. I.C.I. supplies polyester P.E.T. woven or knitted fabric sheets to cover sand banks and prevent wind erosion in dry areas [Hongu, New Fibers, 1990, pg.198]. These are only a few examples to demonstrate the rapidly expanding applications of geotextiles in maintaining of the environment as it is.

Polyester has a high value with regards to its wide variety of uses, in everything from High Street fashion, to surgeons gowns, car tyres and building

components. The list could go on and on with ever more improbable combinations of uses. From the 1960s companies concentrated on advanced materials such as carbon aramid and ceramic fiber aimed at aerospace and other small specialist markets. However for strength, stiffness and bulk at low costs, polyester is undoubtedly the best material. The combination of polyester fibers, polyester matrices and polyester adhesives provide 100 percent recycleable products.

This chapter has attempted to review the results of environmental awareness on polyester production and producers. It has discussed the effect that synthetic fibers have on the environment and the reaction of the textile industry to solving problems of environmental pollution. It also covers briefly the new uses found for polyester products some of which go some way to maintaining the environment. Obviously polyester cannot be dismissed as just a synthetic fiber. No fiber is truly environmentally friendly but polyester can and is utilized to conserve and improve the environment that we have today.

CONCLUSION:

The objective of this thesis was to study and analyse the presented information about polyester as a fiber and to argue a case in favour of it being an indispensable fiber today. Following its path of great heights through to polyesters virtual dismissal as a fiber in the seventies and early eighties and the steady acceptance once again of polyester within many industries not just the textile industry.

After much researching and reading about the history the innovations and the future of polyester I can only say that it is a truly modern fiber which has proved itself as strong, versatile, and indispensable in todays world.

Life today is influenced by synthetic fibers in one form or another, everything from the clothing we wear everyday to the very buildings we stand in and the cars we drive have polyester fibers and components within them. Todays living standards would not be possible without the breakthroughs and innovations which have occurred within the synthetic textile world.

Still the current perception by the general public of polyester is from distant memory ies of poor quality

fabric used in cheap uncomfortable garments produced some 30 years ago. This is slowly changing due to the new fiber developments of the Japanese throughout the 1980s which will surely filter through to the fashion markets here in Europe.

The future for polyester in my opinion is one of continued invention and success as more and more uses are found for this versatile fiber. With the earths natural resources fading the availability of recycleable polyester products will guarantee its use and popularity far into the future. Polyester is a fabric of the past, a fiber of the present and definitely a fiber and fabric for the future.

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