LIST OF SAMPLE SHEETS

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3(a)	Dyed knitted fabric samples (Soya 70: Merino 30)

INTRODUCTION

Chapter-1
INTRODUCTION

Humankind is increasingly becoming aware of the world's limit of dwindling fossil fuels and raw materials. They have started questioning the first phase of industrial manufacture that saw materials as cheap and endlessly renewable and fashion as primary stimulant to demand. Keeping in view the potentially harmful effects of textile industry on the environment today textile companies are ready to work within strict guidelines with ecology often being a main concern. The future of textiles lies in the development of new fibres and fabrics. Recent advances have been truly innovative where aesthetics is as important as performance. The needs of the consumer and the environment are being more closely considered with textiles being developed from renewable sources and manufactured with minimum impact on the environment (Clarke *et al,* 2007).

Since 21st century, the 'green' consumption of world has risen rapidly and the eco-textiles have become the developing trend of the textile industry. There is a need to save non-renewable energy and adequately employ the existing natural resources which leads to exploration of various unconventional sources. The new environmental plant fibres have broad scope for development and have good market potential. Plant fibre is one of the most abundant polymer materials in nature. With rapidly developing raw materials of textile industry and continuously improving science and technology, on one hand new environmental fibres can be developed by exploring nature; on the other hand new environmental fibres can be developed by recycling the agricultural waste (Wang, 2009).

Soyabean is a new vegetable based fibre. Soyabean fibre is a kind of reproducible plant protein fibre, which uses the residual cake after oil is extracted from the Soyabean. High polymer from soyabean cake is extracted and protein spinning solution of a certain concentration is prepared. After obtaining the spinning solution, a filament bundle of a single fibre 0.9-3.0 dtex is spun with the use of the

wet- spinning process (Li-yi-you, 2004). It is an eco- friendly fibre using in-exhaustible natural resource as raw material.

Soyabean fibre was discovered in 1937 by Henry Ford and was called Soy wool. This unique fibre was used in car upholstery at that time, but the fibre became victim to the Second World War. Moreover, the introduction of petroleum-based fibres during the 40's and 50's, which were cheaper to produce, transformed the commercial aspect of Soyabean fibres. The fibre was re-discovered in 1998 and promoted as an eco-fibre in 2000. Due to economic and environmental issues, soyabean fibres are considered a competitive material in the textile industry.

This technical achievement is being considered as truly original and innovative. The invention of soyabean fibre is the contribution of mankind to the protection of resources, care of environment, and the consideration of the global balance. Soyaprotein fibre is only botanic protein fibre in the world, a newly born guard to the mankind's skin. It is also known as "Vegetable cashmere"or Soy silk. The fabric made of this fibre can give cashmere like soft hand, silk like sheen, cotton like moisture absorption and wool like warmth (Janarathanan, 2013). Because its major raw materials come from natural soyabean cake, the quantity of raw material is large and can be readily regenerated. Furthermore, it will not cause waste development. It is plentiful in supply and cheap. Although price of petroleum increased 21 times over last 50 years, the price of soyabean expanded only 6.5 times (Vynias, 2006).

Because the auxiliary and additional agents and materials used are not poisonous, the semi finished fibres can be recovered of most additional agents and used again and the residue remaining after purification of protein can be used as food stuff. Therefore, its production course will not cause pollution to the environment and complies completely with environmental requirements. Another way to look it is like using 'recycled paper' turning waste into useful things thus greatly condensing impact on environment. It is part of an attempt moving consumers away from petrochemical textile products and turning waste into useful products (Vynias, 2011).

Characteristics of Soyabean Fibre

The fabric made of soyabean protein fibre exhibits the sheen of real silk. Its drape ability is also good providing a sense of elegance. The textile, which is woven with high-count soyabean yarn, has fine and clear grain which is highly suitable for the high-grade fabric for shirts (Huppert, 1944).

The knitted fabric of soyabean protein fibre is thin, light in weight and; has a soft and smooth texture similar to that of blended fabric of real silk and pashmina. Its moisture absorption property is equivalent to cotton and its air permeability is much better than cotton, providing comfort and health to the wearer (Kajita, 1940).

The natural color of soyabean protein fibre is light yellow, similar to the color of oak silk. It can be dyed with acid or reactive dye stuffs. Particularly when it is dyed with reactive dyestuff, its color looks fresh and lustrous. Its dyeing property and fastness is better than that of real silk products.

The tensile strength of the single soyabean protein fibre is over 3.0 CN dtex, which is higher than that of wool, cotton and silk and only lower than that of polyester fibre of high intension. But now, 1.27 dtex fibres can be spun into 6 dtex yarn with excellent quality, which can be used for high-quality and high-density fabrics. Moreover, the fabric of soyabean protein fibre shows excellent crease recovery. It is easily washable and dries very fast (Lewin, 1985).

It has been praised locally and internationally by industry experts as healthy and comfortable fibre of the 21st century (Petersen, 1983). The reason is that soyabean protein fibre has antibacterial properties that resist coli bacillus, staphylococcus aurous and candica albicans. It contains 18 amino acids which can activate the collagen protein in the skin that resists tickling and evaporates moisture from the skin thus it is very much beneficial to the human body.

Its anti-ultraviolet property is superior to cotton fibre and much more superior to viscose and silk. The absorption of ultraviolet radiation could reach up to 99.7 per cent. The emissivity of far-infrared could reach up to 87 per cent and it performs the function of heat-effect, promoting micro circulation of skin and

enforcing the immunity, etc. The fabrics made from soya protein fibre and linen or other fibres are ideal for functional underwear and summer wear.

Rationale of the Study

Considering the danger to the planet with unmindful human activities, there is urgent need for development of effective and more sustainable eco-friendly solutions. Since the industrial revolution, the demand for fabric has grown and some sources such as cotton, are now so over used that their current production levels cannot continue without severe consequences. The alternative fibres, such as soyabean, are sustainable and don't need chemicals to grow adequately. The soyabean protein fibre is high grade fibre for textile which is developed with new bio-engineering technology. As introduced by Li Guanqi, the pioneer of this technology, 100 kg of Soyabean fibre can be extracted from 40 kg of protein. The cost of the derived protein fibre is only one-third of real silk or one-fifteenth of cashmere. Although natural protein fibres such as wool and silk have good physical properties and have been used widely in the textile industry, they are relatively costly to use and process. In silk, a large quantity of mulberry leaves is required for the production of a small quantity of silk. Moreover, animal fibres are physically limited in several aspects. First, fibres vary in diameter and their performance profile is limited. Secondly, morphologically, the presence of scales on wool surface results in felting shrinkage. Soyabean fibre with structure and performance properties comparable to other natural fibres is applicable for various high quality fibrous applications. In addition, it reduces dependency on land and the other resources which are required to produce fibres and compete in terms of cost and availability with currently available fibres. The attempts to use by-product of a major food crop as a source for fibres is important, since the growing population will require more efficient land to use in order to feed and clothe people in the poorer parts of the world. Therefore, soyabean fibre shows greater promise in providing large quantities of natural protein fibres with significant economic benefits than any other agricultural by-product.

Researches conducted so far have shown that it is possible to use the 100% soyabean fibre in yarns. The soyabean fibre is compatible in blends with other fibres and is not commonly used on its own. In blends with pashmina, it improves hand

and drape qualities, giving an exceptional shine to the product and helping to decrease rubbing/pilling propensity. Soyabean fibre has been typically blended with other fibres such as organic cotton or spandex to produce garments that feel and look good. Blending with silk prevents the fabric from clinging to the skin. Its stain resistance and moisture permeability improves. In blend with cotton the luster of resultant fabric enhances and drape improves. The fabric is more moisture permeable and dries quicker. It enhances the luster, comfort, drape and ant-pilling properties of cashmere resulting in smooth quality and easier care and lowering in the cost of cashmere. Because of Soyabean fibre's unique softness and absorbency, it is wonderful to wear close to the skin and is ideal for children's and babies clothes.

Keeping in view the improvement in performance of fabrics produced from blend of soyabean with other fibres viz. cotton, silk, cashmere, present study has been planned to explore the possibility of blending soyabean fibre with wool with the aim to produce blended yarn and fabric of improved quality.

In the past years diversity has become a buzz word in polite and educated societies and has become a synonym for originality and sustainability – pushing us to put aside conventional, and find new things. But when it comes to textiles, diversity has become more a necessity than a trend.

An industry cannot survive completely upon a monotonous range of products especially in textile sector which is very much demand provoked. Consumer is the king of market and strategies to capture the market spins around taste of consumer. Fashion conscious customer of today always chase for novelty in ideas and products. The product diversification is the key word in this era of cut- throat competition. The possibilities are countless while the approach needs to be defined. Blending is one such approach which has many advantages. Development of blends is a highly creative task combining the art and science of creation in an effort to balance functionality with innovation.

Fibre blending has been a common practice in the textile industry that can achieve quality products and which cannot be accomplished using one fibre type alone. It can also curtail the cost by substituting a less expensive fibre for more

costly one. Blending helps in better use of functional properties of composition fibre in blended yarns. One can produce very useful yarns and fabric by blending fibres of different origin or with different fibre of same origin possessing different properties. There is no perfect fibre. All fibres have good and poor characteristics. Blending enables the technician to combine fibres so that the good qualities are emphasised and poor qualities are minimized (Gulrajani, 1985).

Among the different kind of animal fibres used by textile industry, wool from sheep is commercially most important. Due to its inherent unique properties, wool plays a crucial role in textile industry and is ideal for numerous applications in apparels, interior and other uses.

Wool is a soft, weak, resilient fibre. It is a crimped, fine to thick, regular fibre (Gohl, 1983). Density of wool fibre is about 1.30-1.32 g/cc, the luster of wool is medium, unless finishes have been added (Hess, 1979). Wool has a tenacity of 1.0-1.7 g/d in dry state and 0.8-1.6 g/d in wet state. Wool is a weak fibre when compared with another fibre, points out (Joseph, 1986). He further adds that wool fibres have a slightly elliptical shape, with a natural crimp and a built in -waviness which accounts for elasticity and elongation properties.

According to Trotman (1982), wool has excellent elasticity and extensibility and can extend up to 20-40% with a recovery of 99%. Wool fibres are hygroscopic, absorbing water from a moist atmosphere in a reversible way, due to which it can readily absorb and release moisture contributing to the wearing comfort in garments.

Corbman (1985) remarks that wool is a wonderful insulator against noise and its ability to absorb moisture prevent a build-up static electricity and therefore, it does not cling to the body. Wool is a flame resistant, dirt resistant fibre and keeps its good appearance for a long time (Hollen, 1973).

According to WTO (2009), wool is '100% natural, renewable and sustainable.' Wool is a preferred fibre for the consumers in all relevant application areas' and as fibre of choice for 'Guaranteeing the maximum of safety and health for its users'.

However, one of the major drawbacks of wool fibre is felting. When wool, in a wet state, is submitted to any form of mechanical action which applies alternate compression and relaxation, it felts. The phenomenon consists of individual fibres packing themselves closer and closer together, until what was originally a comparatively soft structure becomes a hard mass of interlocking fibres. This tendency of wool to felt is a disadvantage for woolen articles of clothing that require frequent laundering (Trotman, 1984).

Wool felts because of the serrated surface of its fibres which is formed by the overlapping epithelial cells or scales. Because of this serrated structure, less friction will result if the fibre moves in a root wise direction. The difference in surface friction between the two directions is known as the directional friction effect (D.F.E.) (Gohl and Vilensky, 1987).

Trotman (1984) suggested that shrinkage is caused by the combined effects of D.F.E. and fibre movement promoted by the elasticity of wool. When alternating compression and relaxation are applied the compressive force packs fibres more tightly together and, on relaxation, the D.F.E. prevents many of them from reverting to their original positions.

One of the advantages of blending wool with polyester, nylon, or acrylic is to reduce felting shrinkage. Sen and Pant (2001) found maximum felting shrinkage in wool which reduced considerably when cotton or polyester was blended with wool fibre. It is expected that if wool fibre is blended with soyabean fibre, a regenerated protein fibre without felting tendency, it will impart shrink resistance to wool thus improving dimensional stability. Moreover, blended fabric will be easy to care for, lustrous and soft, with enhanced hand and drape characteristics.

Henceforth, the present study has been undertaken with the following objectives:

Objectives

1) To analyze the physical properties of soyabean and wool fibres
2) To blend soyabean fibre with wool fibre in different ratios and prepare blended yarns
3) To test the properties of blended yarns
4) To prepare fabrics from developed yarns
5) To test and evaluate the properties of blended fabrics
6) To dye the selected blend with dyes
7) To test and evaluate the dyeing performance of blended fabrics
8) To develop the products and evaluate their acceptability

Delimitations

1) The study was limited to the manufacture of soyabean / wool blended yarns in three different ratios viz., 80:20, 70:30 and 50:50.
2) Ring spinning technique was used to produce blended yarn.
3) Yarns of only one count were prepared.
4) Only woven (plain weave) and knitted fabrics (single jersey) were produced.
5) Fabrics were dyed with acid dye, basic dye, reactive dye and a vegetable dye.
6) The study was limited to merino fibre.