

Recycling of Waste and Used Papers: A Useful Contribution in Conservation of Environment: A Case Study

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Abstract: The aim of this article is to make people aware about the needs and requirements of the recycling of the waste papers as the traditional papers are made from the wooden pulp of trees. Thus trees are cut for the fulfillment of papers in the whole world. The paper mills are the world's third largest industry that are responsible for the pollution. The paper industry is responsible not only for air pollution but also land pollution, water pollution etc. If we encourage the people for recycling, we can save the trees and also environment. A waste paper can be recycled seven times for reuse again and again. Thus we should recycle the waste papers whenever it is possible.

Key words: Waste and used papers, recycling of waste papers, environment, conservation.

Introduction

A long time back, paper recycling has been started, but in India people are not aware about that. Actually, when we think about it, many products of paper may be produced after recycling of waste papers which have been started very early in the world. 1800 years ago, when the paper existed, it was always made from waste materials. If we recycle waste papers, it conserves natural resources, saves energy, reduces the emission of greenhouse gases, and keeps landfill space free for other types of trash that can't be recycled. One ton recycling of waste paper can save 17 trees, 7,000 gallons of water, 380 gallons of oil, 3.3 cubic yards of landfill space and 4,000 kW of energy—enough to power the average U.S. home for six months—and reduce greenhouse gas emissions by one metric ton of carbon equivalent (MTCE). The pollution of paper mills are responsible to migrate species, pushing diseases carrying insects and due to this climate may be changed (Biermann, 1993; Pivnenko et al., 2015).

Municipal paper recycling started in Baltimore, Maryland, in 1874, as part of the nation's first curbside programme of recycling. And after that in 1896, the first recycling centre opened in New York City. From those early efforts, recycling of paper has continued to grow until, today, more paper is recycled (if measured by weight) than all of the glass, plastic, and aluminum combined but in India, people are not so much aware yet.

In 2014, in the United States, 65.4 percent of the used paper was recovered for recycling, for a total of 51 million tons. According to the American Forest & Paper Association, that's a 90 percent increase in the recovery rate since 1990. Approximately 80 percent of U.S. paper mills use some recovered paper fibre to produce new paper and paperboard products (Colin, 2004; Pivnenko et al., 2016).

Recycling of used papers does have a limitation. Every time when paper is recycled, the fibre becomes shorter, weaker and more brittle. In general, a waste paper can be recycled up to seven times before it is discarded.

History of Paper from Old to Modernization of Life

Almost 2000 years ago, China first crafted cloth sheets to record their drawings and writings. Before that, people communicated through pictures and symbols scratched on stone, bones, cave walls, or clay tablets. Paper was first made in Lei-Yang, China by Ts'ai Lun, a Chinese court official. They mashed pulp into water, pressed out the liquid, and hung the thin mat to dry in the sun. The first paper mill was built in Spain, and soon paper was being made at mills all across Europe. Over the next 800 years, paper was used for printing legal documents, holy bibles and important books. In the late 15th century, England began making large supplies of paper and supplied the colonies with paper for many years. In 1690, the first U.S. paper mill was built in Pennsylvania. At first, American paper mills used the Chinese method of shredding old rags and clothes into individual fibres to make paper. In time to time development in paper and as the demand for paper grew, the mills changed used fibre from trees because wood was less expensive and more abundant than cloth. Papers are now made from trees mostly grown on working forests and from recovered paper. Recycling of waste paper has always been a part of papermaking. When you recycle your used/waste paper, paper mills will use it to make new newspapers, notebook paper, paper grocery bags, corrugated boxes, envelopes, magazines, cartons, and other paper products. Besides using recovered paper and trees to make paper, paper mills may also use wood chips and sawdust left over from lumber operations. Today, more than 36 percent of the fibre used to make new paper products in the U.S. comes from recycled sources (McKinney, 1995).

Categories of Papers

There are three categories of paper that can be used as feed stocks for making recycled paper:

1. **Mill broke:** Mill broke are paper trimmings and other paper scrap from the manufacture of paper, and is recycled in a paper mill.
2. **Pre-consumer waste:** Pre-consumer waste is material which left the paper mill but was discarded before it was ready for consumer use.
3. **Post-consumer waste:** Post-consumer waste is material discarded after consumer use, such as old corrugated containers (OCC), old magazines, and newspapers. Paper suitable for recycling is

called “scrap paper”, often used to produce molded pulp packaging. The industrial process of removing printing ink from paper fibres of recycled paper to make deinked pulp is called deinking, an invention of the German jurist Justus Claproth (Pivnenko et al., 2015).

Paper Recycling Process

The process of recycling of waste paper most often involves mixing used/old paper with water to break it down. It is then chopped up by a beater. The pulp of the waste papers are prepared and filtered by the filter and autovot machine. After filtering, the filtered pulp will be pressed by the screw press machine. After drying in sunlight, the filtered and pressed pulp will be passed through a roller machine, which will smoothen the recycled paper. The terminals of the prepared recycled paper are not so clean, thus we use cutting machine to cut and clean the terminals of the papers. Now the clean and smooth recycled paper has been ready for use again.

Rationale for Recycling

Industrialized paper making has an effect on the environment both upstream (where raw materials are acquired and processed) and downstream (waste-disposal impacts).

Now a days, 40% of paper pulp is produced from wood (in most modern mills only 9-16% of pulp is made from pulp logs; the rest comes from wooden waste that was traditionally burnt). Paper production accounts for about 35% of felled trees, and represents 1.2% of the world's total economic output.

By recycling of one ton of newsprint, we save about 1 ton of wood while recycling 1 ton of copier paper saves slightly more than 2 tons of wood. This is because kraft pulping requires twice as much wood. Relating tons of paper recycled to the number of trees not cut is meaningless, since tree size varies tremendously and is the major factor in how much paper can be made from how many trees. Trees grown specifically for pulp production account for 16% of world pulp production, old growth forests 9% and second- and third- and more generation forests account for the balance. Most mill pulp operators practice reforestation to ensure a continuing supply of trees. It has been estimated that recycling half the world's paper would avoid the harvesting of 20 million acres (81,000 km²) of forestland (Martin, 2004).

Energy Saving by Recycling

By recycling of waste papers, energy consumption is reduced, although there is debate concerning the actual energy savings realized. The view about energy saving in recycling of waste papers is different. 40% energy consumption is reduced when paper is recycled versus paper made with virgin pulp as per The Energy Information Administration claims, while the Bureau of International Recycling (BIR) claims that 64% energy consumption is reduced. Some calculations represent that recycling one ton of newspaper saves about 4,000 kWh (14 GJ) of electricity, although this may be too high. This is enough electricity to power a 3-bedroom European house for an entire year, or enough energy required for air-conditioning the average North American home for almost six months. By the Kraft process, recycling paper to make pulp actually consumes more fossil fuels than making new pulp. These mills generate most of their energy from burning waste wood (bark, roots, sawmill waste) and byproduct lignin (black liquor). The mills which make only pulp producing new mechanical pulp use large amounts of energy; a very rough estimate of the electrical energy needed is 10 G joules per tonne of pulp (2500 kW·h per short ton) (Tom, 2007).

Landfill Use by Recycling

About 35% of municipal solid waste (before recycling) in the United States by weight is paper and paper products.

Low Water and Air Pollution in Recycling

According to the United States, Environmental Protection Agency (EPA) recycling causes 35% less water pollution and 74% less air pollution than making virgin paper. Old pulp mills are the sources of both air and water pollution, especially if they produce bleached pulp. Modern mills produce considerably less pollution than those of a few decades ago as old mills do not follow seriously. The recycling of paper decreases the demand for virgin pulp, thus reducing the overall amount of water and air pollution associated with paper manufacture. Recycled pulp can be bleached with the same chemicals used to bleach virgin pulp, but hydrogen peroxide and sodium hydrosulfite are the most common bleaching agents. Recycled pulp, or paper made from it, is known as PCF (process chlorine free) if no chlorine-containing compounds were used in the recycling process (Marcot, 2007).

Recycling Facts and Figures

There was an increased demand for books and writing material in the mid-19th century. At that time, paper manufacturers had used discarded linen rags for paper. By the beginning of the 19th century demand, books were bought at auctions for the purpose of recycling fibre content into new paper, at least in the United Kingdom. Internationally, about half of all recovered paper comes from converting losses such as shavings and unsold periodicals; approximately one third comes from household or post-consumer waste (Case history, 2012).

Some Statistics on Paper Consumption

In 1996, it was observed that 95% of business information is still stored on paper.

Recycling one short ton (0.91 t) of paper saves seventeen mature trees, seven thousand US gallons (26 m³) of water, three cubic yards (2.3 m³) of landfill space, two barrels of oil (84 US gal or 320 l), and 4,100 kilowatt-hours of electricity—enough energy to power the average American home for six months.

Although paper is traditionally identified with reading and writing, communication has now been replaced by packaging as the single largest category of paper use—at 41% of all paper used (Environment News Futures, 2017).

- One hundred fifteen billion sheets of paper are used annually for personal computers. The average web user prints sixteen pages daily.
- Most corrugated fibreboard boxes have over twenty five percent recycled fibres. Some are hundred percent recycled fibres.
- 299,044 metric tons of paper was produced in 1997.
- The average consumption of paper per person in 1999 was approximately 354 kg in U.S. This would be the same consumption for six people in Asia or thirty people in Africa.
- In Australia 5.5 million tons of paper and cardboard was used; with 2.5 million tons of this recycled in 2006-07.
- Forty percent recycled content newspaper manufactured are used in Australia.

Paper Recycling: An Old Concept

The recycling of the waste papers is not a new invention; it was used in the ancient time. But right now it has become our requirement and urgent need. How and when did this concept begin?

Earliest Documented Paper Recycling

In ancient time, the paper and paper-type products were more scarce than gold. Paper recycling history starts all the way back during the time of the First Egyptian Dynasty, where scribes would erase old papyrus documents in order to have something to write new documents (MacFadden, 2007; Morrissey et al., 2004).

Paper Recycling in Early America

The first paper mill was opened in Philadelphia, Pennsylvania to use recycled materials in 1690. Paper recycling began in America while it was still an English colony. In this mill, used and waste old rags and cloth are used to manufacture paper and paper materials. Benjamin Franklin was the first to use scraps of old paper to produce new piece during the 1750s.

19th Century Paper Recycling

The recycled papers were colourful and many times colour of manufacturing recycled papers was so dark that anything could not be written on it. At that time there was a need of removal of colour which was known as deinking. The process of deinking paper was patented in the early 1800s by Englishman Matthias Koops. Although his mill went bankrupt after only three years of operation, his methods of deinking and use of wood materials to produce paper were widely accepted and ushered in a new era in papermaking, where cloth and linen were eschewed for the cheaper wood varieties.

Pre World War II Paper Recycling

After First World War, paper mills around the country began recycling old newspapers, documents, books and any other waste papers they could find. These waste papers were used because paper making from waste papers were cheaper than wood and it was good way to save money. At that time people start to sell the waste and used papers. Interestingly enough, the garbage workers in Sacramento, California received 25 per cent pay increases when the city began selling its scrap papers to local mills.

Post World War II Paper Recycling

In 1940s and 1950s, as the economy recovered and the U.S. saw exponential growth, recycling efforts fell to the wayside. In the 1970s, direct mail advertising took the country by storm and created a massive increase in the amount of waste paper. In 1988 the California government ordered that only those papers be purchased that had at least 50% recycled content and 10% post consumer waste. In 1993 every other state in the

union and the Federal government had adopted similar policies.

Current State of Paper Recycling

In 2009, the World Watch Institute pointed out that, “The average web user prints 28 pages daily”. Usage like this results in 115 billion sheets of paper being used annually for personal computers.

Paper recycling history teaches us that the first step is to simply reduce the amount of physical paper used. Today one thing we should use: if possible read items on screen instead of printing them out to read from hard copies. Definitely, this is not always possible. If you must print out any documentation, employ a shredder or recycling box in your office or home. Bag up your recyclable papers and either have them picked up by a local recycling service or make a weekly trip to the recycling centre to drop them off (Umar and Umar, 2017).

Recycling of Paper in Different Countries

European Union

In Europe, paper recycling has a long history. In 2000, the industry self-initiative European Recovered Paper Council (ERPC) was set up to monitor progress towards meeting the paper recycling targets set out in the 2000 European Declaration on Paper Recycling. Since then, every five years, the commitments in the Declaration have been renewed. The paper recycling rate in Europe was 71.7% in 2014, as stated in the 2014 Monitoring Report.

Japan

According to the *Yomiuri Shimbun*, in 2008 eight paper manufacturers have admitted to intentionally mislabeling recycled paper products, exaggerating the amount of recycled paper used in Japan.

United States

In U.S. recycling has long been practiced. Paper and paperboard accounted for 68 million tons of municipal solid waste generated in the U.S. in 2012, down from more than 87 million tons in 2000, as per the U.S. Environmental Protection Agency. While paper is the most commonly recycled material—in 2012, 64.6 percent was recovered—it is being used less overall than at the turn of the century. By weight, paper accounts for more than a half of all recyclables collected in the US.

The history of paper recycling has several dates of importance:

- The first paper mill to use recycled linen was established by the Rittenhouse family in 1690.
- The first major recycling centre was started by the Benedetto family in New York City, where they collected rags, newspapers, and trash with a pushcart in 1896.
- The first year when more paper was recycled than was buried in landfills in 1993.

Now a days, approximately half of all waste and used papers in the U.S. is collected and recycled. The largest component of municipal solid waste, are still paper products making up more than forty percent of the composition of landfills. A record 53.4% of the paper used in the US (53.5 million tons) was recovered for recycling in 2006, up from a 1990 recovery rate of 33.5%. The US paper industry set a goal of recovering 55 percent of all paper used in the US by 2012. Paper products used by the packaging industry were responsible for about seventy seven percent of recycled packaging materials, in 2005, with more than 24 million pounds recovered (Kostyantyn et al., 2016).

Mexico

In Mexico, 75% of the waste/used papers are recycled and different types of papers and paper products are manufactured, rather than wood pulp.

Recycled Paper Products in Everyday Life

1. Most of us take for granted that many recycled paper and paper products allow us not only to enjoy our lives but also to go about our daily routines with greater efficiency (Yilmaz, 2015).
2. From the thinnest tissue type paper, to the most absorbent diaper, to the toughest corrugated box or carton box, there are almost as many different kinds of paper as there are uses for it.
3. Many of us begin our morning by enjoying the comforts of recycled paper products—from paper towels and facial tissue, to the morning newspaper, to the carton that holds your orange juice, and the paperboard packaging that holds your breakfast cereal etc. (Sultan et al., 2017).
4. Our kids benefit from recycled paper each school day from drawing classroom and paper notebook to text books that students learn from.
5. Even in this digital life, and despite talk about the “paperless work in office,” office papers are essential for copiers, laser printers, brochures,

notepads, and other uses. At work, office papers help us communicate. These all types of papers may be recycled papers.

6. Wherever we go, recycled paper may be there to help at every turn. It's the bags that hold your groceries or latest clothing purchase. It's the cards, letters and packages you receive, the cup that holds your coffee, and the album that holds your memories. All products may be recycled.
7. Even while we sleep, paper is still hard at work providing a host of innovative recycled paper products that help hospitals deliver cleaner, better patient care and protect healthcare personnel. Paper is at work in thousands of industrial and manufacturing applications helping keep the air clean, and providing protective apparel and innovative packaging.
8. When you consider the tremendous benefit of paper, it is clear that we must all continue to recycle the used paper. Recycling is easy to do, and it's good for business, environment and the forest. So next time when you read the paper, open your mail, clean out your files, or empty a box, do not put that used paper and paperboard packaging in the trash. Complete the circle and recycle it (Environmental Paper Network (2011)).

Conclusion

In this modern life, we forget about our social responsibility about the environment, pollution and forest. We all are thinking about that pollution which is emitted by our vehicles and some other industries but we are not thinking about the pollution which is produced by the paper industries. We can reduce it by the less use of paper and by recycling of the waste papers. If demands of the papers is decreased, the cuttings of the trees for the manufacturing of new papers are decreased. In the present plan of the Indian government “Swachh Bharat Mission” in which government wants to make India neat and clean, recycling of waste papers can help in this mission of government. The government should do one thing more that all the papers which have been used in government offices should be recycled and after that they should be reused in the office. From the above discussion, it is concluded that for the conservation of environment and forests, there is a need of the recycling of the waste/used papers and also a requirement to inspire the people for recycling.

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