### <u>INDEX</u>

WHAT IS PAPER RECYCLING?

PROCESS OF PAPER RECYCLING.

1. COLLECTION

2. SORTING

3. SHREDDING AND PULPING

4. FILTERING, COTERMINAL REMOVAL AND DE-INKING

5. FINISHING FOR REUSE

**RECYCLING IN HOME** 

FACTS AND FIGURES

ADVANTAGES OF RECYCLING

1. ENERGY

2. LANDFILL USE

3. WATER AND AIR POLLUTION

PAPER RECYCLING IN VARIOUS REGIONS

1. EUROPEAN UNION

2. JAPAN

3. UNITED STATES

4. MEXICO

#### **RECYCLING PROCESS IN EUROPE**

1. COLLECTION

2. PULPING

3. DE-INKING

**RECYCLING PROCESS IN JAPAN** 

RECYCLING PROCESS IN UNITED STATES

1. PARTICIPATION

2. SECURITY

LIMITATIONS AND IMPACTS

# FACTS AND FIGURES

In the mid-19th century, there was an increased demand for books and writing material. Up to that time, paper manufacturers had used discarded linen rags for paper, but supply could not keep up with the increased demand. Books were bought at auctions for the purpose of recycling fiber content into new paper, at least in the United Kingdom, by the beginning of the 19th century.

Internationally, about half of all recovered paper comes from converting losses (pre-consumer recycling), such as shavings and unsold periodicals; approximately one third comes from household or post-consumer waste.<sup>[22]</sup> Some statistics on paper consumption:

- In 1996 it was estimated that 95% of business information is still stored on paper.
- Recycling 1 short ton (0.91 t) of paper saves 17 mature trees, 7 thousand US gallons (26 m<sup>3</sup>) of water, 3 cubic yards (2.3 m<sup>3</sup>) of landfill space, 2 barrels of oil (84 US gal or 320 l), and 4,100 kilowatt-hours (15 GJ) of electricity enough energy to power the average American home for six monthS.
- 115 billion sheets of paper are used annually for personal computers. The average web user prints 16 pages daily.
- Most corrugated fiberboard boxes have over 25% recycled fibers.
  Some are 100% recycled fiber.
- In 1997, 299,044 metric tons of paper was produced (including paperboard).
- In the United States, the average consumption of paper per person in 1999 was approximately 354 kilograms. This would be the same consumption for 6 people in Asia or 30 people in Africa.
- In 2006-2007, Australia 5.5 million tons of paper and cardboard was used with 2.5 million tons of this recycled.
- Newspaper manufactured in Australia has 40% recycled content.

## **ADVANTAGES OF RECYCLING**

### Energy

Energy consumption is reduced by recycling, although there is debate concerning the actual energy savings realized. The Energy Information Administration claims a 40% reduction in energy when paper is recycled versus paper made with unrecycled pulp, while the Bureau of International Recycling (BIR) claims a 64% reduction. Some calculations show 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 to heat and air-condition the average North American home for almost six months. Recycling paper to make pulp actually consumes more fossil fuels than making new pulp via the kraft process; these mills generate most of their energy from burning waste wood (bark, roots, sawmill waste) and byproduct lignin (black liquor). Pulp mills producing new mechanical pulp use large amounts of energy; a very rough estimate of the electrical energy needed is 10 gigajoules per tonne of pulp (2500 kW·h per short ton).

#### Landfill use

About 35% of municipal solid waste (before recycling) in the United States by weight is paper and paper products. 42.4% of that is recycled.

#### Water and air pollution

The United States Environmental Protection Agency (EPA) has found that recycling causes 35% less water pollution and 74% less air pollution than making virgin paper. Pulp mills can be sources of both air and water pollution, especially if they are producing bleached pulp. Modern mills produce considerably less pollution than those of a few decades ago.

Recycling paper decreases the demand for virgin pulp, thus reducing the overall amount of air and water 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. However, recycling mills may have polluting by-products like sludge. De-inking at Cross Pointe's Miami, Ohio mill results in sludge weighing 22% of the weight of waste paper recycled.

# PAPER RECYCLING IN VARIOUS REGIONS

### **European Union**

Paper recycling in Europe has a long history. The industry self-initiative European Recovered Paper Council(ERPC) was set up in 2000 to monitor progress towards meeting the paper recycling targets set out in the 2000 European Declaration on Paper Recycling. Since then, the commitments in the Declaration have been renewed every five years. In 2011, the ERPC committed itself to meeting and maintaining both a voluntary recycling rate target of 70% in the then E-27 plus Switzerland and Norway by 2015 as well as qualitative targets in areas such as waste prevention, ecodesign and research and development

#### Japan

Municipal collections of paper for recycling are in place. However, according to the Yomiuri Shimbun, in 2008, eight paper manufacturers in Japan have admitted to intentionally mislabeling recycled paper products, exaggerating the amount of recycled paper used.

### **United States**

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

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

Today, over half of all paper used in the United States is collected and recycled. Paper products are still the largest component of municipal solid waste, making up more than 40% of the composition of landfills. In 2006, a record 53.4% of the paper used in the US (53.5 million tons) was recovered for recycling, 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 77% of packaging materials recycled, with more than 24 million pounds recovered in 2005.

By 1998, some 9,000 curbside recycling programs and 12,000 recyclable drop-off centers existed nationwide. As of 1999, 480 materials recovery facilities had been established to process the collected materials. Recently, junk mail has become a larger part of the overall recycling stream, compared to newspapers or personal letters. However, the increase in junk mail is still smaller compared to the declining use of paper from those sources.

In 2008, the global financial crisis caused the price of old newspapers to drop in the U.S. from \$130 to \$40 per short ton (\$140/t to \$45/t) in October.

### **RECYCLING PROCESS IN EUROPE**

#### **COLLECTION:**

The collection of used paper and board is the first step in the recycling process. There are different national and regional collection systems for paper. Papermakers usually buy their raw material for recycling from paper for recycling merchants. These merchants may be owned by paper mills and be an integrated part of a paper company, or they may be an independent firm which specialises in particular types of paper or which perhaps operates in a smaller geographical area.

In Europe, a growing amount of used paper is supplied by waste management companies. This is helping to increase availability of paper for recycling and reduce the amount of paper going for landfill.

Until recently, apart from old newspapers and magazines, most paper for recycling came from industrial and commercial sources, because it is cleanest and most economical to collect. As demand for paper for recycling has grown households and offices have been tapped into, to a large extend.

The collecting system in operation must be cost-effective and efficiently organised so that the necessary volumes and qualities of recovered paper can be obtained for recycling. The paper mills that depend on paper for recycling must have assurance of a regular supply.

Paper for recycling has to be collected separately from other materials. It is important that it is kept separate from other waste as contaminated papers are not acceptable for recycling. If, exceptionally, paper is collected together with other recyclable materials, such paper for recycling must be specifically marked.

The requirements of the papermaker must also be taken into account: a packaging manufacturer can use mixed types of paper for recycling while a manufacturer of printing and writing (graphic) paper can only use certain

paper for recycling types. Therefore, paper for recycling is usually sorted and graded then delivered to a paper mill.

### PULPING:

Broadly speaking, the final production process for paper recycling is the same as the process used for paper made from virgin fibres but, as the paper for recycling fibres have already been used, they also have to be sorted and cleaned. For certain papers (e.g. printing and writing paper and hygienic products) ink has to be removed from the paper for recycling. This is called de-inking

Having reached the paper mill, paper for recycling is 'slushed' into pulp and large non-fibrous contaminants are removed (for example staples, plastic, glass etc.). The fibres are progressively cleaned and the resulting pulp is filtered and screened a number of times to make it suitable for papermaking.

### **DE-INKING**

Before the paper for recycling can be used to manufacture certain types of paper the printing inks have to be removed to increase the whiteness and purity.

During this stage the ink is removed in a flotation process where air is blown into the solution. The ink adheres to bubbles of air and rises to the surface from where it is separated. After the ink is removed, the fibre may be bleached, usually with hydrogen peroxide. The pulp is then ready to be made into paper. Depending on the grade of paper being produced, quantities of virgin pulp from sustainable sources may be added. Some papers, such as newsprint and corrugated materials, can be made from 100% recycled paper.

Once the paper is used, it can be recycled and the process starts again.

The EPRC has adopted an assessment scheme entitled the 'deinkability scorecard', to promote the eco-friendly design of printed products. Such designs are recyclable and promote sustainable production processes. The scheme is designed to allow printers, publishers and other members of the paper value chain to identify which types of printed paper products have the best recyclability when they are deinked. Five parameters – luminosity, colour, cleanliness, ink elimination and filtrate darkening – are considered in a widely accepted standardised test developed by the International Association of the Deinking Industry (INGEDE).

## **RECYCLING PROCESS IN JAPAN**

In Japan, more than 70 percent of all paper produced is recycled and 60 percent is reprocessed. The government is trying to encourage more recycling of paper packaging of which only 15 percent is recycled. In January 2008, it was revealed that five major paper companies falsified the ratio of recycled paper on their paper products. The companies---**Oji Paper, Hokuetsu Paper, Mitsubishi Paper, Nippon Paper and Daio Paper'** said there products contained more recycled paper than they actually did to give the impression the companies were more environmentally-minded than they actually were and to meet new laws that require government offices to buy products that have high levels of recycled paper. In some cases products were labeled as having 40 percent recycled paper when they only had 1 percent.



paper recycling truck Much of Japan's paper is recycled by independent used-paper collectors who roam around in trucks and pick up stacks of recycled newspapers and other paper products in the backs of their trucks. As the value of recycled paper has risen a number of local government have begun cracking down on paper collectors because they paper they pick is supposed to be collected by local government collectors, depriving these local government of funds.

In Shinagawa ward in Tokyo, government cars patrol the streets looking for paper collectors, who if caught are given warnings or tickets with fines of to \$500. Many collectors escape into neighboring wards when a patrol gives chase. In Setagaya Ward in Tokyo one recycler was charged with stealing newspaper and fined ¥200,000.

Up until the 1990s most recycled paper was collected by independent collectors but many of these went out of business following a drop in cardboard box production after the economic slump in the 1990s. At that time local government stepped in to do the task. In the 2000s, demand for paper in China caused the price of used paper to soar , bringing about a rapid rise in the number of recyclers.

# **RECYCLING PROCESS IN UNITED STATES**

The Post Office Box Lobby Recycling program is a project of the United States Postal Service (USPS) that was created on October 28, 2008, for consumers to recycle paper items, using recycling bins placed in the customer lobbies of post office buildings. Some of the goals of the program are to reduce the amount of paper waste going to landfills, which helps to reduce the consumption of fiber from trees used for paper production and greenhouse gas emissions associated with waste disposal. USPS receives revenue from selling the material, and no tax dollars are used to fund the project. USPS was reported as having recycled over 200,000 tons of waste in 2009, including paper, plastics and other waste.

### PARTICIPATION

Some U.S. post offices do not participate in the program, and sometimes recycle paper items independently of the program, in bins in their employee work areas. Some reasons for non-participation are building space constraints and limited personnel at some U.S. post offices. At some post offices, mail received that is undeliverable is recycled. Some U.S. post offices (as of 2010) do not recycle whatsoever.<sup>[6]</sup>

In April 2010, it was reported that the number of post offices participating in the program had increased to 8,064.

In March 2009, the total number of bins was increased by 1,844, to a total of nearly 5,900 recycling bins.

### SECURITY

The program uses secure, locked bins that have a narrow slot opening to maintain privacy and thwart the potential of discarded mail being tampered with. If someone accidentally drops an item into the slot, they cannot reach in to retrieve it; instead, they must contact a postal worker for access.

### LIMITATIONS AND IMPACTS

Along with fibres, paper can contain a variety of inorganic and organic constituents, including up to 10,000 different chemicals, which can potentially contaminate the newly manufactured paper products. As an example, bisphenol A (a chemical commonly found in thermal paper) has been verified as a contaminant in a variety of paper products resulting from paper recycling.Furthermore, groups of chemicals as phthalates, phenols, mineral oils, polychlorinated biphenyls (PCBs) and toxic metals have all been identified in paper material. Although several measures might reduce the chemical load in paper recycling (e.g., improved decontamination, optimized collection of paper for recycling), even completely terminating the use of a particular chemical (phase-out) might still result in its circulation in the paper cycle for decades.