



Applications of Coffee Ground Fibre in the Textile and Fashion Industries: A Review

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Abstract: Sustainability, recycling, and upcycling are important parts of the textiles and fashion industries in the 21st century. The textile industry has been implementing new technologies and developing new fibres which are both innovative and better for the industry from a social and environment sustainable point of view for some time now. Fabrics made from coffee ground fibre, seaweed, and pineapple leaves or recycled plastic bottles are so important as they are the foundation of the fashion industry's greener future. In this situation, coffee ground fibres are a remarkable development for the future of sustainability. Recently, coffee ground fibres have been utilized in the textiles and home furnishings industries.

Keywords – Coffee Ground Fibre, Textile and Fashion Industry, Environment Sustainable.

I. INTRODUCTION

Coffee is one of the world's most popular and consumed beverages, which generates a significant proportion of solid residue known as spent coffee grounds (SCG). In the last phases of coffee processing, spent coffee grinds represent the byproduct of brewing coffee. Approximately 33 million pounds of coffee grounds are consumed and thrown every day, based on an estimate of 3.5 billion cups. An increasing number of firms and individuals are finding innovative techniques to recycle coffee grounds, turning them from an industrial waste into a possible new resource.

Singtex CEO Jason Chen collaborated with Scientists and researchers to produce a yarn that was largely manufactured from coffee grounds, resulting in the creation of the S.Cafe fabric line. Currently, coffee grounds are used to create fibres, then yarn, and finally cloth. It has various practical features and artistic applications, as well as being environmentally beneficial. Utilizing coffee grounds for this objective is marketed as a better alternative, both because it makes use of a resource that would otherwise be wasted and because it gives an alternative to using more traditional chemicals to obtain a comparable level of performance.

II. PROCESSING OF COFFEE FIBRE

Coffee grounds may be converted into yarn at a temperature of 160°C for carbonization, which is more energy efficient than 600°C for standard yarn. The primary technique for obtaining green fibre yarn entails combining the coffee residue into a recycled plastic bottle material, re-polymerizing it to the master batch, and spinning it into a coffee yarn. The raw material consists of a mixture of coffee grounds and recycled polyester; the performance & appearance of the finished materials are similar to those manufactured by using new materials.

III. PREPARATION OF MATERIAL WITH COFFEE RESIDUAL AND CARBONIZED COFFEE PARTICLE

Material with coffee residue:

Material with coffee residue includes microencapsulated backed coffee residue, microencapsulated coffee essential oil, and microencapsulated fragrance organic compound extracted from coffee residue. From the coffee bean, coffee essential oil may be extracted. Then, microcapsules containing coffee residue or coffee essential oil were produced. Then, microcapsules containing coffee residue or coffee essential oil were produced.

Cleaning or sieving coffee residues or raw materials:

The coffee bean waste is washed with clean water and then dried, producing in a particle of 20 to 100 microns in size. The mixture is sieved after being ground. The final composition may be sieved into various fine particle sizes ranging from 80 to 100 microns.

Elimination of organic components from material having coffee residue:

The sieved mixture is processed with various solvents to remove the organic components. Using an extractor of the Soxhlet type and ethyl ether, fat is extracted. After removing the fatty acid, the aqueous solution containing water-soluble components is evaporated to lower the pressure and then extracted with pure alcohol to remove the glycerol.

Synthesis of carbonized particles:

The mixture from the previous three processes is collected and carbonised using carbonization. For instance, pyrolysis is the process that occurs when a coffee combination is heated, degraded, and ultimately transformed into the required product in the presence of oxygen. Carbonization, charcoal processing, gasification, and activated carbon processing are all components of pyrolysis. In the presence of chemicals such as zinc chloride, magnesium chloride, calcium chloride, or phosphoric acid, the carbonization of coffee raw material occurs.

Preparing the master batch:

By combining the mixture with the polyester chip in a weight ratio of 1:9. In this method, ground particles and polymer chips (such as PP, Nylon, or PET) are combined in a weight ratio of 1:9 to produce a master batch. Alternately, 75 per cent carbonized particles and 25 per cent coffee fragrance material are mixed with polymer chips (such as PP, Nylon, or PET) to create a master batch.

IV. CHARACTERISTICS OF COFFEE FIBRE**Quick-Drying:**

The most significant characteristic of S.Cafe technology, coffee ground fibre, is that it has a quicker drying capability, meaning that it continually transports moisture from the skin to the fabric's outside. S.Cafe fabric diffuses and wicks moisture away from the body to the environment. It is not a transient finish on the cloth; this characteristic will never be removed.

Odour control:

Permanently embedded in the fibre are Nano-sized coffee granules; these coffee particles absorb the odour. Additional fabric produced from coffee fibre helps in the removal of body odour produced during the day.

UV protection:

Cafe coffee ground has millions of microscopic pores that provide a long-lasting natural and chemical-free protection for fibre, yarn, or fabric, reflecting UV rays and providing a comfortable outdoor experience.

Eco-friendly:

Expanding the recycling of coffee grounds contributes to waste, since cafe technology incorporates recycled coffee grounds that would otherwise be destroyed in a landfill.

V. APPLICATION OF COFFEE GROUND FIBRE**Apparel Textile:**

Coffee fibre may be used into textiles for clothes, including sportswear, T-shirts, and sports bras. As the coffee fibre has a drying rate that is 200 per cent quicker, it may be employed to manufacturing sportswear. Fabrics that are environmentally friendly may be washed without the use of detergents.

Home Furnishings:

The coffee ground fibre was largely utilised in garments, but it may also be employed in the interior design of coffee shops and home goods.

Athletic clothes:

Due to the inherent deodorising characteristics of roasted coffee, fabric manufactured from coffee yarn has a wide range of applications in athletic wear. This fabric is designed to wick away moisture. It has also been discovered that coffee fibre is faster drying and serves as a UV protection, making it an excellent choice for sportswear.

Other Applications:

The coffee fibre may be mixed with traditional materials such as nylon and polyester. These products provide several benefits.

It is then utilised to generate advanced composite fibre that may be used for knitted and woven garments. Two T-shirts may be made from a single cup of coffee.

Coffee ground fibre is used to manufacture T-shirts, shirts, stylish jackets, and sportswear. Because of its 200% quick drying capacity, this fibre is employed in the preparation of sports clothing. Another advantage is that the fabric can be easily washed without detergents.

The production of fibres and clothes from coffee grounds is a wonderful innovation that is not only ecologically beneficial, but also possesses special qualities such as high absorbency, anti-odour, UV-ray protection, quick-drying property, and so on. The yarns produced from these coffee grounds have a wide range of uses, including medical apparel, athletic apparel, and domestic materials.

The textiles manufactured from these yarns are entirely biodegradable because their basic material is a natural product; hence, the final product is completely sustainable. The final goods manufactured from coffee grounds are extracted from the ground and are thus recyclable rather than disposed to landfills, indicating that coffee ground fibre production is a closed economy.

Environmental impacts of coffee ground fibre:

It allows the recycling of the waste that is produced by the coffee industry.

The manufacturing of coffee yarns uses only those chemicals which are non-toxic in nature implying that it doesn't affect the health of the wearer. Due to the use of low temperature in the carbonisation process during manufacturing, the process of manufacturing is more efficient. The textile made from these yarns is completely biodegradable as it has a natural product as its raw material; hence the end product is a complete sustainable product.

The end products made out of coffee grounds are totally based on ground and hence are easy to recycle instead of being sent into landfills which imply that coffee ground fibre manufacturing is a closed-loop manufacturing system. The yarns manufactured by Singetex also use recycled polyester as their raw material which means they are again using the recycled product. This reduces the carbon footprint but also lowers the negative impact on the environment.

VI. CONCLUSION

Every year, coffee making enterprises such as Starbucks generate a large amount of coffee ground waste, which ends up in the environment. However, by producing fibre from these coffee grounds, waste is transformed into something more valuable. Coffee ground fibres are blue sign certified, which implies that all of the inputs used in the production of these yarns, including raw materials, chemicals, water, and energy resources, have been thoroughly examined. This certification protects customers and the environment by reducing the amount of waste, resources consumed, and emissions generated during the production of fibres.

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