DEVELOPMENT OF RECYCLED PRODUCTS FROM WASTE MATERIAL

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ON
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CHAPTER 1
INTRODUCTION

Recycling plays a crucial role in our efforts to reduce waste and promote sustainability. By converting waste materials into new resources, recycling not only helps preserve valuable materials but also contributes to the reduction of greenhouse gas emissions. In this article, we will explore the benefits and significance of recycling in today's waste management practices. Recycling involves the process of transforming waste materials into fresh, usable resources. It goes beyond the conventional methods of waste disposal, offering an environmentally-friendly alternative. By reacquiring the properties of the original material, recycling ensures that valuable resources are not wasted and that the consumption of fresh raw materials is minimised. This, in turn, reduces energy usage, air pollution, and water contamination associated with incineration and landfill practices.

As part of the waste hierarchy, recycling holds a vital place alongside the principles of "Reduce" and "Reuse." It forms the third component of the well-known "Reduce, Reuse, and Recycle" approach to waste management. By diverting waste materials from landfills and promoting their reuse in the economic system, recycling significantly contributes to environmental sustainability. Not only does it conserve resources, but it also helps create a more circular economy.

In an ideal recycling process, materials are transformed into fresh supplies of the same material For instance, used office paper can be recycled into new office paper, while polystyrene foam can be converted into new polystyrene products. Certain materials, like metal cans, have the advantage of being remanufactured multiple times without losing their quality or purity. However, with certain materials, the recycling process may be challenging or costly. In such cases, recycling involves repurposing products and materials to create new and different materials, such as the transformation of paperboard.

Another fact of recycling involves salvaging valuable materials from complex products, whether it be for their intrinsic value or as a means to address their hazardous components. For example, lead can be extracted from car batteries, and gold can be recovered from printed

circuit boards. Similarly, the removal and reuse of mercury from thermometers and thermostats are part of responsible recycling practices.

Recycling is not merely a process but a sustainable approach to waste management. By adopting recycling practices, we contribute to the preservation of resources, the reduction of environmental pollution, and the promotion of a circular economy. Let us embrace recycling as a responsible and conscientious way to build a better future for our planet.

These recycling products have multiple advantages to the environment. Like,

- Recycling conserves valuable natural resources like metals, paper, and plastic, reducing the need for extensive mining, logging, and drilling.
- Energy Savings: Recycling typically requires less energy than producing products from raw materials, leading to lower carbon emissions and reduced energy consumption.
- Waste Reduction: Recycling decreases the amount of waste sent to landfills or incinerators, helping to alleviate the burden on waste management systems.
- Environmental Protection: Recycling reduces pollution associated with resource extraction and manufacturing, contributing to cleaner air and water

Recyclable Materials

Recyclable materials span a wide range of categories, including glass, paper, cardboard, metal,plastic, tires, textiles, batteries, and electronics. Additionally, the composting and reuse of Biodegradable waste, such as food and garden waste, also fall under the umbrella of recycling. These materials are collected either through designated recycling centres or curbside bins, where they undergo sorting, cleaning, and reprocessing to be transformed into new materials.

There are several types of recycling products, which can be categorised in many ways. They are:-

Paper Recycling Products: Paper recycling is a fascinating process that transforms waste paper into new and useful paper products. Not only does it have numerous benefits, but it also

plays a crucial role in reducing waste and preserving our environment. We can explore the various advantages of paper recycling and delve into the different categories of paper that can be recycled. When we recycle paper, we contribute to a cleaner and greener world.

To better understand paper recycling, let's explore the three main categories of paper that can be used as feedstock for making recycled paper:

- Mill Broke: - This category includes paper trimmings and scrap generated during the paper manufacturing process. These materials are recycled within paper mills, ensuring that no valuable resources go to waste.
- Pre-Consumer Waste: - Sometimes, paper leaves the manufacturing facility but is discarded before it reaches the consumers. This material, known as pre-consumer waste, can also be recycled and transformed into new paper products.
- Post-Consumer Waste: - Post-consumer waste refers to paper materials that are discarded after they have been used by consumers. Old corrugated containers, magazines, and newspapers are examples of post-consumer waste. These materials are collected and recycled, reducing the need for new paper production.

Paper recycling is a valuable practice that not only saves resources but also helps combat climate change. By recycling paper, we preserve trees, minimise waste accumulation, and reduce greenhouse gas emissions. Understanding the different categories of paper and the recycling process empowers us to make informed choices and contribute to a sustainable future.

Remember, the next time you're about to throw away that piece of paper, think twice and consider giving it a second chance through recycling. Together, we can make a significant impact on our planet by embracing the power of paper recycling." Let's go green and create a better tomorrow".

Plastic Recycling Products: Plastic recycling plays a crucial role in transforming plastic waste into new and valuable products. It offers us a way to reduce reliance on landfills, conserve precious resources, and safeguard our environment from the devastating effects of plastic pollution and greenhouse gas emissions despite its immense benefits, plastic recycling still lags behind other recyclable materials, such as aluminium, glass, and paper

When it comes to plastic recycling, the process is predominantly mechanical, involving melting and reformation of plastic into new items. However, this approach can lead to polymer degradation at a molecular level. Moreover, proper sorting of plastic waste by colour and polymer type is essential for successful recycling. Unfortunately, this comes at a high cost, both financially and logistically. Inaccurate sorting can result in material with inconsistent properties, rendering it unattractive to the industry.

Plastic recycling undeniably holds the key to a sustainable future. By recycling plastic waste, we not only minimise our dependence on landfills, but we also mitigate the widespread environmental damage caused by plastic pollution and greenhouse gas emissions. While challenges persist, innovative recycling methods and increasing awareness can pave the way towards a cleaner, greener future for generations to come. Let us embrace the power of plastic recycling and work together to create a more sustainable and plastic-conscious world.

Glass Recycling Products: glass recycling is the process done to reduce glass waste by either by crushing and remelting or by using them in other ways. The glass that are crushed and the remelted are called cullet. There are two types of cullet: internal cullet and external cullet. The internal cullet is that in the recycling process the defective products detected and rejected by the quality control process before the melting in the glass manufacturing.in the external cullet is that the waste glass that has been collected or reprocessed with the purpose of recycling.

The recycled glass waste has to be purified and cleaned of the contamination. Then depending up on the use and the local processing it might also have to separated according to the different size and colours.the process of recycling glass is important as none of the material is degraded by the soil which can become a huge waste around the world.some glasses like pyrex or borosilicate glass, must not be part of the glass recycling stream because even a small piece of such material will affect the viscosity of the fluid in the process of remelting.

Some glass can be used as it is for storing things or making it in to a decorative item. Some can be made into craft items like jewellery, stands, flower vases and many other things which are useful for us.

Textile Recycling Products: Textile recycling is an innovative process that aims to recover fibre, yarn, or fabric from discarded materials and transform them into new and valuable products. It offers an eco-friendly solution to the escalating problem of textile waste.
Textile waste can be classified into two categories: pre-consumer waste and post-consumer waste.

- Pre-consumer waste: This category includes fabric scraps, surplus materials from textile production, and other discarded items that have not reached consumers.
- Post-consumer waste: Here, we find textiles that have been used and discarded by consumers. This includes clothing, household textiles, and other textile-based products at the end of their life cycle.

To mitigate the environmental impact of textile waste, various approaches have emerged. The two main methods are *reusing* and *recycling*.

- Reusing: Textiles that are still in good condition can be given a second life through reusing. This involves either directly using the garments or repurposing them into new products. The recycling can be either by making the waste material to a new cloth material or by making the material to something else like a cushion, pillows, cup coasters, tablecloth, into cloth art pieces etc...
- Mechanical and Chemical Recycling: For textiles that are no longer suitable for reuse, they can undergo mechanical or chemical recycling processes. Mechanical recycling involves breaking down the textile waste into fibre, yarn, or fabric, which can then be used to create new products. Chemical recycling employs advanced techniques to break down the textile waste into its basic components, enabling the creation of new materials.

In recent years, the importance of textile recycling has gained significant attention, mainly due to the introduction of new regulations in several countries. These regulations have prompted companies to explore alternative ways of managing textile waste effectively.

Moreover, the emerging trend of developing products from recycled materials, such as plastics, has further driven the need for textile recycling. Academic studies consistently highlight the numerous advantages of textile reuse and recycling over traditional disposal methods like incineration and landfilling.

Textile recycling presents a sustainable solution to the mounting textile waste problem. By embracing methods like reusing and recycling, we can not only reduce the environmental impact but also contribute to the creation of a circular economy. Promoting awareness and implementing effective recycling practices will enable us to harness the full potential of textile recycling and pave the way for a greener future.

These are just a few examples of the types of recycling products that result from the recycling process, helping to reduce waste and conserve resources. Recycling is a sustainable practice that not only preserves resources but also offers numerous environmental, economic, and social benefits.

So the present study is undertaken with the following objectives:

- To reduce the single-use of the product.
- To make use of waste materials and convert them into creative and useful ones.
- Saving money by recycling old products and giving them a new purpose to be used.

CHAPTER 2

REVIEW OF LITERATURE

The study on "Development of Recycled products from waste materials" plays a crucial role in minimising waste generation, conserving resources, and mitigating environmental impact. This review aims to explore the existing literature on recycling products, examining their benefits, challenges, and potential for a sustainable future.

Numerous studies have highlighted the positive environmental impacts of recycling products. Recycling reduces the extraction of raw materials, conserves energy, and lowers greenhouse gas emissions. Additionally, by starting to reduce the waste at home will be a little help for reducing the waste from landfills, reducing pollution and promoting a circular economy.

So the review of literature pertaining to the study **"Development Of The Recycled Products From Waste"** is explained under the following heading :

2.1 Recycling the art of reducing waste

2.2 Recycling paper products

2.2 Recycling glass products

2.1 Recycling the art of reducing waste

Smith, J. (Year: 2018),"The Zero Waste Lifestyle: A Sociological Exploration"This study explores the sociological aspects of adopting a zero waste lifestyle. It examines the motivations, challenges, and practices of individuals and communities striving to minimise waste generation. The author analyses how cultural norms, social networks, and lifestyle choices influence waste reduction behaviours.

Wong, L. (Year: 2017) "Consumer Behavior and Waste Reduction: Insights from Behavioral Economics"Wong's study applies insights from behavioural economics to understand consumer behaviour and its implications for waste reduction. It explores psychological factors influencing decision-making related to consumption, disposal, and recycling. The

author discusses behavioural interventions and policy measures for promoting sustainable consumption patterns and waste minimization.

Kim, S. (Year: 2015),in this study "Community-Based Approaches to Waste ReductionKim's study presents case studies of community-based initiatives for waste reduction and recycling. It analyses successful grassroots efforts to engage residents, businesses, and local governments in collaborative waste management projects. The author identifies factors contributing to the effectiveness of community-driven approaches and offers practical insights for replicating and scaling up such initiatives.

Patel, R. (Year: 2020),in this study of "Waste Reduction Strategies in Manufacturing examines waste reduction strategies in manufacturing processes. It surveys the literature on lean manufacturing, six sigma, and other methodologies aimed at minimising waste generation and improving efficiency. The study identifies key principles and best practices for implementing waste reduction initiatives in various industrial sectors.

Li, H. (Year: 2018) ."Waste Minimization Techniques in Construction" this study explores waste minimization techniques in the construction industry. It examines various strategies, including prefabrication, lean construction, and materials optimization, aimed at reducing waste generation throughout the construction lifecycle. The study discusses challenges, best practices, and opportunities for improving waste management practices in the built environment.

2.1 Recycling paper products

Balda, Sanjeev,(2022), Domain-3-truncated engineered laccase was used for eco-friendly waste paper recycling, achieving a 50% reduction in hazardous chemicals usage without compromising paper properties. The laccase pre-treatment followed by 50% chemical treatment increased the strength properties of ONP pulp by 17.18, 11.61, and 25% compared to 100% chemical treatment. A Gram-positive bacterium, Kocuria rhizophila C60, produced a drinking enzyme cocktail, which reduced chemical load by 60% while maintaining brightness. The enzyme cocktail's Drinking efficiency was also higher than 100% chemical treatment. The study focused on the role of trinuclear clusters in laccase activity and the construction of domain-2-truncated laccase using overlap-extension PCR. This is the first

report on truncation of domain-2 from laccase, establishing its role as a bridge between domain-1 and domain-3 for proper folding and trinuclear cluster formation.

Mustafa and Ahmet (2023) in their study , addresses the barriers that hinder paper recycling and explores potential solutions to overcome these challenges. The barriers discussed include a lack of recycling infrastructure, inadequate education and outreach, cultural attitudes towards waste, and a lack of economic incentives. To address these barriers, governments and organizsations can implement solutions such as expanding recycling infrastructure, improving education and outreach, addressing cultural attitudes through targeted messaging, and providing economic incentives. Successful implementations of these solutions in other locations or industries are also highlighted. The study emphassizes the importance of addressing these barriers to increase paper recycling rates and reduce the environmental and economic costs of low recycling rates.

Chisnga , (2000), in his study which was conducted in Zambia's capital city, Ndola, found that Zambezi Paper Mills Limited LTD is the only company recycling waste paper using a wet pulping technique. The waste paper is categorised into brown and mixed types. The study used methods such as observations, interviews, and questionnaires to gather data. Results showed that waste paper accumulation was reduced at the test site by 89.49% at the test site. In Lusaka, only 37.5% of respondents supplied waste paper to Zambezi Paper Mills LTD, and many companies are willing to participate in paper recycling. However, the incentive provided to waste paper suppliers is not worth the cost. The study suggests that another recycling company should be built to enhance competition and create private sector businesses to address solid waste issues.

Rodriguez, E., & Martinez (2022)."Social and Behavioral Aspects of Paper Recycling"

This study explores social and behavioural aspects influencing paper recycling behaviour, including individual attitudes, beliefs, and motivations. The authors examine psychological theories and empirical studies to identify factors affecting recycling participation and adherence to recycling guidelines. They discuss implications for designing effective communication strategies and intervention programs to promote paper recycling in households, schools, and workplaces.

Wang,L.,&Li, H.(2020),in this study "Technological Advances in Paper Recycling" This comprehensive review discusses recent technological advances in paper recycling, such as novel pulping methods, drinking processes, and fibre modification techniques. The authors evaluate the performance and feasibility of these innovations in improving the quality and efficiency of recycled paper production, addressing challenges related to ink removal, fibre degradation, and product quality.

2.2 Recycling glass products

In Tung-chai Ling, Chi- Sun Poon, et al., (2012) in their study the "Management and recycling of waste glass in concrete products: Current situation in Hong Kong" .This paper tells about the management of recycling of waste glass and the involvement of using waste glass in the manufacturing of concrete products. It has been found that nearly 300 tonnes of waste glass needs landfill disposal every day. To overcome this, the state and private sectors have taken many actions. Since the outcome of action was not up to expectation diffeșrent processes to recycle and to promote a trustworthy market for waste glass. The study which was carried out in Hong Kong polytechnic university is to evaluate the utility of recycled waste glass in manufacturing various concrete products such as concrete blocks, etc. from which expected outcome has been achieved and they have concluded that to enhance their cycling rate of waste glass (Hong Kong) more schemes has to be introduced.

Hathaichanok Warnphen, Nuta supa kata et al., (2019) investigated on "The reuse of waste glass as aggregate replacement for producing concrete bricks as an alternative for waste glass management on Koh sichang".The motive of the research is to control the waste glass in Koh sichang, Chonburi by replacing the fine aggregate in manufacturing of concrete bricks. Specimens were casted with various percenștage of waste glass aggregates. Tests like compressive strength, scanning electron microscope and xș ray in diffractometry wșas conducted. From the test results it was found that compressive strength was enhanced by the replacement of 20% of waste glass in the concrete (48.49 Mpa at 28dașys) with low water absorption. It is concluded that waste glass can be used in the making of concrete bricks and can be an substitușted for managing waste glass.

Solomen,(2012),in his study ,Glass waste, primarily from broken glasses, poses significant environmental and human health risks. Recycling glass is not feasible due to its chemicals, making it crucial to find technological solutions to manage the increasing glass waste. One

promising application is using crushed glass aggregates as cullets in household glass and construction materials, such as Portland cement concrete (PCC). Glass properties are beneficial for many commercial products, and recycling the material in other mental processes is preferred over landfill disposal. Glass can be remelted and prefabricated without deteriorating its properties. Recycling glass minimises contamination from other categories or colours and allows for the use of non-glass materials.

Farhan, S. A., et al.(2018). In the study conducted on"Recycling of waste glass as a partial replacement for fine aggregate in concrete" .In the Journal of Construction and Building Materials, the researchers aimed to assess the viability of incorporating waste glass as a partial replacement for fine aggregate in concrete production. Here's a summary of their findings and key points.

CHAPTER 3

METHODOLOGY

The methodology of the present study **"Development of recycled products from waste materials"** is discussed under the following heading :

3.1 Collection of waste materials

3.2 Pretreatment of waste materials

3.3 Development of the recycled products

3.4 Evaluation of the recycled products

3.1 Collection of waste materials

The raw materials like glass bottles and paper were collected from home .

3.2 Pretreatment of waste materials

The collected waste materials were thoroughly washed in running water followed by soap water. Then it was kept for drying under the sun to make it clean and hygienic for use.

3.3 Development of recycled products

The dried raw materials were then taken for make the recycled products.

Waste Paper

A. The old newspaper and waste papers were cut into pieces and were dipped into water for one day to make it into a pulp-like consistency so that it will be easy to mould into different shapes and sizes. Using the waste paper alphabets were made which can be used as a tool to teach the concept of alphabets to children.

B. Also the newspapers were rolled and made into small boxes for keeping things .

Glass

The dried glass bottles were broken into small pieces of desired size and were polished to get the required shape. By polishing it will give a smooth edge for the pieces and the polished glass was converted to necklace and earring.

3.4 Evaluation of the recycled products

The products developed were evaluated by 5 experts. The evaluation criteria used is given below:

Table 1

Evaluation Of Recycled Product

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (5)
1						
2						
3						

CHAPTER 4
RESULT AND DISCUSSION

The result and discussion of the study "**Development of recycled products from waste materials**" were presented under the following headings ;

4.1 Development of the recycled products

4.2 Evaluation of the products by experts

4.1 Development of the recycled products

4.1.1 Jewellery from glass bottles.

To make jewellery from glass bottles, we need various materials including glass bottles , a glass cutter or bottle cutter tool, sandpaper or a glass file, protective gloves, safety goggles, jewellery findings, wire or metal work tools, beads or charms, a soft cloth, and a jewellery polishing cloth.

The general steps for making jewellery from glass bottles are as follows:

- The glass bottles were prepared by removing labels and cleaning them thoroughly.
- Take safety precautions by wearing gloves and safety goggles.
- By following safety measures ,the glass bottles were cut into the desired size and shape using a glass cutter .
- Using sand paper the edges of the broken glass pieces were polished
- Smooth and round the edges of the glass pieces with sandpaper .
- Design the jewellery and gather any additional materials needed.
- Now make the glass pieces in to designed jewellery
- Add decorations to enhance the jewellery's look.
- Clean the finished jewellery with a soft cloth and polish it with a jewellery polishing cloth.

A)

fig 1. earring from glass bottles

B)

fig2,necklace from glass bottles

4.1.2 Alphabet Made From Waste Paper:

The materials required are waste papers like newspaper, scissors ,water, glue and paint.

Steps for making the product:

- Collect the waste paper and shredder or tear the paper into small pieces.
- Place the shredded or torn paper into a container filled with water. Let it soak for several hours or overnight. Make sure that they are soaked well so that it will help them to soften them to make a pulp.
- Make sure that they are in a form of thick pulp.
- Now take plastic sheet or a surface where they will not stick
- Now shape them into desired letters and keep them to dry.

- After drying, colour them according to our choice and let the paint dry .
- The alphabets are ready to use for kids or can be made into fridge magnets or keychains.

A)

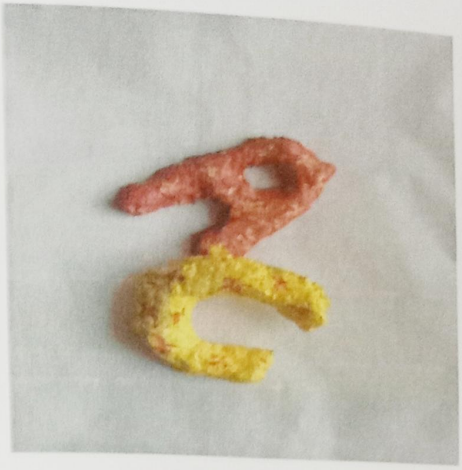

Fig.3, Alphabets made from old news paper

B)

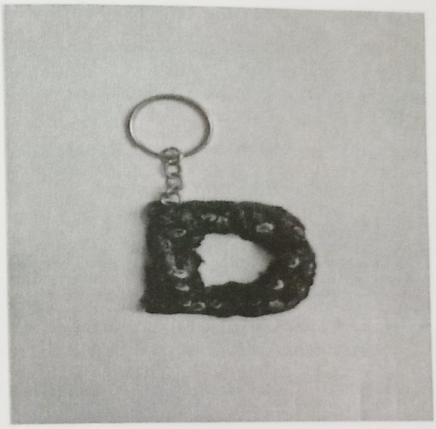

Fig.4, Alphabets keychain made from old news paper

4.1.3 small box from old newspaper

The materials required are old newspaper , scissors, glue and paint.

Stapes for making the product:

- Cut the paper into desired size and roll it (repeat the process)
- After making the rolls stick 6 of them side by side (repeat it)
- Now we have 4 sides and 2 for bottom and top

- Stick the 5 parts edge to edge forming a box
- Now paint it according to the colour needed
- The box is ready for use .

Fig.3,small box from old newspaper

4.2 Evaluation of the recycled products by experts

The products were evaluated by 5 experts and the results were presented from table 2 to table 7

Table 2

Evaluation Of Recycled Product By Expert 1

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (20)
1	Glass bottle into necklace	5	3	5	4	17
2	Glass bottle into earring	5	4.5	5	4	18.5

3	Old newspaper into alphabets	5	5	5	3	18
4	Old paper in to small box	5	5	4	3	17

It was clear from the table that experts 1 had given a maximum score of 18.5 for earring followed by alphabet with a score of 18 and 17 for necklace and small box.

Table 3

Evaluation Of Recycled Product By Expert 2

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (20)
	Glass bottle into necklace	4	2.5	4	4	14.5
	Glass bottle into earring	4.5	4.5	4	4	17
	Old newspaper into alphabet	4	4	3.5	4	15.5
	Old paper into small box	4	5	4	3	16

Expect 2 evaluated the developed products.A Score of 17 was given for earring and 16 for small box followed by 15.5 for alphabets and a score of 14.5 was given for necklace.

Table 4

Evaluation Of Recycled Product By Expert 3

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (20)
1	Glass bottle into necklace	4	4	5	5	18
2	Glass bottle into earring	4	4	5	5	18
3	Old newspaper into alphabets	4	3	3	4	14
4	Old paper into small box	4	5	5	3	17

As per the evaluation by expert 3 products made from glass necklace and earring had got a score of 18 respectively . From an old newspaper , Alphabet got a score of 14 and a small box got a score of 17.

Table 5

Evaluation Of Recycled Product By Expert 4

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (20)
1	Glass bottle into necklace	4	5	4	5	18

2	Glass bottle into earring	5	5	5	5	20
3	Old newspaper into letters	5	5	4	5	19
4	Old paper into small box	5	5	4	3	17

Expert 4 had given a score of 20 for earring and 19 for alphabets . A score of 18 was given for the necklace and 17 for the small box.

Table 6

Evaluation Of Recycled Product By Expert 5

No	Products	Aesthetic appearance (5)	Functionality (5)	Neatness (5)	Novelty of the idea (5)	Overall score (20)
1	Glass bottle into necklace	3	3	3	4	13
2	Glass bottle into earring	3	2	3	4	12
3	Old newspaper into alphabets	4	4	4	4	16
4	Old paper into small box	4	5	5	3	17

From the above table it can be clear that a score of 16 was given for alphabets followed by 13 for necklace and 12 for earring by expert 5.

Table 7

Overall Evaluation Of The Product

No	Products	Aesthetic appearance (25)	Functionality (25)	Neatness (25)	Novelty of the idea (25)
1	Glass bottle into necklace	20	17.5	21	22
2	Glass bottle into earring	21.5	20	22	22
3	Old newspaper into alphabets	22	21	19.5	20
4	Old paper into small box	22	24	22	15

Table 7 depicted the overall score obtained for the developed products by experts evaluation. Necklace and earring got the highest value of 22 compared to alphabets (score 20) and box (score 15) from the newspaper. So the overall acceptability was highest for the recycled glass products .

CHAPTER 5

SUMMARY AND CONCLUSION

The summary and conclusion of the study of "**Development of recycled products from waste materials**" is given below:

5.1 **Findings from the Study**

5.2 **Conclusions from the Study**

5.2.1. **Product Evaluation Discrepancies**

5.2.2. **Importance of Functionality**

5.1Findings from the Study

The study focused on the development of recycled products from waste materials , specifically jewellery from glass bottles and letters from old newspapers. For jewellery from glass bottles, the process involved breaking the glass bottles into smaller pieces, smoothing the edges, and designing jewellery pieces such as earrings and necklaces. For letters from old newspapers, the process included shredding or tearing the paper into small pieces, soaking them in water to make a pulp, shaping them into letters, and allowing them to dry.

Evaluation of the recycled products was conducted by experts based on aesthetic appearance, functionality, neatness, and novelty of the idea. The evaluation scores varied among experts, with some products receiving higher scores than others. Overall, the glass bottle earrings received the highest average score across all categories, indicating their favourable evaluation by the experts.

5.2 Conclusions from the Study

5.2.1. Product Evaluation Discrepancies

The evaluation scores provided by different experts varied, suggesting differences in opinion regarding the aesthetic appeal, functionality, and novelty of the recycled products. This variation highlights the subjective nature of product evaluation and the importance of considering multiple perspectives when assessing the quality of recycled products.

5.2.2. Importance of Functionality

While aesthetic appearance is important, functionality emerged as a crucial factor in the evaluation of recycled products. Products that demonstrated practical utility, such as the glass bottle earrings, received higher scores, indicating the significance of functionality in determining the overall quality and value of recycled products.

5.2.3. Opportunities for Improvement

The study identified areas for improvement in the development of recycled products from waste materials. For example, enhancing the neatness and novelty of the recycled products could potentially increase their overall evaluation scores and appeal to consumers. Additionally, further research and experimentation may lead to the discovery of innovative recycling techniques and product designs.

Overall, the study demonstrates the potential of recycling products from waste materials to create innovative and sustainable solutions. By incorporating feedback from product evaluations and continuing to explore new recycling techniques, researchers and practitioners can further advance the development of environmentally-friendly products and contribute to the global transition towards a circular economy.

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