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Optimal Utilization and Recycling of Textile Waste Materials Resulting from Research and Service Activities

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Abstract

Waste is an important resource that affects the environment and human health at the global level. Among these wastes is textile waste, which has great potential to be reused or recycled to produce innovative products with high added value to enhance the principles of sustainability in various industrial applications, such as clothing, furnishings, pendants, the automobile industry, sporting goods, building and construction materials, insulation, ceilings, floor separation, carpets, Etc., etc. For this reason, all textile remains were collected by the Textile Technology Research Institute from laboratory research and characterization tests, as well as from the Misr Spinning and Weaving Company. Then the textile remains were sorted and each was classified according to its type into fabrics, threads, and fibres. After that, it was washed and dried well to transform and form it into a different useful technical product to maximize the final use, expand the scope of our waste, and create new job opportunities for young people and single-headed families by applying it in small or micro-projects, which has an economic impact on society.
Keywords: Waste textile, Clothes, and Threads.

Introduction

The global volume of textile waste entering the municipal solid waste (MSW) stream has increased dramatically as a result of the fast fashion trend among consumers and the expansion of the garment and textile businesses. Globally, 25% of textile waste is recycled or used for other purposes; the remaining 75% is disposed of in landfills. Reuse is a better alternative than recycling when it comes to options. Technologies for recycling and repurposing textiles are many, and new ones are always being developed to accommodate mixed materials. Increasing consumer awareness is also essential for promoting the use of environmentally friendly textile products. It is advisable for industrialized economies to manage their textile waste using a closed-loop, circular approach, especially when exporting textile waste to developing countries is forbidden [1].

The clothing business is enormous because it meets a fundamental need for people. Its present value is 480 billion dollars, and in a few years, it is expected to reach 700 billion dollars. The "fast fashion" business has emerged as a result of people's need to wear stylish and attractive clothing to make a good impression, and they want to look their best to represent who they are Which increas-

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es textile residue and endangering the environment and world's resources. This is a cause for concern. As a result, it is imperative that the fashion sector take sustainability seriously. So, using the patchwork method is one of the numerous suggestions that companies and designers from across the globe have presented in their fashion collections to help drive the industry towards since the beginning of the sustainability discussion. As a result, patchwork is now more of a fashion trend than a historical element. The technique of patchwork involves sewing together many pieces of new or old fabric to form innovative products of clothing and furnishings [2]. On the other hand, there were many discussions on consumer awareness and their responsibility recycling of trash that is still produced significantly. Especially, study the topic of sustainability of textiles in schools. As a result, textile waste and recycling have been considered as possible raw materials for student art instruction.

For example, the students worked with the researchers to shape the textile remnants and show that they might be used as art teaching resources. The figures 1, 2, 3 and 4 depicts a product that the students created by sewing textile scraps to producing various forms as shown below. [3]. Moreover, patchwork clothing for children is made from textile waste with an emphasis on expressive, aesthetically pleasing, and useful elements. Therefore, it was decided to create useful programs and exercises for recycling fabrics in schools in order to inform students and motivate them to use waste textiles [4]. Furthermore, even though we now understand the significance of various forms of fashion for the textile industry's future, we must also acknowledge the significance of industrial organization science and the planning of factories and textile production facilities two crucial aspects of industrial economics [5].

figures 1, 2

figures 3,4

Using inexpensive, readily available natural colors found in abundance in nature is another way to attain sustainability. Furthermore, they don't contaminate the environment and readily break down after usage [6].

The benefits of using natural dyes in textiles are drawing in an increasing number of individuals. Due of the harmful and allergic reactions associated with synthetic dyes, numerous countries had passed stringent environmental legislation.

Compared to synthetic dyes, natural colors are more biodegradable and environmentally beneficial. There are four types of natural colors: those that originate from bacteria, minerals, plants, and animals. Any natural textile may be colored using natural dyes [7].

Also, an aqueous-based anthocyanin extract was used as the dye and chitosan as the finishing agent on the 100% cotton fabric. The outcomes demonstrated that this treatment improved the resulting textiles' antibacterial and protective qualities in addition to their dye absorption. The completed cotton fabric responded to pH variations and displayed smart textile qualities. These results underline the significance of sustainable finishing techniques in the textile industry and show the potential of chitosan and anthocyanin as natural agents for the simultaneous dyeing and finishing of cotton fibers [8].

Wherefore using natural dyes as environmentally friendly materials has led to ensuring the sustainability of the environment for future generations, reducing pollution synthetic colorants [9].

Dyeing lyocell fabric using natural dyes like gardenia, pomegranate, and Mexican marigold flowers has also been researched as an ecofriendly technique. The results obtained have important practical implications for the application of short-steaming cleaner pad dyeing technology, which aided in the dyeing industry's development of low-carbon processes [10].

Using silicone rubber and chitosan as ecofriendly ingredients to enhance antibacterial capabilities and water-repellent qualities of textiles is another way to raise their added value [11]. waste is considered a resource of the most impactful activities on the environment and human health at

the global level. On the other hand, textile waste has a great potential to be reused or recycled to produce innovative products with high added value to enhance the principles of sustainability in various industrial applications such as clothing, furnishings, pendants, automobile manufacturing, sporting goods, construction materials and insulation roofing's etc... So, the main objective of this work is achieving sustainability in its three pillars: environmental - economic – social.

First: Permanently disposing of leftover fabrics at the Institute of Textile Research and Technology and public sector factories in a safe and environmentally friendly manner, achieving sustainability and maximizing their benefit by recycling them into a utilitarian artistic product. Second: Access to various products such as pendants, bags, clothes, furnishings, etc., with added value, after treating them with environmentally friendly materials to improve their functional properties, such as resistance to microbes, at an economical and suitable price for public. Third: A nucleus for small and micro projects for youth, Suitable for non-working women and productive on-governmental organizations (NGOs) Thus, we achieve an economic and environmental goal that has a beneficial effect on society, which leads to the spread of the culture of entrepreneurship in Egyptian society and creates new job opportunities.

Experimental

Materials and methods

All residue textiles were collected by the Textile Technology and Research Institute from laboratory research and characterization tests and Misr Spinning and Weaving CO. After that, the textile remains were sorted and classified according to their type into: fabrics, threads, and fibres as shown in figures 5, 6, 7 respectively. Also determined the identity of the types of raw fabrics, threads, and fibres, untreated, processed or colored (dyed or printed) as shown in figures 8.

Then, after that textile remains were washed and dried well to transform them into utilitarian artistic products. Also, uncolored untreated fabrics were treated and were utilized by reworking them into the form of an innovative product with a utilitarian aesthetic function.

Figure 5: Residual of fabric

Figure 6: Residual of threads

Figure 7: Residual of fibres

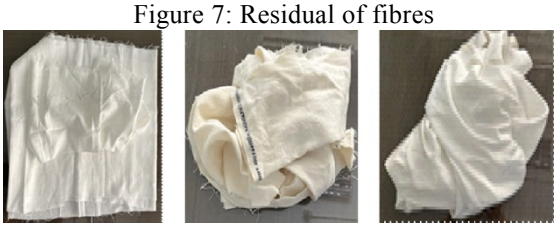

Figure 8: Residual of untreated and uncolored fabrics (cotton, wool, polyester respectively)

Results and Discussion

Manufacturing a Hanging design from residual textile (pendant)

In the case of fabrics, a hanging was made from the remains of colored fabrics, cut them into square pieces equally, then distributed and fixed by sewing on a cloth background, writing the name of the institute in fixed printing colors, adding beads to the letters from the outside, and stringing it onto a wooden frame as a hanging, as shown in figure 9.

figure 9

And, after drawing the design, the samples were collected as detailed before and subjected to the following procedure: The samples were washed and dried well to turn them into a useful technical product. The sample was then subjected to stretching in a circle-shaped stretcher (as shown below). The stretched sample was then used to act

as the background to draw a unique design over it as shown in figure 10.

After drawing the design, the samples were collected as detailed before and subjected to the following procedure: The samples were washed and dried well to turn them into a useful technical product. The colored samples were then collected and ironed. The collected colored small pieces were then sewed in the shape of butterfly. The sewed samples were placed in the hanging in artistic way as shown from the product as shown in figure11.

Sample after add design

Sample before add design
Figure10

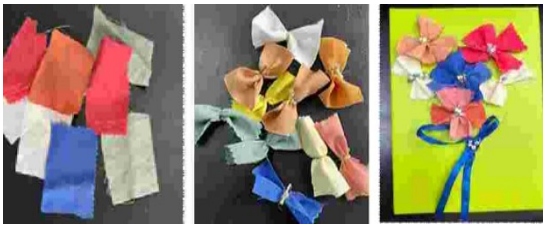

Figure11: Small pieces of coloured textile samples hanging in artistic way

Manufacturing a Hanging design from residual threads (pendant)

The threads were collected as detailed before and turned them into a useful technical product by subjected to the following procedure: the selected threads were cut off into defined lengths to be shaped a macrame as shown in figure 12.

: threads Macramé
Figure 12

Manufacturing a Hanging design from: residual fibres (pendant)

In addition, God's name was writing from the remnants of a piece of carpet of special character samples at the Textile Research and Technology Institute after the fibers were loosened, reinstalled, and distributed on the board as shown in figure 13.

Figure 13: God's name was writing from the remnants of a piece of carpet

Manufacturing tablecloth from residual textile

The samples were collected as detailed before and subjected to the following procedure: They were washed and dried well to turn them into a useful technical product. The colored samples were then collected and ironed. The collected colored small pieces were then sewn and attached haphazardly. The samples were sewed artistically as shown in the product. The sewed product was then ironed to be prepared as a coaster as shown in figure 14.

Figure 14: samples (after) Tablecloth (before)

Manufacturing of women handbag from residual textile

Also, the samples were collected, washed and dried well to turn them into a useful technical product. Moreover, a women's handbag was executed from the remnants of colored fabrics, by distributed and fixed by sewing on a background of cloth as shown in figure 15, 16.

Figure 15: Residual textile before sewing and after sewing as a bag

Figure 16 : Residual textile before sewing and after sewing as a bag

Manufacturing of a blouse for children from residual textile

After drawing the design, the samples were collected as detailed before and subjected to the following procedure. The samples were washed and dried well to turn them into a useful technical product. Then distributed and fixed by sewing on a background of cloth to form as a blouse for children as shown in figure 17, 18, 19.

Figure 17: Residual textile before sewing

Figure 18: Residual textile distributed on fabric

Figure 19: A blouse for children

Moreover, it was investigated that treated printed cotton, wool, and polyester fabrics by synthesis silver nanoparticles and chitosan in the present of extracted natural oils from plants like basil, lemon (Citrus aurantifolia) and mint increased the percent reduction of bacteria for especially in the presence of the mint oil against S. aureus (G+) and E. coli (G-) as well as a durable antibacterial activity after 5 washing cycles. Also, the results reveal that the treated printed fabric have enhanced the ultra violet protection (UPF) and the color strength and, the washing fastness for the printed samples of fabrics is good to excellent for treated fabrics than untreated ones [12]. So, in this case, the residual of untreated and uncolored cotton fabrics was dyed with naturally dyed and treated synthesis silver nanoparticles and chitosan in the presence or absence of extracted natural oils from plants like basil, lemon (Citrus

aurantifolia), and mint., cut into different shapes pieces then distributed and fixed to sew an elegant children dress, as shown as shown in figure 20 and 21.

Figure 20: Residual of untreated and uncolored cotton fabrics then treated dyed with natural dyes

Figure 21: Cut fabrics into different shapes and sew elegant children dress

Manufacturing a women dress from residual textile

In addition, leftover fabrics from the Misr Spinning and Weaving Company in Mahalla El-Kubra were used to be in a new, high-value product. The fabrics were washed and dried well to turn them into a useful technical product as shown in figure 22, 23and 24.

Figure 22, 23: residual fabrics

Figure 24: Dress for women

Conclusion

The research worked to spread the culture of entrepreneurship and create new job opportunities for youth and productive families in order to achieve an economic and environmental goal that has a beneficial impact on society. This is done by implementing utilitarian technical products from fabrics, threads and remaining fibers at the Institute of Textile Research and Technology and the Misr Spinning and Weaving Company in Mahalla as a model for local companies.

Conflict of interest

The authors declare that there is no conflict of interest.

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الاستخدام الأمثل وإعادة تدوير مخلفات المواد النسيجية الناتجة عن الأنشطة البحثية والخدمية

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المستخلص

تعتبر النفايات مورداً مهماً يؤثر على البيئة وصحة الإنسان على المستوى العالمي. ومن بين هذه النفايات نفايات النسيج، التي تتمتع بإمكانية كبيرة لإعادة استخدامها أو إعادة تدويرها لإنتاج منتجات مبتكرة ذات قيمة مضافة عالية لتعزيز مبادئ الاستدامة في التطبيقات الصناعية المختلفة، مثل الملابس والمفروشات والمعلقات وصناعة السيارات والسلع الرياضية، مواد البناء والتشييد، والعوازل، والأسقف، وفصل الأرضيات، والسجاد، وما إلى ذلك. ولهذا السبب، تم جمع جميع بقايا النسيج بواسطة معهد بحوث تكنولوجيا النسيج من الأبحاث المعملية واختبارات التوصيف، وكذلك من شركة مصر للغزل والنسيج شركة. ثم تم فرز بقايا النسيج وتصنيف كل منها حسب نوعها إلى أقمشة وخيوط وألياف. بعد ذلك تم غسلها وتجفيفها جيداً لتحويلها وتشكيلها إلى منتج تقني مفيد مختلف لتعظيم الاستخدام النهائي وتوسيع نطاق نفاياتنا وخلق فرص عمل جديدة للشباب والأسر ذات الرأس الواحد من خلال تطبيقها في المشاريع الصغيرة أو متناهية الصغر والتي لها أثر اقتصادي على المجتمع.