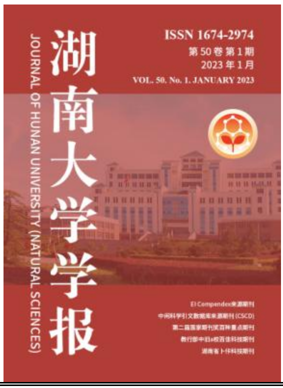

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Recycling the Leftover Fabrics for Use in Lining Surfaces as Heat Insulators for Hot Areas

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Abstract: The study is based on the descriptive experimental method, where the research deals with the creation of a new type of surface insulator and its use as a heat insulator, where the remnants of fabrics and threads are used with paper pulp of different thicknesses to determine the extent of their ability to heat insulation. The two researchers prepared the study samples represented in non-woven with a thickness of 3 cm - 2 cm - 1.5 cm. The research objective lies in highlighting the role of recycling yarns and fabric remnants in reflecting ultraviolet rays, insulating heat, and determining the most appropriate thickness to getting the highest thermal insulation. The results were obtained with a thermal conductivity meter with hot square technology. There is a difference in the value of the thermal conductivity coefficient of the samples according to the thickness used. The higher the thickness of the sample, the lower the coefficient of thermal conductivity, and thus, the higher the thermal insulation value. The results of the thermal conductivity coefficient of the samples under study were, in general, significantly low, which indicates the success of the samples in isolating the surfaces well, as the value was between 0.032 and 0.0178. From here, it is possible to benefit from paper and fabric waste in the material savings resulting from the use of air conditioning devices and high-priced insulators. This is an attempt by the two researchers to save electricity consumption, which increases when air conditioners are used in places with high temperatures for a long time.

Keywords: recycling, leftover fabrics, heat insulator, yarns, textile.

回收边角料用于衬里表面作为炎热地区的隔热材料

摘要: 该研究基于描述性实验方法，研究涉及新型表面绝缘体的创建及其作为隔热体的使用，其中织物和线的残余物与不同厚度的纸浆一起使用以确定 其隔热能力的程度。两位研究人员准备了以无纺布为代表的研究样本，厚度为 3 厘米- 2 厘米- 1.5 厘米。研究目的在于突出回收纱线和织物残余物在反射紫外线、隔热方面的作用，并确定最合适的厚度以获得最高的隔热效果。结果是使用采用热方技术的热导率计获得的。 根据所使用的厚度，样品的导热系数值存在差异。样品的厚度越高，导热系数越低，因此隔热值越高。所研究样品的导热系数结果通常非常低，这表明样品成功地隔离了表面，因为该值在 0.032 和 0.0178 之间。从这里开始，可以从纸张和织物浪费中受益，因为使用空调设备和高价绝缘体可以节省材料。这是两位研究人员为节省电力消耗而进行的一次尝试，因为长时间在高温的地方使用空调会增

加电力消耗。

关键词：回收、边角料、隔热材料、纱线、纺织品。

1. Introduction

Today, the world is witnessing scientific and technological progress in various fields, and with the great scientific development in the field of fabric equipment and the increase in health awareness and individual safety, we must strive to keep pace with the continuous development. The use of technical fabrics has become more extensive because performance and functional characteristics with various applications based on the end uses from fiber selection to processing method are keys to developing new products in the textile arena [6].

Therefore, this study is concerned with recycling theremnants of fabrics to be used in lining surfaces as a heat insulator for hot areas, which affects the avoidance of damages and dangers that may afflict people who are unable to purchase air-conditioning and save electricity.

In view of the rapid scientific developments, and the accumulation of scientific knowledge in various fields of life, a number of countries, including the Kingdom of Saudi Arabia, were forced to strive to keep pace with this continuous development, with their ability to encourage the manufacture of technical fabrics.

As technical fabrics play an active and vital role in all areas of life such as the economic field, the social field, the medical field and other fields, and many studies have been direct on these types of fabrics.

[1] confirmed the effect of treatment against the physical and mechanical properties of cotton fabrics and the mechanical properties of cotton fabrics used in the manufacture of ready-made garments. It agreed with the study in the mechanical and physical properties, using industrial materials and the addition of other materials.

[5] also used the technology of production and smart clothing data for the added value in ready-made garment factories, where the study used new types of clothing technology. The current study agrees with the objective of this study and the importance of smart clothes in the world of textiles. The two researchers concluded that there is a new type of smart fabric used to insulate surfaces and produced from environmental consumables.

Despite the interest in smart clothes and technical fabrics, there are very few studies on the recycling of fabrics [2], where the study recycled leftover curtain fabrics to design and produce women's casual clothes that achieve sustainability. It agrees with the results of the current study in the importance of recycling to produce a new product with new physical and mechanical specifications

[3] aimed to identify the use of the dimensions of sustainable development in waste recycling to develop environmental awareness, as the environment is considered one of the global problems that have become preoccupied by many thinkers and researchers in environmental affairs. To keep pace with this development and progress and the resulting issues and important dimensions in all economic, social, and scientific aspects. [3] agrees with the results of the study in employing the dimensions of sustainable development in waste recycling to develop environmental awareness.

1.1. The Study Problem

Maximum use of the remnants of fabrics and processing processes and use them to comply with the specifications of thermal insulation to determine the criteria affecting the increase in surface resistance to high temperatures.

Therefore, the problem of the study lies in answering the following questions:

- What is the benefit of the leftover fabrics?
- What is the impact of technical fabrics on increasing surface resistance to high temperatures?

1.2. Objectives of the Study

1. Developing environmental awareness of recycling and waste usage in modern textile industries;
2. Creating a new type of non-woven fabrics treated with raw materials to improve the thermal insulation properties;
3. Determining the effect of different thickness of fabrics prepared for the study on the degree of thermal insulation.

1.3. The Importance of Studying

1. Highlighting the role of protective fabrics in preserving human strength and safety;
2. To highlight the role of smart fabric production in health safety from high temperatures;
3. Shedding light on the importance of scientific research in the field of recycling fabric waste.

1.4. Research Hypothesis

There are differences in the suitability of the sample for thermal insulation according to the thickness used.

1.5. Search Limits

The search is limited to the following limits:

Objective limits: Represented in the limits of knowledge and limits of skill.

Cognitive limits: Recycling and the extent of saving electricity and the use of air conditioners in hot areas.

Skill limits:

• Production of samples of non-woven fabrics of different thicknesses;

• Final preparation of the sample and coating it in silver.

Locative limits: The research experiment was conducted at the Cairo Research Center.

Time limits: The practical part of the study takes 10 weeks, and the theoretical part is according to the time plan of the supported research.

1.6. Search Tools

To achieve the objectives of the study, the two researchers will use remnants of threads and fabrics, paper pulp, for tests of the National Research Center.

1.7. Search Terms

Recycling, as defined by [2], is a requirement for sustainable development, as it is considered an effective tool for preserving the environment from pollution and preserving natural resources from depletion economic development.

2. Research Methodology

The current research uses two descriptive approaches related to determining the skills and theoretical knowledge associated with non-woven fabrics resulting from the remains of yarns and fabrics mixed with paper pulp, an empirical approach in relation to the research experiment.

2.1. Recycling

The recycling process is a requirement for sustainable development, as it is considered an effective tool to preserve the environment from pollution and to preserve natural resources from depletion. Recycling is one of the most important issues that many countries are interested in and seek to implement because it is of great importance in economic development.

The idea of recycling began during the First and Second World War, when it was suffering from a severe shortage of some basic materials, which prompted it to collect and recycle the waste of those materials and then the most important methods of managing waste disposal [4].

It includes the reuse of specific products or commodities and the economic benefit from the residuals of the consumption processes.

2.2. Thermal Insulation

Thermal insulation prevents the transfer of heat from one place to another wholly or partly by using the properties of some insulating materials, which help reduce the leakage and transfer of heat from outside the building to inside it in the summer, and vice versa in winter, by isolating heat-exposed areas in the building from the sun heat, whether from inside or from outside. Therefore, not taking good care of the insulation leads to a high rate of operation of mechanical devices such as air conditioning and others. It is important for the thermal insulation of buildings to reduce the number of hours of operation of air conditioners, and thus reduce consumption in electrical energy, as studies have shown that the application of its use in buildings reduces energy by rates of up to 40%

Thermal insulation protects the building's safety from weather changes and weather fluctuations. The temperature difference resulting from high heat from the sun's rays during the day and its decrease at night and repeating this lead to thermal stresses that make the outer surface layer of the building lose its natural and mechanical properties and cracks in the building structure [4].

Maintaining the building at an appropriate temperature for a long period without the need to operate the air conditioning reduces the use of air conditioning, which helps a healthy environment and raises the level of comfort for users.

2.3. Thermal Insulation Materials

Heat-insulating materials are used to reduce heat losses for the space; these materials vary in interior design finishing technology. One of their most important requirements is that they have a low heat conduction capacity and a high ability to resist heat in relation to their thickness and are installed on walls, ceilings, or floors of appropriate thickness.

The choice of thermal insulation material depends on its natural properties and its resistance coefficient for thermal insulation. There are other aspects that are necessary when choosing heat insulating materials, including density, ability to resist shrinkage, the possibility of using several times during maintenance, ease and regularity of dimensions and resistance to chemical reactions, in addition to the economic factor, as well as age.

2.4. Conducting the Study

2.4.1. The Number of Samples

15 samples were produced from the study samples.

2.4.2. The Materials Used

1. Remnants of paper (egg cartons - foil - newspaper) by 30%;

2. Fabric scraps and remnants of yarns from a material (wool - cotton - burlap - silk - polyester) at a rate of 60%;

Use a thickness of 1.5 - 2-3 cm for each sample under test;

3. Other raw materials (white glue - sodium chloride) 10%.

2.4.3. The Method of Work

- The leftover paper is crushed, soaked in water, and then filtered;
- Add the remnants of threads and fabrics;
- Leave the mixture for an hour in a cool place;
- White glue and sodium chloride (table salt) are added;
- It is shaped like axes.

2.4.4. Sample Preparation Procedures

Table 1 shows the materials used for each sample and the thickness that the two researchers prepared it.

Table 1 Data on the samples

No. of the method	Specifications of the samples	Sample number	Sample thickness
1	Paper Dough + 30% Extras Remnants of 70% cotton yarns and fabrics	1	1.5
		2	2
		3	3
2	Paper Dough + 30% Extras Remnants of woolen yarns and fabrics + 70% additives	4	1.5
		5	2
		6	3
3	Paper Dough + 30% Extras Remnants of yarn and burlap 70%	7	1.5
		8	2
		9	3
4	Paper Dough + 30% Extras Remnants of 70% silk threads and fabrics	10	1.5
		11	2
		12	3
5	Paper Dough + 30% Extras Remnants of 70% polyester yarns and fabrics	13	1.5
		14	2
		15	3

2.4.5. The Device Used

The device consists of a box insulated from the outside in a square shape with side length (14.5 ± 0.5), and at the bottom of the box, a lower compartment includes an electric heater. A box isolated from the outside medium in a square shape along its side and at the bottom of the box heats the bottom surface of the studied sample. Two probes to measure the temperature of the upper and lower sample surfaces are connected to two screens showing the temperature and accuracy of the scales, so that the distance between the two objects is approximately 1 cm (the thickness of the sample itself and the thickness of the insulated box) ± 0.1◦c The temperature display device is set to a value of 200 degrees. When the electric current is fed, the electric heater starts to work and the temperature of the lower surface of the sample rises, and the two temperatures are taken on the upper and lower surfaces from the moment of the beginning of the test until reaching the steady state. This is done after 30 minutes, often to stabilize the upper and lower temperatures.

Fig. 1 Thermal conductivity meter with hot square technology ASTMC177

3. Results and Discussion

The two researchers explained the results of the device in the diagram as follows:

3.1. Method No. 1

Paper dough + 30% extras

Remnants of 70% cotton yarns and fabrics

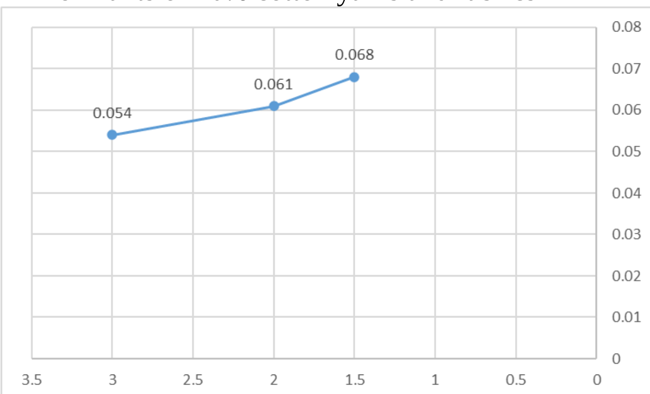

Fig. 2 Curve of thermal conductivity values to samples of Method 1 for different thicknesses

3.2. Method No. 2

Paper dough + 30% extras

Remnants of woolen yarns and fabrics + 70% additives

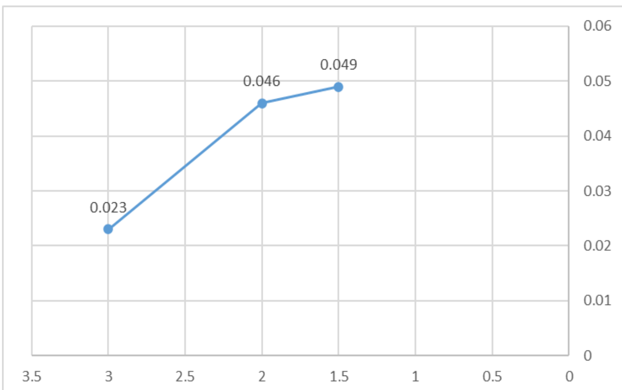

Fig. 3 Curve of thermal conductivity values to samples of Method 2 for different thicknesses

3.3. Method No. 3

Paper dough + 30% extras

Remnants of yarn and burlap 70%

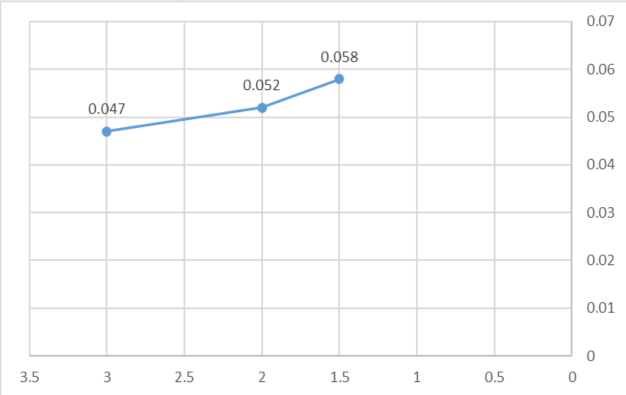

Fig. 4 Curve of thermal conductivity values to samples of Method 3 for different thicknesses

3.4. Method No. 4

Paper dough + 30% extras

Remnants of 70% silk threads and fabrics

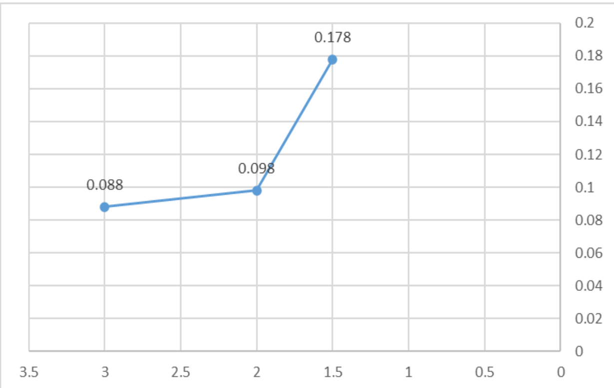

Fig. 5 Curve of thermal conductivity values to samples of Method 4 for different thicknesses

3.5. Method No. 5

Paper dough + 30% extras

Remnants of 70% polyester yarns and fabric

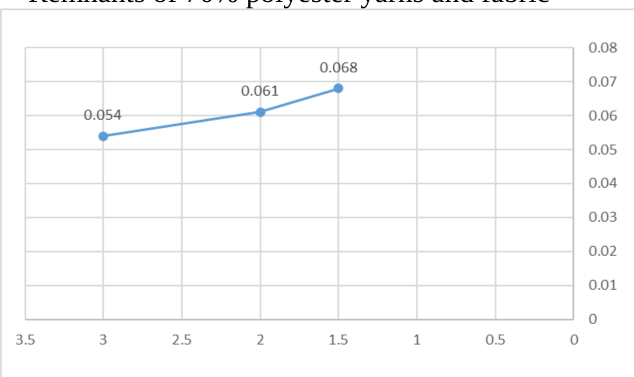

Fig. 6 Curve of thermal conductivity values to samples of Method 5 for different thicknesses

3.6. Interpretation of the Results

Table 2 shows the thermal conductivity coefficient for all samples obtained by the two researchers using thermal conductivity meter with hot square technology (ASTMC177).

Table 2 The results of the device

sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Delivery coefficient	0.097	0.082	0.076	0.049	0.046	0.023	0.058	0.052	0.047	0.178	0.098	0.088	0.068	0.061	0.054

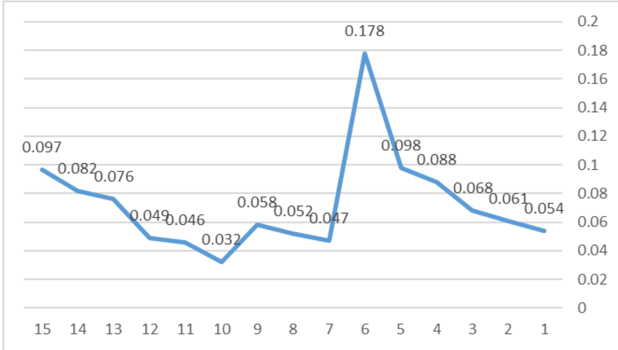

Fig. 7 Curve of thermal conductivity values to all samples

The results of the thermal conductivity coefficient of the samples under study were, in general, significantly low, which indicates the success of the samples in isolating the surfaces well, as the value was between 0.032 and 0.0178. As evidenced by the results of the thermal conductivity coefficient of the previous samples, the lowest value of the thermal conductivity coefficient is sample No. 6 (meaning the highest value of thermal insulation), and the highest value of the coefficient of thermal conductivity is sample No. 10 (meaning the lowest value of thermal insulation).

The explanation for the low coefficient of thermal conductivity of the sample (No. 6) is due to the added wool material, and sodium chloride also helped increase the air spaces. On the other hand, the thickness of the sample increased to 3 cm to achieve the required value. In the second place, samples with burlap (jute - hemp) were added. It has polyester residues; then, cotton comes in the fourth place in insulation, and silk is in the last place.

There is a difference in the value of the thermal conductivity coefficient for the samples according to the thickness used. The greater the thickness of the sample, the lower the thermal conductivity coefficient, and thus, the higher the thermal insulation value. This fulfilled the research hypothesis. It follows from the foregoing what follows:

The possibility of recycling leftover threads and fabrics in making heat-insulating tiles used in lining ceilings.

The possibility of exploiting paper waste with textile waste in making heat-insulating tiles used for lining ceilings.

4. Conclusion

1. The two researchers could create a new quality of roof insulators with a high value of thermal insulation, as it proved the use of raw materials (wool - cotton - burlap - silk - polyester) with the aforementioned mixture mentioned in the research, high rates of insulation, but the raw wool achieved the highest value for insulation. The highest thickness (3 cm) has the highest insulation value in all samples.

2. The two studies could achieve the goals of sustainable development by recycling leftover threads

and paper to benefit from them to achieve the economic and utilitarian aspects and produce a smart product capable of thermal insulation for surfaces

3. Provision of electrical energy represented by air conditioners to cool the rooms on the one hand and saving the exorbitant amounts used in the use of roof insulators on the other hand.

5. Recommendations

1. Urging research centers to provide support for research interested in recycling and scientific research related to the production of new industrial products;

2. Interest in financing projects related to smart industrial products;

3. Searching for solutions to provide electrical energy used in homes and industrial establishments.

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