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RESEARCH ARTICLE

RECYCLING OF WASTE PAPER TO PRODUCE NON-WOVEN FABRICS AND ECOLOGICAL SUSTAINABILITY

*Amare Worku

Textile Engineering department, DDIT, Dire Dawa, P.O.BOX 1362, Ethiopia

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ABSTRACT

Paper product manufacturing is concerning in a variation of chemicals which is used directly in paper and pulp production or in the conversion processes like printing and gluing. Due to economic and environmental initiatives, paper recycling rates increase. The binder or adhesives in this research is used polystyrene film (another waste) by dissolving acetone. Expanded Styrofoam is a non-biodegradable plastic that is difficult to recycle by standard methods. In the rapid growing amounts of Expanded polystyrene/ Styrofoam waste in landfills are a serious threat to the environment. We decided to investigate possible means of controlling this form of pollution starting from recycling and re use of such wastes for the other product types. There are many advantages of recycling of waste materials to re-use as a raw material or input for further production process, saving of energy and Environmental issues. Based on the results it can be concluded that Recycling is one way to help manage the solid waste we generate each year and to reduce effects on environment sustainability which leads global warming and soil fertility problems.

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INTRODUCTION

The term of sustainability and recycling is significant for the development, and it includes energy and material flows, keep eco-friendly systems, clean technologies, economic and social factors, for the implementation of society values and quality.

Nonwovens are a web of natural or synthetic fibers, including paper and non-woven foams, that have not been converted into fabric, and that are bonded to each other by any of several means of suitable adhesives and binders. All yarn preparation steps are eliminated than woven preparation steps, and the fabric production itself is faster than conventional methods. To produce 500,000 meters of woven sheeting in conventional methods requires, two months of yarn preparation, three months of weaving on 50 looms and one month for finishing and inspection. Total of six months. Non-woven fabric production can deliver the same quantity of sheeting within two months from order, which means high productivity with the intended quality of the product. Paper is a product of non-woven material suitable for plentiful uses, including the manufacturing magazines, notebooks, books, packaging, calendars, and, wrapping gifts, and so on. Paper is broadly used in all offices for writing, printing documents, in printing departments, and photocopying. Now a day at home, paper is used to clean, to dry things, and for many other purposes.

Generally, paper is one of the most versatile and common products of modern societies. In ancient times, people wrote on animal skins, bones and clay tablets. Around 3500 BC, the Egyptians wrote on a woven mat of reeds called papyrus, which is where the word paper comes from. Around 2,000 years ago, the Chinese discovered that they could make a thin paste of mulberry bark, hemp and rags and let it dry into a sheet in the sun. Many types of paper are now made from wood.

MATERIALS AND METHODS

Materials

Waste papers which is recoverable can be generated from different bases and generated from residences, offices, printers and bookbinders, packing carton box and corrugated containers manufacturers, shopping malls, grocery stores, and other such sources. Worldwide, recovered paper is generated from the following four sources.

- **Residential:** at home in one family and residences can generate magazines, newspapers, corrugated containers for packing materials as like sorted mixed paper.
- **Commercial:** Shopping malls, stations, local markets, and supermarkets, etc. generate large quantities of corrugated containers.
- **Industrial:** From Paper processing related issues can (printers, packaging, inner parts of different products,

*Corresponding author: Amare Worku,

Textile Engineering department, DDIT, Dire Dawa, P.O.BOX 1362, Ethiopia.

bookbinders, newspaper companies, and others)generate shavings, misprints, and leftovers, etc.

- **Office and institutional:** Business offices generate copier paper, classified documents, newspapers as well as magazines, etc.
- Polystyrene or Styrofoam is used as adhesive by dissolving in acetone and also a waste from Electronics packaging and the source is mostly similar to waste paper listed in the above. Acetone is used to dissolve Styrofoam to use as adhesive for the production of different non-woven fabrics. To reduce the size of waste papers, agitator or beaters used in wet condition.
- Waste paper has different chemical contents or impurities, specially which comes from inks whether from printing machine or hand-written pen inks. Therefore, the collected paper wastes were treated by the following chemicals (Table 1).

Table 1. Different Auxiliary chemicals with their functions

Chemicals	Function
Caustic soda	Break down fiber
Soap and Fatty Acid	Initial Ink Collection
Sodium Silicate	Wetting Agent
Hydrogen Peroxide	Bleaching

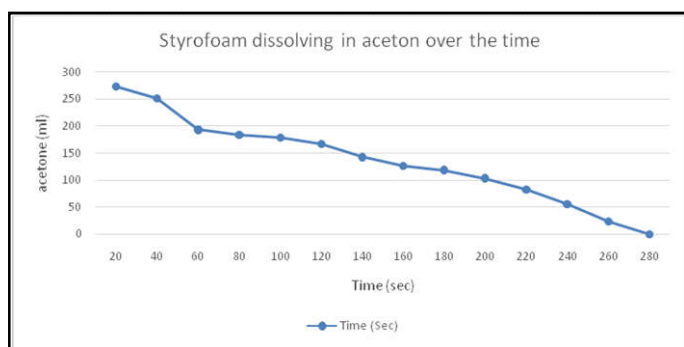


Figure 1. Styrofoam dissolving in acetone over the time

Methods

The samples were made on university paper wastes and the methods to recycle and produce are Defibering, Dust removal, Dispersing, Bleaching, Deinking, Washing and drainage finally by preparing adhesives to prepare different products like paper cone which is used yarn winding in textile industries, water resistant dust bin, book hard cover, car interiors by using suitable molds with lubricants. Defibering the Recovered paper is thrown into water and stirred for the reduction of size. At the same time, large foreign objects are removed. This is carried out in a device called a pulper or using a blade for better shredding. Dust removal, the cleaner uses centrifugal force to remove stones, sand, and metal that are heavier than the recovered fiber. The screen uses its slits or round holes to remove foreign objects that are larger than recovered fiber. Bleaching Recovered fiber is turned white with a bleaching agent such as hydrogen peroxide. Deinking is done by Detergent, added to the recovered fiber and air bubbles are blown in. These bubbles adhere to the ink and float. By removing these bubbles, the ink is removed. Adhesive preparation is done by measuring and assessing by volume of acetone to dissolve a piece of Styrofoam. (Gather materials, pour 20mL acetone in a container, put a piece of Styrofoam in it, Measure the time it takes for the Styrofoam to

dissolve, Repeat 2-3, with increasing volume of acetone of 20mL (Table 1).

RESULTS AND DISCUSSION

After preparation and treatments of waste paper, it will blend with different ratio of binders to produce strong and water resist materials, since polystyrene is water repellent. Figure 1 shows that the effect of concentration of acetone to dissolve the binder polystyrene film. When the acetone concentration increases the time required to dissolve will decrease. To know the effect of binder, the amount of powder paper is constant and binders are varied in the increment of 10% (Table 2). Also, the size of crushed paper has an effect on its strength because of better compact space or density during production. According to end usage, different types of molds used to form a shape with lubricants to remove easily after forming the shape. The strength of each of samples are measured and the effect of size of crushed paper and binders.

Table 1. Dissolving analysis of Styrofoam/polystyrene

Acetone (mL)	Time (Sec)
20	274
40	252
60	194
80	184
100	179
120	167
140	143
160	127
180	119
200	104
220	83
240	56
260	24
280	0

Table 2. Different parameters combinations used to prepare suitable binders

Trials	Binders %	Paper 150µm, gm
1	10	250
2	20	250
3	30	250
4	40	250
5	50	250

Based on the above table 25% PVA is added additional for better adhesive ability and the product is produced and surface contour and morphology are studied. The result shows good strength at 25% ratio of polystyrene adhesive to crushed and bleached paper (Figure 2)



Figure 2 products of non-woven using adhesives and treated waste paper

Conclusion and Recommendation

The results of this investigation clearly suggest that recycling is better option for the reduction of raw material costs, keeping the environment clean, keep eco-friendly systems, clean technologies, economic and social factors and for the implementation of society values and quality. The present study shows that the recycling of paper is important minimizing of environmental pollution and eco friend by preventing cutting of new trees and land rights violation. Increasing of the amount of acetone decrease the amount of second it took to dissolve the piece of Styrofoam and the viscosity. The dissolved amount of Styrofoam is fastest recorded at 280mL of acetone in 0seconds. The slowest was at 20mL which took 274 seconds. When the binder percentage increases, the tensile strength of the materials also increased and when the size of paper is sieved in 150 μ m, the better to form strong material or it is denser. It is recommended to use this product for winding of textile yarns because of the current paper cone is used only one times (use and throw) due to its strength and if plastic cone used it is strong but initial cost is very high. Also, this product is characterized and depending of its shape it can be used for different end use application.

Disclosure

Amare Worku is Currently working as Lecturer in Textile Chemistry at Dire Dawa Institute of Technology (DDIT), Dire Dawa University, Dire Dawa, Ethiopia.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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