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Asian Light Fabric: Manufacture and Wearer Comfort

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Biographies

Gordon Dixon is currently a Visiting Professor. Retiring in June, 1997, Gordon Dixon's continues to make a contribution to MMU research. He is a life consultant to Taiwan County Government, and non-exec director of a technology company. Previously responsible at senior level for Information Technology research, the supervision of a large group of researchers, and an adviser on research supervision. He is also interested in developing higher education computing in Malaysia, a centre of excellence in design computing, and advising on graduate schools. Other academic interests included editing, expert systems for building commissioning, building layout planning, and literary and linguistic computing.

Tohing Tang has carried out textile research at Leeds University and Manchester Metropolitan University. His research at Hollings Faculty is entitled 'The influence of clothing fabric properties on thermal comfort'. He is an associate professor at the Institute of Organic and Polymeric Materials, Department of Molecular Science and Engineering, National Taipei University of Technology in Taiwan, where he is responsible for lecturing and research work in subjects related to textiles and clothing engineering. He has extensive experience of the textile industry having held a number of appointments as consultant for local textile mills. He is also a Fellow of the Chinese Institute of Textile Engineers.

Abstract

This paper describes an empirical investigation into the production systems and marketing strategies of a special type of textile, that of batik. The work is concerned with elements of garment manufacture, fashion, wearer comfort, and the characteristics of light fabrics. Evaluations of traditional woven fabric production and techniques, along with literature searches, were carried out. An industry profile is presented that includes aspects of traditional culture and fabric fashions. Computer measurements established precise characteristics influencing both clothing design and wear ability.

Keywords: production processes, batik painting, fashion, culture, wearer comfort analysis

1 Introduction

This work describes types of garment production processes, their management, fashion, associated wearer comfort, and the properties of light fabrics. Care was taken in the selection of test fabrics, eventually converging onto Malaysian batik which is considered by many to be a beautiful fabric. Traditional production processes and techniques are presented along with both the hand painting of batik and its fashion characteristics.

Identifying the location of factories and the selection of fabrics formed important stages in this work. Contact was made with Asian businesses and permissions obtained to visit their factories. The light fabric selected for this paper, Malaysian batik, is used for daily wear and as fashion wear, a point emphasised by Probst (1987) and Nakao (1987).

Many batik fabrics were found to be non-standard textiles. They were often made by numerous small-scale entrepreneurs who used traditional methods without modern production facilities. However, the results from this work have revealed just how complex and creative are the techniques being applied, as well as the importance of culture in marketing these fabrics.

2 Methods

In selecting fabrics for this study it was considered important to choose those that had been produced from traditional factory facilities. Therefore, fabrics were obtained on-site from local factories in Malaysia. One of the factories visited was Isah Batik (Penambang Hilir), a compact Malaysian batik factory, set among tropical trees on the north east coast. It consisted of a traditional production facility where fabrics were treated with wax and coloured, whilst in another part of the factory there were final dyeing troughs. To avoid colour loss through the effect of sunlight, the batik fabrics were laid out on trestles beneath the tree cover; this aspect of the effect of sun on colours was studied by Fianu and Adams (1998). Popular colours included earth-colours, such as crimson, gold, raw umber, black, ochre, sap green, red ochre, green, olive green, burnt umber, cyan, and orange. Such earth-colours were referred to by Von der Eltz (1988), Scarborough (1980), and in cultural terms by Ismail

(1989) and Rajab (2000). Isah Batik provided a fabric sample of each stage of the process. Specific attention was drawn to the 'cracking' features deemed to be an attractive feature in this traditionally hand-made product.

Another visit was to Rashidah's House of Exclusive Batik which provided an opportunity to observe hand painted batik. The results were in the form of elegant fabrics for fashion wear which was a feature discussed by Fein and Vasilopoulos (1988). Similar to Goldman's 1987 observations, flowers were depicted on female batik and in line with Hyink's 1987 comments, strong geometric patterns for males. No cracks were present in the normal range of products. When questioned about this departure from previously observed batik, Puan Rashidah said that if more resin was added to the wax then cracking could be induced. These hand painted batiks are not subjected to folding and dyeing rather they are hand painted throughout their manufacture. The background of hand painted batik is filled in by the application of colours by brush - for areas greater than two metres an extra charge is added due to the need for a team of painters to work together. Joshi (1983) reported on similar techniques as did Wax Works (1985). When completed, the colours were fixed by the application of a concentration of sodium silicate.

Additional test materials were obtained from the Penang batik factory of Craft Batik Sdn. Bhd., where the director, Quah Chin Choon, provided an original sample with the wax resist already on the fabric (similar to Francis and Sundara, 1988). The Penang company exports to the USA where acceptance of batik is dependent on standards certification on wearability. A laboratory in Singapore certifies that the batik meets such standards as tautness, colour fastness and dye reaction to the fibre. In the UK, one batik process includes an automatic batik wax applicator, where a large roller applies the wax; this was operating at Tootal-Brunschweiler in their Manchester factory. In Kuala Lumpur an opportunity was taken to view the work of the Infokraf Malaysia craft centre. Various techniques were described by Director Dato' Sulaiman Othman whose deep knowledge of batik proved very helpful in guiding this work. The craft centre exhibited a wide range of cultural objects including a selection of elegant Malaysian batiks, including batik scarves. To consolidate our understanding of the final processes, a visit was made to the Infokraf Malaysia Kota Baru fabric-testing laboratory.

Continuing searches led to the Kampung Penambang factory of A. Kamil Hj. Hussain being visited to observe Cik Minah's songkit weaving and to obtain samples. The factory was based on traditional manual weaving techniques - apart from the aid of a machine to automatically wind thread onto the shuttles. Pattern shafts were pre-structured on wooden base platforms, the width of the loom, with ties in position for the production of specific designs. A weaver worked on the weft producing the songkit whilst an assistant constantly followed the changes in pattern by inserting bamboo strips in between the wires of the warp; a larger piece of bamboo was used to divide each new combination selected by ties to the warp.

These small enterprises using traditional forms of production contrasted sharply with modern factory methods and techniques, such as cotton cleaning; carding; drawing-frames; air-spinners; warping; singeing; pre-shrinking; desizing; scouring; bleaching; also applying heat setting before dyeing, and curing after dyeing fabrics - with the enhancement of shininess and dimensional stability achieved through mercerising processes. In these systems, colour is applied by sophisticated eight or twelve colour printing processes. These processes can follow after weft-straightening and stentering have been carried out to ensure both wefts and warps are in parallel; special qualities to modern fabrics being added through resin finishing. In contrast, aspects of more traditional painting and fashion are presented below.

3.0 Production

From the work in Section Two it is clear that dentifying suitable factories and selecting fabrics had formed important stages in this work. Many of these fabrics were made by numerous small-scale entrepreneurs using traditional methods without modern production facilities. From an evaluation of traditional woven fabric production processes and techniques it became clear that many batik fabrics were not standard textiles

3.1 Painting

Hand painting is an elegant feature of batik production and there are many artists involved in this process. For example, Woermann in Textilkunst (1986) features the batik paintings and silkscreen prints of artist Baerbel Albermeier. Well-defined shapes and solidly contoured masses often distinguish her works. Also, J. Willach in

Textilkunst (1985) examined Brigitte Willach's batiks and provided photographs of her finished work. Furthermore, the batik business of Eliza van Zuylen, the largest in Pekalongan, Central Java, during the early 20th century, has been profiled by Raadt Apell in the Textile Museum Journal. These largely cotton garments and designs produced at her compound are described and characterised, and the batik process and dyes used are discussed. In 'Handpainted Textiles by Artist Craftsmen' Mihalik in Textilveredlung, indicates that to supplement existing classical hand dyeing procedures such as icat, plangi, tritik and batik, new dyeing and painting methods have been worked out. Resists with hydrocarbon/rubber solutions or wax, dyeing with cotton balls, and painting with brushes are mentioned. These processes provide novel possibilities, which among others led to the so-called neo batik technique. The application of dye types not used before result in novel patterning effects and a better quality of the print.

West German artist Ellen Goldman creates fantasy images based on plant motifs. They are painted in the batik method and are influenced by the flower paintings of Willy Fleur, and the batik work of Raden Suwondo Sudewo of Indonesia, among others. The work of Dorothy Caldwell, a Canadian textile artist who explores the rituals of myth and magic in her work, specialises in fabric printing and painting, batik and resist dyeing, stitchery, and quilting. She juxtaposes realistic and abstract images to create three-dimensional structures in a primitive, surreal style. In the USA, batik artist Ferril Nawir’s design collection features hand batiks on rayon, cotton, and silk. Each chapter of F. J. Kafka's book on 'Batik, Tie Dyeing, Stencilling, Silk Screen, Block Printing: The Hand Decoration of Fabrics', deals with a specific technique for the hand decoration of fabrics. Basic design considerations, the best materials and tools used for each technique, unusual effects with basic methods, and two/three colour processes are clearly explained. Step-by-step instructions are illustrated. Sarah Tucker’s book Batik (1999) describes designs for this fabric as an exciting art form in which vivid and original fabric designs are steadily built up by the repeated use of hot wax and dyes. She provides seven easy to understand step-by-step projects for beginners to follow and discover the fascination of this craft. Additionally, the 'Study of Graphic Batik having Artistic Effects' by M. Ihara in Sen-i Kako describes graphic batik with particular artistic effects. While the work of Joruba batik artist Nike Davies was described by K. M. Vas, and reviewed as the woman with an artist's brush by J. M. Borgatti (1997). In describing a rather unusual procedure, J. Scarborough in Fiberarts (1980) explains that the unconventional procedure for making 'Earth Batik' includes a waxed design on fabric, painting certain areas with food, waxing these areas, and partly burying the fabric in the earth for several months. When removed, the fabric is washed, the wax ironed out, and mounted.

3.2. Fashion

Fashion has been an inherent feature in the manufacture of batik for many years; much of the production of these fabrics is targeted towards the fashion market. Although artistic designs are varied, there arises a need to sense the demands of the fashion market and to produce new fabrics for that market. A great deal of the literature describing batik processes, and depicting batik as an important fashion product, can be found in the 1970s and 1980s. According to Clark (1977) The wearing of expensive wax prints is regarded as a status symbol in West Africa, and with growing prosperity the demand for them is expected to increase. H. Livingston, Jr., in The Daily News Record (October, 1983), discussed fashion trends in the men's wear market for spring 1984 with reference to themes and variations. For example the use of combined fabrics, such as cotton with ramie, with rubber or batik prints, or with madras, and experimental fabrics, such as oil-coated and pigment-washed cloths for apparel and home fabrics.

In the Australian Textile Journal (1981), An Huef provides technical information on the production of fancy fabrics using batik dyeing resist printing azo dyes, fabrics, pattern application, resisting agents and waxes. Further, L. Flower wrote a book that presents an overview of the teaching of textile production at Berkshire College of Art and Design (the college has merged with the Reading College of Arts and Technology). For students following courses in art and design at any level, this book relates the elements of good design to the various techniques of fabric production. The introductory chapters refer to the work of artists in different fields and to the discovery of new designs. The technical chapters which follow deal with printing, fabric painting, air-brushing, dyeing, batik and tie-dye techniques, with practical step-by-step guidance; there is a list of UK suppliers of equipment and materials (including fabrics).

A report by Von Kempski in Textilkunst (Sep., 1987) features the works of Joachim Blank, a West German art student who travelled extensively in the Far East. Blank uses impressionistic styles to depict scenes of southern Europe, Turkey, and Indonesia, executing these works with batik on silk. Another artistic approach combines two textile concepts by making textile works based on quiltwork patterns using triangular pieces from Japanese batik patterns. The careful placement of pieces create patterns within the patterns, due to the intricacy of the batik fabrics - this was reported by I. Holz in Textilkunst (Dec. 1987). A Daily News Record report (Dec. 14, 1987) by L. Fein and V. Vasilopoulos, profiled the neckwear and accessories market for spring. Dominant trends included elegant woven ties, silk crepe fabric, small, hand-blocked neat patterns, and suiting patterns. Casual ties were said to be appearing in silk, linen, seersucker, batik, or stonewashed cotton. The width is three and a half inches with a bottleneck shape that ties into a smaller knot. Accessories such as hats, glasses, suspenders and braces, cuff links, and tie clips are also discussed. In leather goods, texture is the salient feature.

F. Stuart in the Daily News Record (Feb. 2, 1987) previewed new print fabric patterns. Marble effect, batik looks, abstract patterns, and patterns based on the Monopoly board game are among the newly popular designs. A preview of summer wear for children was presented by 'Sunny Side Up' in Y For The Young (Jan. 1987). Colours were said to be bright and cheerful in all styles from beachwear to party dresses. The season's line-up included new varieties of prints, such as people patterns, tie-dye, batik, jungle, and dinosaur images. Various fashions from different manufacturers are featured. 'The Boxer Rebellion' in Body Fashions/Intimate Apparel (Aug. 1986), featured the boxer set, as a fashion item for women. The boxer is feminised by bold florals or made ethnic through batik. In a market that is romancing shorts, boxers are said to be perfect for multipurpose dressing. F. Stuart's report 'Wild Ones' in The Magazine (Aug. 1986) predicted that sporty, tropical prints featuring fruits, flowers, and birds in brightly coloured batik, looks to be big sellers for Spring. Colour photographs show designs from Hampton, Crantex, and Lida.

The combination of Java batik look textiles and papers for guest room decoration is presented by F. Dirala in 'Guest Room in the Java Batik Look', Fussboden Zeitung (July/Aug. 1985). Design principles are also discussed. Furthermore, in 'Tambal -

Javanese Patchwork in Batik Technique' by A. Haake Textilkunst (Sept. 1984), the batik of Ibu Sunardi is presented as an example of traditional folk art successfully blending with modern techniques without denying its cultural heritage. Sunardi uses the patchwork technique of American quilts to make traditional Javanese ceremonial costumes. Other techniques are reviewed anonymously in Fabric of Enhancement: Batik of the North Coast of Java (1999). In Creative Batik (Rosi Robinson, 2001), Rosi shows how to create a range of beautiful batik designs, patterns and pictures using a series of innovative step-by-step projects. Many different techniques are explored, such as from making simple marks and drawing with wax, to dipping and painting with dyes, etching, cracking, and discharging. Unlike Malaysian designs, her pictures are principally figurative.

4.0 Thermal comfort and wearability

Comfort and wearability are important factors with lightweight materials, such as men's shirts, women's dresses and outdoor leisure wear. So is the maintenance of body temperature within relatively small limits which is known to have the most direct effect on the wearer's physical and mental condition. Under conditions where the thermal comfort cannot be achieved by a person's own ability, appropriate clothing must be worn to support temperature regulation by resisting or facilitating the heat exchange between the body and the environment.

4.1 Clothing comfort

Clothing protects from cold or heat to maintain body thermal comfort throughout the full range of human activities. The design of clothing related to comfort deals with an emotional or effective experience. According to the CIBSE Guide, thermal comfort depends on four variables in the environment: air temperature, mean radiant temperature, mean relative air velocity and ambient humidity, although the last of these is often ignored. Heat can be transferred within apparel in the forms of conduction, convection, radiation and latent heat transfer by moisture transport. Conduction, convection and radiation are dominated by the temperature difference between the skin surface and the environment, and are therefore grouped as dry heat transfer. On the other hand, latent heat transfer is achieved by moisture transmission related to water vapour pressure between the skin surface and the environment.

These modes of heat transfer are naturally affected by the geometry of human bodies. Fan (1989) stated that heat transfer is also affected by the body's skin temperature, skin wetness and body movement, the conditions of environment such as wind, radiation, temperature and humidity, and the physical properties of clothing and its constituents.

In colder climates, according to different design and fit of the clothing, the air gaps between layers of fabrics and openings around the body will result in different effects on thermal efficiency. It was reported by Keighley (1985), that as much as 75% of total heat can be lost through openings at the places like the neck, the waist, the wrists and ankles by bellows action when the body is moving in windy conditions. Taylor (1990) noted that this heat loss can be reduced for well designed and fitted clothing. Fabrics contain still air entrapped between the fibres, and this air is a very poor conductor of heat. Thus the greater the volume of air space in a fabric, the better it is as an insulator of heat. Therefore, fabric with such a material or structure that entrap a high proportion of air will be suitable for cold conditions. In the dry state the thermal conductivity of natural and synthetic fibres are about the same, but Schneider and Hoschke (1992) point out that because of the natural fibres' capacity to absorb moisture, an increase in relative humidity will cause their thermal conductivity to increase.

When latent heat transfer is important for thermal comfort, the water-vapour permeability is of particular interest for clothing material. The magnitude of the permeability depends on the size and length of the pores in the fabric structure and the nature of the fibres. It has been universally agreed that the thermal insulation of clothing materials are proportional to their thickness. On this basis, the compression of clothing materials will reduce the thermal insulation due to the loss of thickness. Mak (1980) found that the rate of reduction of thermal insulation with increasing pressure was the maximum at the lowest pressure, and minimal at the highest pressure. According to Miller (1992), cotton woven fabrics have been widely used to make shirts due to their good resistance to abrasion, very good absorbency and soft, cool to touch characteristics. Cotton/polyester woven fabrics also provide good shirt making materials for their better strength and easy-care properties. Apparel International reported that microfibre (the term used to describe fibres or filaments of approximately 1.0 dtex or less) fabrics have been produced for elegant sportswear, outwear and fashion apparel.

4.2 Fabric characteristics

This study benefits from reactions to concerns that were being expressed more than twenty years ago about the lack of objective fabric measurement standardisation. Kawabata (1980) commented: ‘standards are assessed from judgements of experts who do not agree’. These concerns had become a critical factor in the interface between the clothing and textile industries. The result was international collaboration, in particular between Australian and Japanese associations. Objective measurement of fabrics became the subject of many studies and conferences.

A research leader in this field was Sueo Kawabata. He developed a testing device that within 10 years was to become a standard textile test facility around the world. According to Kawabata et al. (1982) and Postle (1984) the Kawabata Evaluation System (KES) - used to analyse the batik in this paper - is a sophisticated computer testing facility that enables a variety of fabric tests to be carried out. Australian research also led to the development of a testing device called Fabric Assurance by Simple Testing (FAST). The FAST system uses standard fabric strips 5cm long whereas the Kawabata system uses 20cm x 20cm strips (16 parameters describe a fabric’s mechanical and surface properties). There are wet and dry stages. Agreed quantitative tolerances are now in place. These timely developments coincided with an increase in the level of automation which demanded prediction and control of fabric behaviour during production (Dobner, 1989).

Many fabric testing facilities exist in Asia. Observations were made during academic activities in Malaysia (Kota Baru fabric testing laboratory), Hong Kong and Taiwan. At the Hong Kong Polytechnic University, Institute of Textiles and Clothing, comparative objective measurements of fabrics were observed that used both Kawabata and FAST systems. In Taiwan, facilities exist at the National Taiwan University of Technology where a FAST system is installed. There was a strong association with the China Textile Institute, which has both FAST and Kawabata systems, and also an environment chamber for analysing the performance of fabrics fitted to instrumented manikins. The general opinion was that recorded FAST data could be swiftly applied to commercial production, but the Kawabata system was said to be an ideal laboratory tool and a precise factory testing facility.

4.3 Identifying properties

The process of analysing fabrics has changed both in terms of the technology available, the production requirements, and the needs of the market. At the same time advanced computer developments have been made which are associated mainly with gaining a fuller understanding of fabric properties. Previous literature related to wearer comfort and fabric properties established the ‘state of the art’ in this field.

Fabric analysis is known to be complex, so too are the needs of modern production units in order to swiftly process basic fabrics into marketable products. Therefore, analysis systems should output results in a way that is meaningful to experts in the field, and also comprehensible to others (Kawabata, 1989). The main advantages are seen to be in the analysis system’s positive contribution to a better understanding of this problem area, its value to the profession through updating of the fabric knowledge base, its clear potential for contributing to the avoidance of production problems, and increasing wearer satisfaction. This activity has led to many improvements in the process. It is possible that new insights will be identified, which might be of significance, as analysis systems become indispensable.

Using a Kawabata Evaluation System, computer analysis was carried out on the batik obtained from Malaysia at Hollings Faculty, Manchester Metropolitan University. The KES system enabled characteristics of the fabric to be obtained by the application of differing tests measuring mechanical and surface properties. The properties described in these tests are of importance not only in the identification of the scientific elements of the feel or 'handle' of fabrics, but also to fabric manufacture and use (Matsudaira, 1994).

Before batik is worn the wax is normally removed in the production process, however, on occasions the wax is specifically retained as a fashion element. Therefore, tests were carried out on both types of fabric. These tests included Tensile, Bending, Shear, Lateral Compression, and Surface Characteristics, the results of which were sufficient to describe the fabric’s mechanical and surface properties. To ensure accurate measurement, calibration of each unit was conducted prior to testing the fabrics. There were 16 tests, all carried out on 20 x 20 cm. slips of dyed and waxed fabrics. In testing surface properties across a fabric, four were made in the warp direction and four in the weft direction, and then the mean was found.

The results were interesting: Tensile established the main tensile linearity was fairly easy to extend, therefore, the force needed to extend the fabric is quite low. Bending determined there was a higher bending. Shear found that this kind of fabric was similar to interlinings which are bonded and do not have fibres that move easily – they do not tend to shear but in fact buckle. Compression tests found that medium compressible energy was needed to compress the fabric, a result similar to a UK women's thin dress fabric. Surface tests of raw cotton would normally find a higher than normal friction value, but the cracking effect produced surface roughness which lead to a lot more friction and slightly higher roughness.

Variation of measurements occurred within each test. These were probably due to various surface properties across the fabric caused by wax residue, paint/dye type, and penetration. The variability therefore depended on where exactly the cloth is measured. Tests were carried out on the effect of wax and the effect of dye in different areas of the fabric with different consistencies being observed. The wax probably gave a distorted result in surface roughness as the fabric felt rougher than the results indicated.

Appreciation is given to the Department of Clothing Design and Technology, Hollings Faculty, for allowing these tests to be undertaken on their KES computer system.

5. Marketing

Marketing is inherent in the structure of this industry, which is managed in the main by numerous local entrepreneurs, producing in small factories, with local outlets. However, results have revealed the complex and creative techniques that are being applied, as well as the importance of culture in marketing these fabrics. Producers of traditional fabrics are forming collaborative arrangements, and attempting to gain a foothold in economic opportunities in the West with competitively-priced goods.

5.1 Batik support

This traditional technique lacks a strong literature due to many reasons. One aspect is the fact that this form of manufacture is often based in developing countries where publication is not well established. Khanna (2001) explains such experience as set out in reports of the World Health Organisation workshops, for example concerning the World Batik Special Programme.

There is a Batik Guild that was formed in 1986 by a small group of batik artists and now have hundreds of members. The Guild aims to promote and improve education in the field of batik, and encourages and supports its members as individual artists or craftspeople. The Art of Batik (1999) is the Batik Guild's own publication which provides an informative introduction to the art of batik, designed with school teachers and students in mind. It includes eighteen loose-leaf colour pages covering equipment and materials, the traditional batik method, alternative and contemporary batik methods, safe workshop practice, the history of batik, batik teachers, and a list of batik suppliers.

Also, there was an exhibition in Gent, Belgium, that featured batiks of all styles from 47 of the world's top contemporary batik artists, from Australia, Austria, Belgium, Burkina Faso, Chile, China, England, Estonia, Germany, India, Indonesia, Ireland, Japan, Republic of Moldova, Russia, Spain, and the United States. As editor, Rita Trefois (1999) produced the Wax Cracks Catalogue of this Gent 'Now & Then' International Batik Gathering.

The Shirley Institute in the United Kingdom has been active in the field of textiles research for more than 80 years and produces many informative and technical documents. A Technical Information Document by the BTTG (a merger of the Wool Industry Research Institute and the Shirley Institute) described the production of novelty coloured effects of the batik type. These colour-printing systems were on hanks (Colorama) and the dyeing was only in parts of cones (Robotrama). Today, BTTG is still concerned with providing an independent research service and evaluations of technology. Within BTTG, Shirley is active along with Wiratec, BCTC, BTTG Certification, Training, Spinning and Nonwovens, and Quality and Innovation. http://www.bttg.co.uk

5.2. Environments

In colder climates where the target is to retain heat, according to Fanger (1982), thermal insulation and ventilation capacity of clothing are the most important properties concerning thermal comfort. Though both these properties are needed for winter clothing, it is difficult to obtain clothing with both good thermal insulation and good ventilation because clothing with good ventilation capacity has little thermal insulation and vice versa. Ventilation capacity is affected by both air permeability of a clothing material and openings in the clothing, particularly at the lower hem of female dresses. The ventilation of the clothing microclimate is vital to the removal of sensible and insensible heat and, therefore, an important determinant of thermal comfort.

Banhidi (1993) carried out thermal comfort investigations in Hungary with humans and thermal manikins. Measurements were made of the following: comparison of different heating systems from the point of view of thermal comfort, energy consumption and local discomfort; comparison of different heat and sunshine protection formulations; determination of acceptable temperature for different activities; checking different kinds of ventilation; examination of the thermal comfort conditions of disabled persons; and determination of different values for clothing. Pascoe et al. (1994) pointed to the fact that human thermoregulation is variable and modified by heat transfer interactions between skin surface area, clothing and environment. Much of the original research on the influence of clothing on work performance was the result of ergonomic concerns. Currently, the importance of clothing and the influence of new clothing technology aimed at minimising thermal stress are generating new interest.

Another aspect of comfort and energy balance is the water vapour transport characteristics of clothing materials. The most common techniques include guarded hot plate sweating skin simulants and cup-type moisture vapour transmission rate tests. According to Gibson (1992), theoretically, all such tests measure an identical property, water vapour resistance, but the results from different test methods rarely agree. The reasons for the discrepancies were said to be the different conditions present in each test: in some cases the intrinsic properties of the materials are altered by the test conditions. Three studies carried out by Gibson illustrated important factors to be considered when evaluating the thermal and moisture vapour transport properties of textile materials. The first study involved an experimental correlation between two kinds of water vapour permeability tests. The second study looked at the influence of air permeability on heat and water vapour transport through woven and nonwoven fabrics. The final study determined the agreement between three different guarded hot plate (sweating skin simulant) test facilities that differ mainly in the air velocity over the test samples. In a cold climates, the wearer must balance the need for a clothing barrier for warmth with the potential for accumulating too much heat as the result of metabolic heat production from exercise. To counteract this potential problem, it is suggested that cold-weather clothing be worn in layers that can be removed during exercise and replaced during less active periods.

However, this paper concentrates on fabric worn in Asia, that of batik, which has led to a closer examination of studies related to clothing for warmer climates. Such as the Ha, Tokura and Yamashita (1995) study on females in Japan. This study was concerned with the effects of clothing made from hydrophobic and hydrophilic fabrics on the sweating physiology in environmental conditions where only the mechanisms of wet heat loss could occur. Six female students, aged from 21 to 28 years, served as subjects. The subjects wore clothing made from either polyester (E) or cotton (C) fabric and rested quietly for 60 minutes in a chair mounted on the bed scale under the influences of environmental conditions of 37 degrees C and 60% relative humidity with an air velocity of 0.1 m $s^{-(1).}$ A comparison was made of the local sweat rates from the forearm and their related physiological parameters between each clothing at an ambient temperature of 37 degrees C. Their major conclusions were reported as: 1) local sweat rates were distinctly higher in E than in C in five out of six female subjects, 2) clothing surface temperatures at the chest level were significantly higher in C than in E, 3) the positive relationship between local sweat rates and mean skin temperature over bar ambient temperature existed both in E and in C. The local sweat rates were mostly higher in E under the influences of the same ambient temperature. They concluded that the different properties of moisture absorbency between E and C could play a role for sweating physiology in the environmental conditions where only the mechanism of wet heat loss could occur.

Another study in Japan by Jeong and Tokura (1993), studied the effects of different types of clothing on body temperature with six healthy male subjects in a supine posture. Clothing type A covered the whole body area with garments except the face (1.97 do) and B covered only the trunk and the upper half of the extremities with garments (1.53 do). The do is a measure of the resistance to heat transfer by clothing and is expressed relative to units of thermal insulation. The experiment was carried out in a climatic chamber at 55%+/-5% relative humidity under cooling and warming temperatures: the temperature was changed from 22 degrees C to 10 degrees C (cooling) and returned to 22 degrees C again (warming). Thermal comfort appeared to be influenced more by the rate of skin temperature change than by the level of skin temperature. By comparing derived do values with Heat Index values and windchill for the same data sets, relationships were obtained. The do is a single index that is applicable to all seasons. It provides a guide to relative comfort and can serve as a climatic seasonal clothing index.

Budd et al. (1997) used a climatic chamber to compare light, heavy, and encapsulating clothing during 60 minutes of moderate exercise (energy expenditure 382-464 W) in warm, dry conditions with no added radiant heat (air and mean radiant temperature 30 degrees C, relative humidity 33%, air velocity 0.5 m $s^{(-1)}$). Their results showed that high insulation and reduced ventilation restricted the evaporation of sweat and thus hindered the dissipation of metabolic heat. These adverse effects were apparent in: 1) a reduced cooling efficiency of sweat and hence a higher sweat rate; 2) increased heat storage, cardiovascular strain, discomfort, and fatigue; and 3) a failure to attain thermal equilibrium even after 60 minutes of work. Shigaki et al. (1993) developed a new type of simulator to observe the humidity fluctuation of clothing microclimates. A quick rise and fall in the surface temperature of cotton fabric was observed under rapid fluctuations of the microclimate humidity. However, under the same humidity fluctuations, the temperature of polyester fabric rose and fell more moderately than that of cotton fabrics. They concluded that the rapid and large changes in the fabric temperature against the skin, which were observed especially for hygroscopic cotton fabric, must affect the thermal comfort of clothing.

For hot climates, new fabrics have been developed with improved wicking properties to keep the wearer cooler and drier, and to enhance heat transfer from the body while providing greater comfort; light colours, particularly white, are often preferred. In contrast, the challenge of cold environments requires clothing to minimise the free movement of air and water along the skin surface of the body. The materials used should also be able to absorb radiant heat from the environment and be non-conductive.

6. Conclusions

The work presented in this paper relates to types of garment production processes, their management, fashion, associated wearer comfort, and the properties of light fabrics. Environmental conditions are important for such studies in relation to both clothing design and the marketing of fashion products. It was necessary to take care in the selection of test fabrics, a process that eventually converged onto Malaysian batik. Traditional production processes and techniques have been described along with both the hand painting of batik and its fashion characteristics. The work of many artists established a cultural as well as a dynamic feature of the art and craft involved.

The Malaysian batik under test was traditionally made and this is reflected in the results. These tests identified the fabric as being made to be worn as a loose garment and could provide comfortable clothing for the wearer. It is not suitable for extensive sewing. The medium compressible energy recorded compares well with women's thin dress fabrics which, similar to this batik, do not shear easily. These results fit in well with continuing studies into comfort factors associated with shirt fabrics and lightweight leisure wear.

Batik was found to be a desirable traditional and cultural fashion-wear fabric for males and females. Clearly, modern production facilities exist in which multi-colour roller printing replaces traditional processes. However, there is a fashion-marketing factor that presents original manufacture, earth colours, and wax cracking effect imperfections, as elements of superior batik fabrics.

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