Recycling of printed products

What can the printing industry do to make it easier?

THE ENVIRONMENTAL COUNCIL OF THE
SWEDISH PRINTING INDUSTRIES

INTERGRAF

MILGRAF AB

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PROJECT MANAGEMENT Marie Silfverstolpe
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FOREWORD

THE ENVIRONMENTAL COUNCIL of the Swedish Printing Industry was the leading partner in the initial project carried out in the year 1999/2000.

The Environmental Council of the Swedish Printing Industry is a joint body bringing together the Swedish Graphic Companies' Federation, Swedish Newspaper Publishers' Association, the Graphic Workers Union, the Union of Clerical and Technical employees, the Swedish Organisation for Managers, and the Swedish Association of Graduate Engineers.

ADDITIONAL PARTNERS in the original project were:

- Febelgra, the Belgian Federation of Graphic Industries
- Intergraf, the International Confederation for Printing and Allied Industries
- TNO, the Dutch Institute of Industrial Technology via its department for paper and board
- Tryckeri AB Primo, a Swedish printing company
- Milgraf AB.

The original project enjoyed the support of the **European Commission** via the Leonardo Programme. It aims at stimulating cooperation and research on environmental, educational or industrial subjects among European partners.

The Swedish paper industry, mainly SCA and their mill in Ortviken and Aylesford Newsprint, has supported the project with knowledge and information. Svenskt Papper AB has also supported the project.

The project does not aim at reporting about the latest scientific developments in the field of paper recovery and recyclability. The findings of different scientific reports were taken into consideration. The purpose is to identify problem areas in the field of collected waste paper and to suggest solutions to reduce their impact on the paper recycling process.

In 2008 Intergraf undertook to produce an updated version.

INTERGRAF is also a partner of the "**European Declaration on Paper Recycling**", jointly signed by several industry associations which promote the effective recycling of waste paper. The first edition of the European Declaration was signed in 2001 and the second one in 2006.

CHAPTER 1

INTRODUCTION

ENVIRONMENTAL AWARENESS has acquired a strategic importance for European countries and the European Commission. So far the European Commission has refrained from introducing legislation that would request the recycling of waste graphic products. A European legislation on packaging and packaging waste has however been worked out. The European Commission is active in the field of forest certification, competitiveness of the recycling industries, "negotiated agreement" instruments, and standardisation issues.

At national level, most European countries have included waste management and recycling activities among their environmental concerns. Among measures implemented by European countries, print buyers and producers of graphic products are requested to contribute to a high level of waste paper collection and increasing recycling rates. In some countries laws and regulations were adopted, while others rely on voluntary agreements. Some countries levy higher taxes or fees if producers of printed material fail to take responsibility for waste paper management. Finally, European citizens also put pressure on actors in the "paper communication chain" to place products on the market with a low environmental impact. A significant part of the solution towards a high recycling rate is the production of products enabling an easy recycling process.

The rapid development of information technology makes it possible to choose between different media when sending a message, publishing information literature, or providing entertainment. This puts increased commercial pressure on the printing industry, which must demonstrate that environmental aspects are taken into consideration throughout the life cycle of printed products.

The fact that paper is made from renewable sources is the primary argument in favour of printed products, compared with other media. A further argument is that it can be recycled. This document represents a contribution of the European printing industry towards increasing the recycling of graphic products. It aims at answering key questions about the recycling process and distributing knowledge about the recyclability of printed products to both the printing industry and to its customers.

BACKGROUND

THE HUSBANDRY OF RECYCLED paper to produce new paper is important in an ecological society, because it leads to the effective utilisation of raw materials and a reduction in landfill deposits. Paper recycling reduces the costs of waste management, since paper is a large proportion of traditional waste. In terms of weight, paper and board make up the largest part of solid waste.

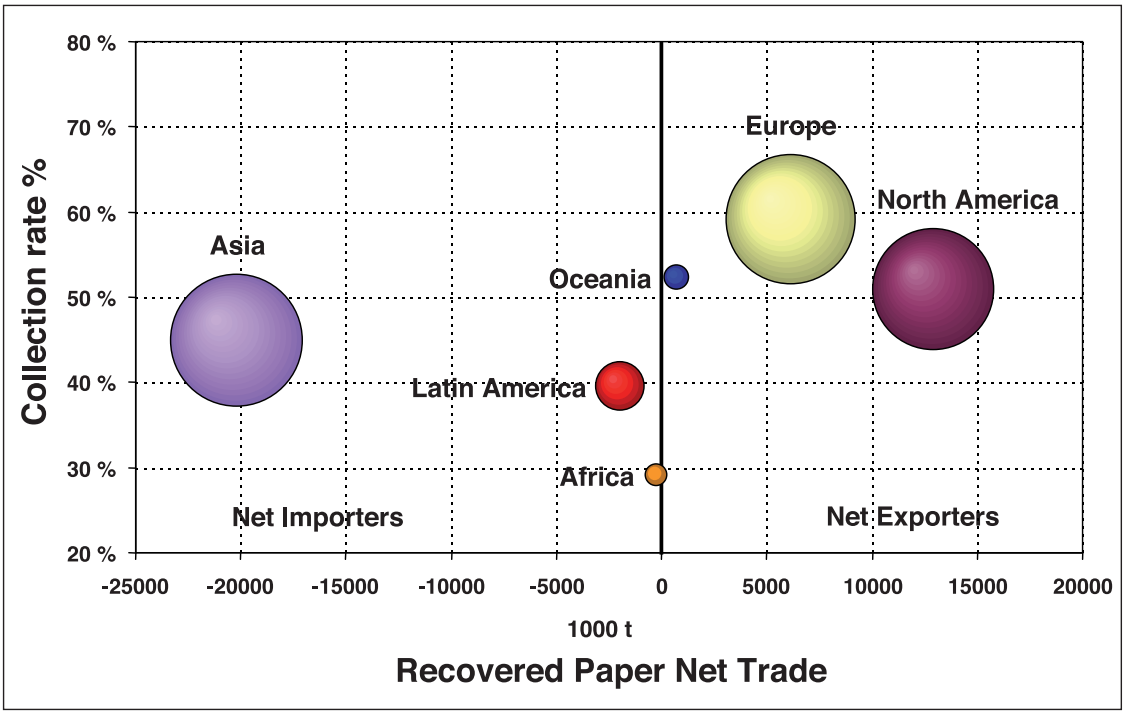
Through recycling paper valuable land is conserved – about 3 square metres per ton of paper. The recycling of paper cannot be done an unlimited number of times, since certain deterioration occurs in the paper fibre and some fibres are destroyed in every recycling cycle. Dirty paper cannot be recycled. Fresh fibres from the forest must therefore be added to the system. Both fresh and recycled fibres are needed if the eco-cycle is to work.

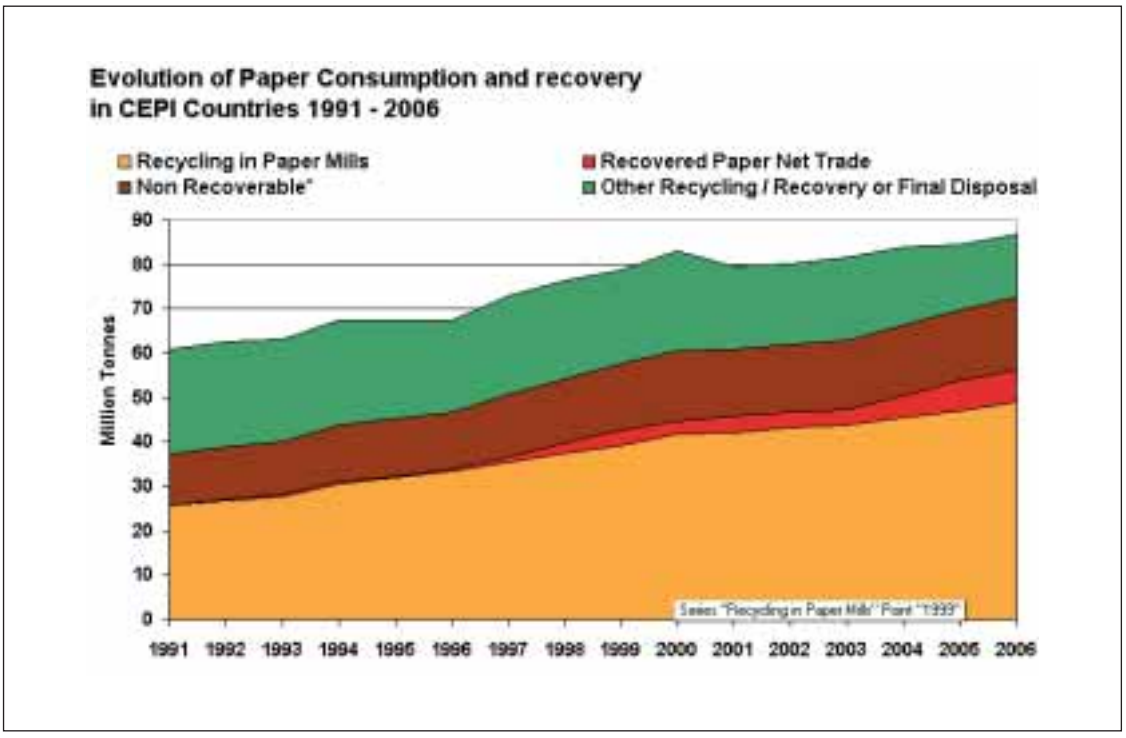
It is not possible to recover all types of paper, for example hygienic paper cannot be recovered, and cigarette paper is burned. Some paper is intended for a more permanent use, e.g. books, archives, artistic works or accounts, and the print buyer will burn some. Others are simply non-recoverable because they are bonded to other materials in their use, which are not recyclable, or they are too contaminated.

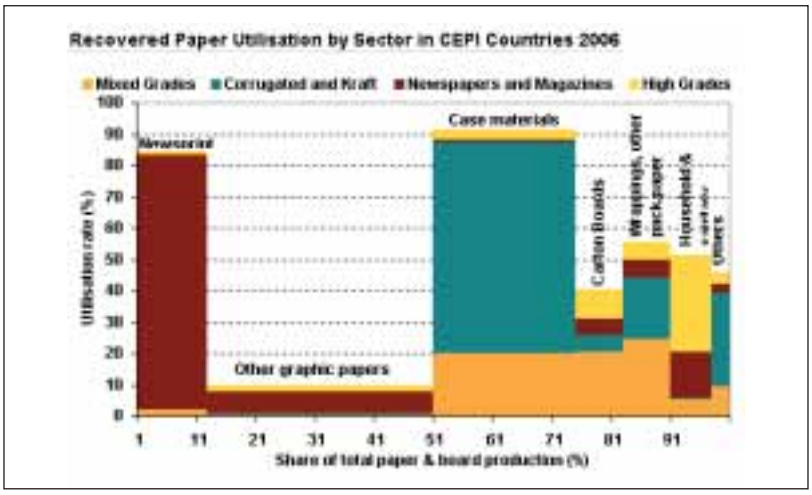
The original motivation for paper recycling was primarily economic. The intention was to use collected waste paper in the manufacturing of paper. This was primarily a concern in countries without indigenous forests, which could ensure their production of newsprint and packaging material. Today environmental concerns are the main motivation.

Recycled fibre has traditionally been used in the board industry, for packaging material etc. However, its use in the production of newsprint has increased significantly since the 1980s. Further progress has been made in the tissue sector. Growing amounts of printing and office paper are incorporated in recycled paper.

CEPI, the Confederation of European Paper Industries is monitoring closely developments in quantities of recovered and recycled paper. CEPI contributed with several graphs from their 2006 Annual Statistical Report.







There are several reasons why the use of recycled fibres has increased:

- The price of recycled fibres is competitive compared to that of fresh fibres although it fluctuates.
  The cost of transport and the environmental impact of transport are now taken into consideration. Recycling plants, often located close to large metropolitan areas, are close to the source of the raw materials, which improves the competitiveness of recycled fibres.
- Increased initiatives in various parts of the world, as well as commitment to the environment by organisations and citizens, influence the collection of paper positively.
- The regional, national, and international importance of environmental questions creates direct and indirect pressure for collection in many countries. Landfill is not seen as an acceptable alternative in many countries, while other countries are worried about waste incineration. This has led to increased pressure on collection, recycling, and reuse of paper.
- Some paper manufacturers want to project an image of being leaders in the recycling of paper.

COLLECTED PAPER comes mainly from two sources; households and printing plants. The collection of paper at offices has also become more common.

Collection from households is mainly carried out by private companies or in some countries non-profit organizations such as the scouts or sport teams who then sell it and earn money. House owners can also put waste paper in special bins in the neighbourhood that are owned either by the municipality or private companies.

PAPER FROM PRINTING PLANTS consists primarily of make ready waste, paper trimmed from sheets and reels, paper left on reel cores and unwanted or damaged paper, which may be both printed or non-printed. This paper is usually of high quality and contains little foreign material. Paper collectors pay according to the quality of the paper, i.e. what type of paper it is and how well it is sorted.

Paper collected from various points is sometimes sorted by hand on a conveyor belt.

This is often done on the premises of paper collection companies. Wrapping paper, cardboard and other unbleached products with brown fibres are removed if the paper is to be used for manufacturing of magazines or newsprint.

DIFFERENT CATEGORIES of waste paper have been established based on criteria such as the type of material, the amount of unwanted material it contains, and how it is to be used in the recycling process. More than 50 qualities are defined in the European standard list of recovered paper qualities. These categories can be divided under four broad headings:

1) High grades are top quality waste which requires little or no cleaning to make new paper. Mills use them primarily to make graphic or office paper. The high grades consist of unprinted discarded paper, trimmings from printers and converters, sheets and scraps.

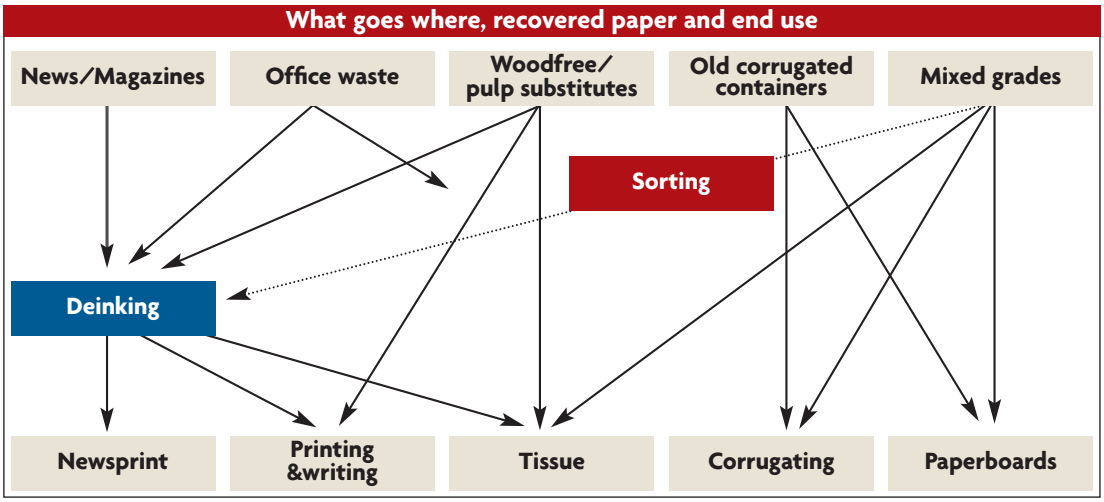
2) De-inking grades are those from which the ink is removed before the recycling process. Office waste is mainly used to make new graphic paper and hygienic paper, while newspapers and magazines are used for newsprint.

3) Kraft grades come from unbleached packaging materials such as paper sacks. They are used for new packaging material.

4) Low grades consist of mixed papers, old corrugated containers and boards. These

grades of waste paper are uneconomic to sort due to the small quantities of each type, or the excessive level of non-recyclable material. These grades are used to produce packaging .. papers and boards. Most recovered paper is produced of mixed paper.

IF THE DISTANCE of the paper mill is too far from collection locations, or if the quality of the collected paper is insufficient, incineration is economically sounder than recycling. Most of the collected paper is an important complement to a finite amount of raw material. For example, the sorting and separate collection of packaging is relatively expensive and represents only 10% of the total flow of paper.



CHAPTER 2

EXISTING LEGISLATION

2.1 WASTE MANAGEMENT

THE EU WASTE MANAGEMENT DIRECTIVE 94/62/EC, Packaging and Packaging Waste, harmonizes national rules on the management of packaging waste.

At the end of 2006, the Commission presented a report on the implementation of the Packaging Directive and on the options for increasing the prevention and reuse of packaging. Directive 2005/20/EC sets a later deadline for the ten new Member States (the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia) to meet the targets of the revised Packaging Directive.

The Directive covers all types of packaging (paper, board, plastic and metal) that is on the market in the Community as well as all packaging waste. This is regardless whether it is used or released at industrial or commercial sites, in offices, shops, services or households or in any other manner, despite the choice of material used.

The Directive sets priorities. The first priority is to prevent the production of waste. Secondly, reuse of the packaging, thirdly recycling and other forms of recovering packaging waste, and finally a reduction in the disposal of such waste. The targets for recovery and recycling of waste must be

achieved according to a fixed plan and the Directive needs to be revised every five years.

The Directive requires member states to ensure that 50 to 65% of all waste is recovered from the waste stream and between 25 and 45% is recycled with a minimum of 15% of each type of material being recycled.

Many of the member states have already had such systems for collecting and recovery of packaging waste in place for several years. Some countries have solved this through voluntary agreements between industry and government. In other countries a national law exists. There are different targets for recovery, recycling and incineration in various European countries. In order to overcome the problem of varying terminology, CEN standards on recycling measurement were worked out.

2.2 WASTE PREVENTION & RECYCLING

THE EUROPEAN COMMISSION proposed a Thematic Strategy on Waste Prevention and Recycling (December 2005), which sets up a framework for a holistic review of the existing EU waste policy, based on prevention and recycling. The Strategy shifts the focus of existing EU waste policies from preventing pollution to a more comprehensive approach. Some of its provisions have a direct link with our subject:

- **Prevention.** Member states will be required to develop waste prevention policies that will "reach out to the individuals and businesses" responsible for waste generated in the first place. These will have to be adopted within three years after the adoption of the revised waste framework directive.
- **Recycling.** EU-wide environmental standards on recycling will be adopted to "support the development of an EU market for secondary (recycled) materials".

The document describes the EU Strategy, but does however not prescribe any specific targets.

CHAPTER 3

ECO CYCLE

3.1 DISTURBANCE OF THE NATURAL ECO CYCLE

NATURAL LAWS GOVERN nature and humanity's conditions for existence. In nature there are two main types of processes, one is slow and one is fast.

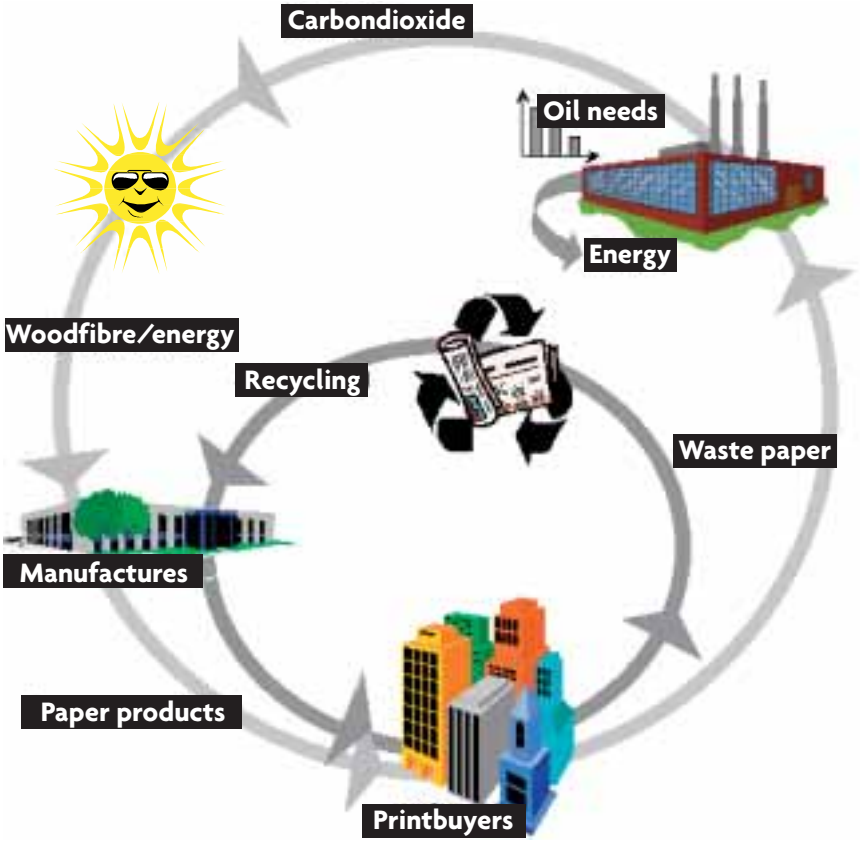
The slow process occurs in the heat and high pressure deep within the earth's crust. During a time span covering millions of years, small particles are compressed into oil, coal, iron, and copper ore etc. These resources are called finite since they are renewed very slowly.

The fast process takes place every second in green plants and is called photosynthesis. The green cells in a plant, driven by solar energy, use water and carbon dioxide to create sugar. All the oxygen in the air around us has been created through this process. Resources, such as forests, farmland and pastures, are renewable resources for humanity. Harvesting of forest resources should not exceed the replantation potential.

Herbivores (plant eating animals), due to decomposition in their cells, partly use the energy-rich compounds as nutriment and partly all other substances like protein and fat, that have been generated in green plants. Carnivores (flesh-eating animals) get their nutrition from secondary sources, namely from the animals they eat. When dead plants and animals decompose, water and carbon dioxide are released, and the chain is closed and can begin again.

However, if the food chain is disturbed in large areas of forest, such as rain forest, and impoverishes, the amount of oxygen decreases and the amount of carbon dioxide increases.

The resources, which are available to us under the earth's crust, will be depleted. The earth's population is continually increasing. Today 20% of the earth's population uses 80% of its resources. The remaining 80% of the population want better living conditions, meaning further depletion of the earth's resources, something which the earth's ecosystem will not be able to handle. Not only will our resources be depleted, but waste will also take up parts of the earth that are needed for agriculture.



The sun is the driving force behind the renewal of forests. In growing trees, water and carbon dioxide are transformed into wood fibre with the help of the sun. The wood fibres are used for production of timber products such as pulp and paper, as well as energy. When the waste paper is burned or broken down, carbon dioxide is released. The trees to be reused in photosynthesis absorb carbon dioxide. When the forest is cultivated in a sustainable way the process is ongoing.

3.2 CLOSING THE ECO-CYCLE: SUSTAINABLE FOREST MANAGEMENT

THE FOREST IS A PLACE for people, animals and plants to co-exist. Biodiversity is what makes our planet not only habitable but beautiful. We depend on the natural richness of our planet for the food, energy, wood, raw materials, clean air and clean water which make life possible and drive our economy. But we also look to our natural environment for less tangible things such as aesthetic pleasure, artistic inspiration and recreation.

The forest is also a place where trees and other plants grow naturally and, under proper management and control, provides a source of fibres for future generations. The forest and forest-based products are renewable and the fibres used in papermaking can be reused.

Throughout Europe, forest management has changed over the recent years to include more environmental aspects. Under new forestry policies, the preservation of nature has become as important as the production of wood.

Towards sustainable forestry

The forest industry is doing considerable research and development to ensure that new forest management methods are in harmony with the natural environment. The combination of daily concerns for nature conservation, adapted forest management and the planning of ecological landscaping are producing positive results.

Large forest areas benefit from special care for environment preservation

In some European countries the forest industry is involved in preservation programmes and has managed to combine rational forestry management with good nature conservation. Such programmes ensure the survival of rare plants and animals.

Nature values recreated

New forestry policies try not only to preserve the nature values, but also to recreate an ideal environment, lost due to earlier poorly adapted human activities. Important goals include increasing the share of deciduous trees and old trees. More dead trees are now left untouched to provide habitats for many endangered species. From a time perspective such work will need to stretch over several hundred years.

Environmental certification in forestry

The forest industry is collaborating with environmental organisations and other parties to create a system of environmental certification in forestry. Paper is based on a natural resource which is renewable, recyclable and it is a source of energy after use. The pulp and paper industry are in a position to meet all the demands of sustainable development within the forest, the production of pulp and paper, and the use and recycling of pulp and paper products.

Pulp and paper are today produced in an environmentally adjusted process, which effectively rescues potential emissions from water and air. The emission of sulphur dioxide to air has been reduced by 90% since 1970, while emissions to water of oxygen-consuming materials has been reduced by 85% over the same period.

In some parts of the world intensive forest harvesting could lead to shortages of the raw material. If forests were cut down without replanting, soil erosion and desertification are the natural consequences.

According to Wikipedia, the consequences of the reduction of rain forest areas in recent decades can be described as follows:

Tropical and temperate rain forests have been subjected to heavy logging and agricultural clearance throughout the 20th century, and the area covered by rainforests around the world is rapidly shrinking. Protection and regeneration of the rainforests is a key goal of many environmental charities and organizations. Another factor causing the loss of rainforest is expanding urban areas.

About half of the mature tropical rainforests, between 750 to 800 million hectares of the original 1.5 to 1.6 billion hectares that once graced the planet have already been felled. The devastation is already acute in South East Asia, the second of the world's great biodiversity hot spots. Most of what remains is in the Amazon basin, where the Amazon rainforest covered more than 600 million hectares, an area nearly two thirds the size of the United States. The forests are being destroyed at an ever-quickening pace. Unless significant measures are taken on a world-wide basis to preserve them, by 2030 there will only be 10% remaining with another 10% in a degraded condition. 80% will have been lost and with them the natural diversity they contain will become extinct.

European forests are generally recognised as well maintained. The annual rate of growth exceeds harvesting by 193 million m_. It is a result of good forest management, care, harvesting and reforestation.

Many forest companies are environmentally certified according to ISO 14001 or EMAS, and part of their environmental policy is often to act to maintain biodiversity and to manage their forests using ecologically sound methods. The main systems used by forest companies are the **FSC-standard** (Forest Stewardship Council), practising silviculture (the cultivation of the forest) and the standard of **Pan European Forest Certification**.

FSC is an independent international membership organisation whose aim is to encourage an adjusted environment and economically strong use of the world's forest resources. The international FSC organisation has established an internationally valid accreditation programme.

FSC's ten principles are:

1) Compliance with Laws and FSC Principles
Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

2) Tenure and Use Rights and
Responsibilities
Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

3) Indigenous Peoples' Rights
The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognised and respected.

4) Community Relations and Worker's Rights
Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.

5) Benefits from the Forest
Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

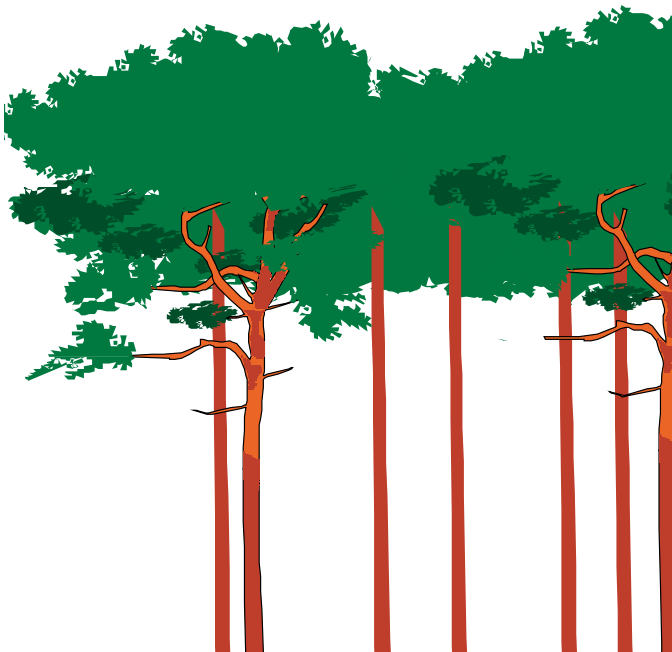
6) Environmental Impact
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

7) Management Plan
A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.

8) Monitoring and Assessment
Monitoring shall be conducted -- appropriate to the scale and intensity of forest management -- to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

9) Maintenance of High Conservation Value Forests
Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

10) Plantations
Plantations shall be planned and managed in accordance with Principles and Criteria 1 - 9, and Principle 10 and its Criteria. While plantations can provide an array of social and eco-



nomic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

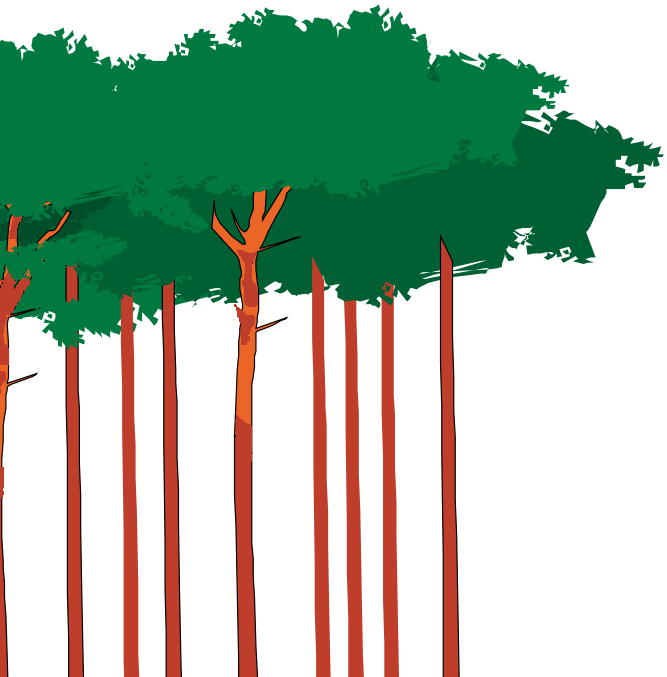
Forest owners in some European countries initiated another certification system, PEFC (Pan-European Forest Certification).

Objectives of Pan-European Forest Certification:

1) A voluntary private sector initiative based on sustainable forest management at the national or regional level. The six criteria for sustainable forest management are:

- Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.
- Maintenance of the heath and vitality forest eco-systems.
- Maintenance and encouragement of productive functions of forests (wood and non-wood).
- Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.
- Maintenance and appropriate enhancement of protective functions in forest management.
- Maintenance of other socio-economic functions and conditions.

2) Strengthening and enhancing of the image of forestry and wood as renewable raw materials.



3) Promotion of economically, viable, environmentally appropriate and socially beneficial management of forests.

4) Involvement of independent third party audit.

5) Regional certification levels.

The most important differences between the two systems are:

- While FSC distributes the influence evenly between economic interests, the environmental movement, and societal representatives, PEFC gives the right to the forest owner to decide on the cultivation of the forest.
- PEFC criteria for social and environmental management are less stringent, e.g. logging of original forests in Europe is permitted.
- PEFC certification can be done centrally for a large area. It cannot be guaranteed that concrete measures will be taken for particular forest properties.

Chain of Custody

Growing customer and stakeholder demands for assurance that wood, paper, and also building products come from forests that are responsibly managed, led to the development of a new instrument referred to as a "chain of custody" certification standard.

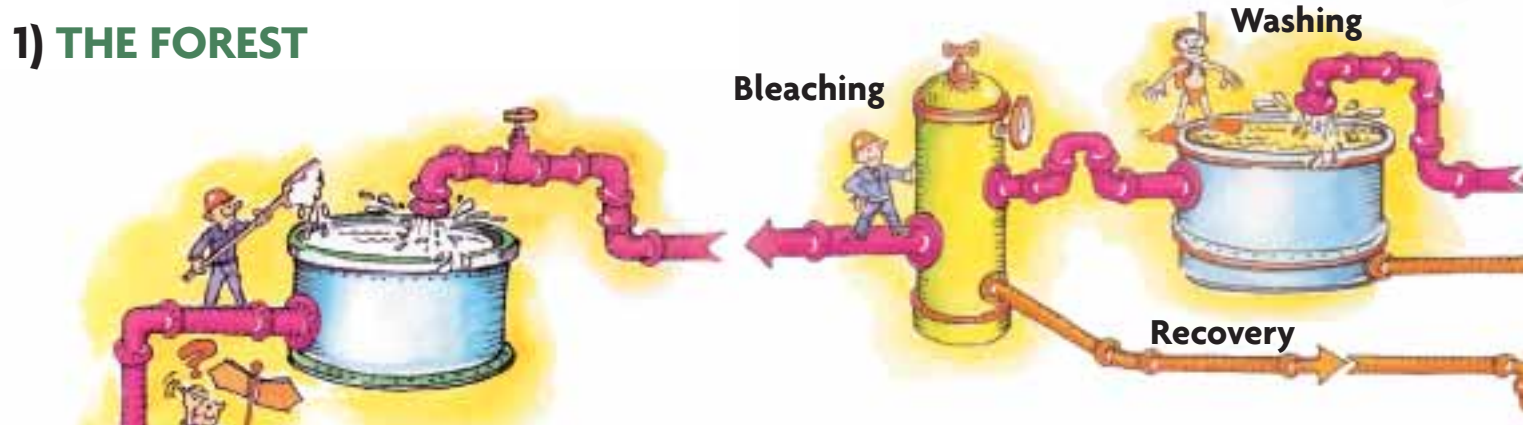
The concept was developed among stakeholders, and some recognised accreditation bodies were entrusted with the task to develop criteria ensuring that business actors have the systems and controls in place to meet their stated environmental objectives.

These schemes can accommodate the combination of recycled waste paper and certified wood fibre, to help meet the overall objective of producing environmentally responsible paper products. Numerous printers throughout EU countries have engaged in such schemes and have the possibility to promote their use among customers.

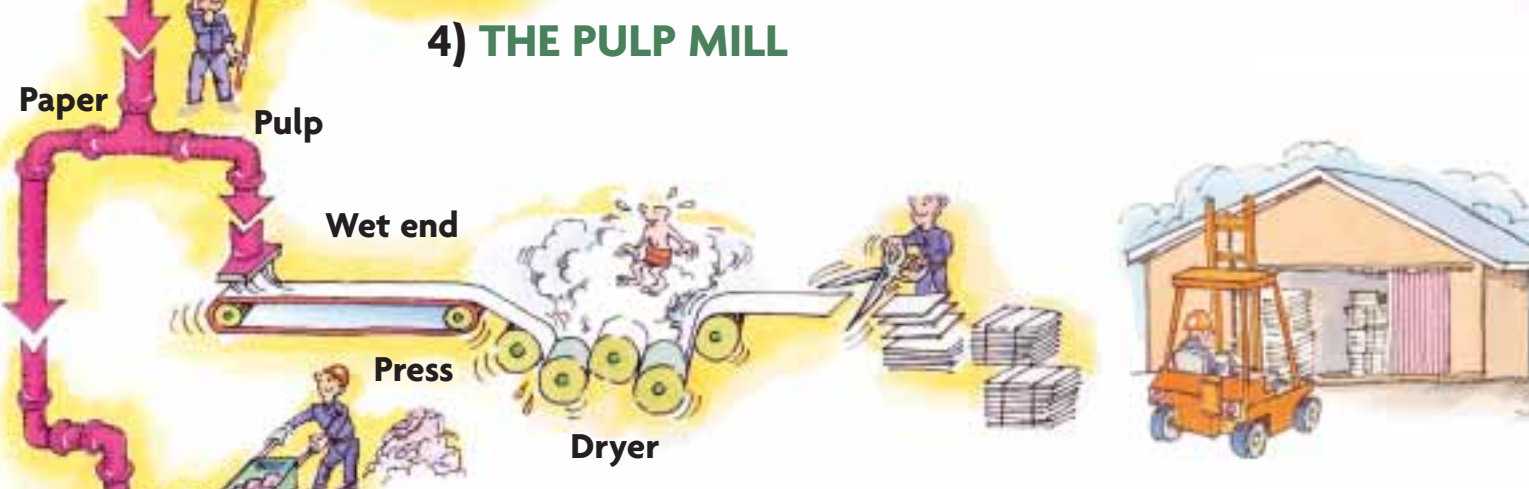
This certification involves inspection and auditing of the land from which the timber and pulpwood originate and tracking it through all the steps of the production process until it reaches the end user. The certification is combined with a FSC or PEFC accreditation.

FROM TREE TO PAPER

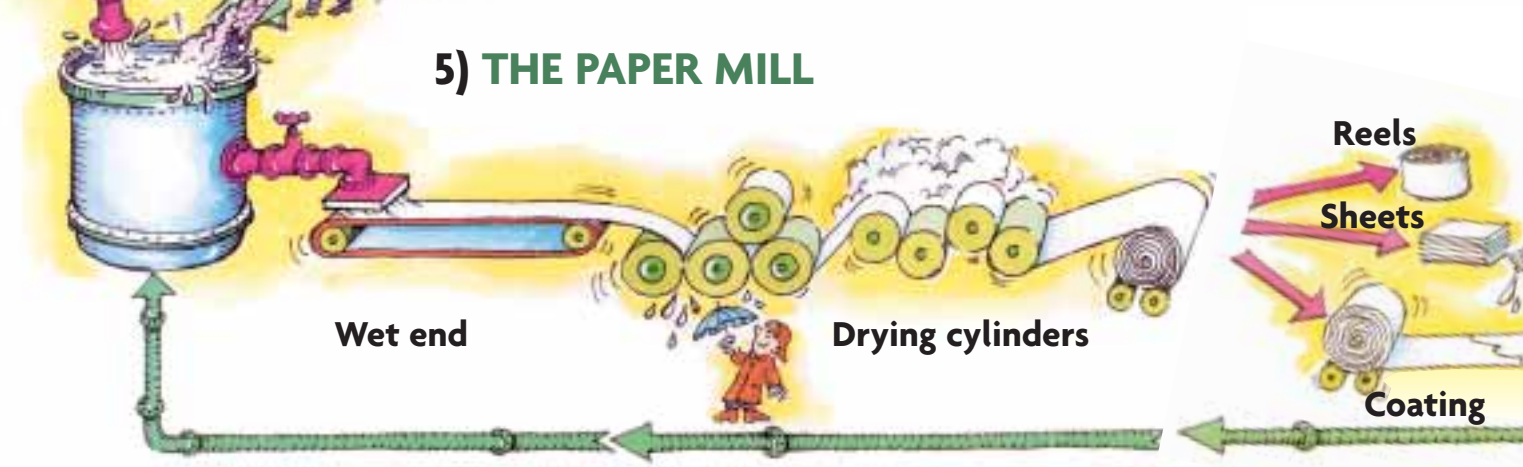
1) THE FOREST

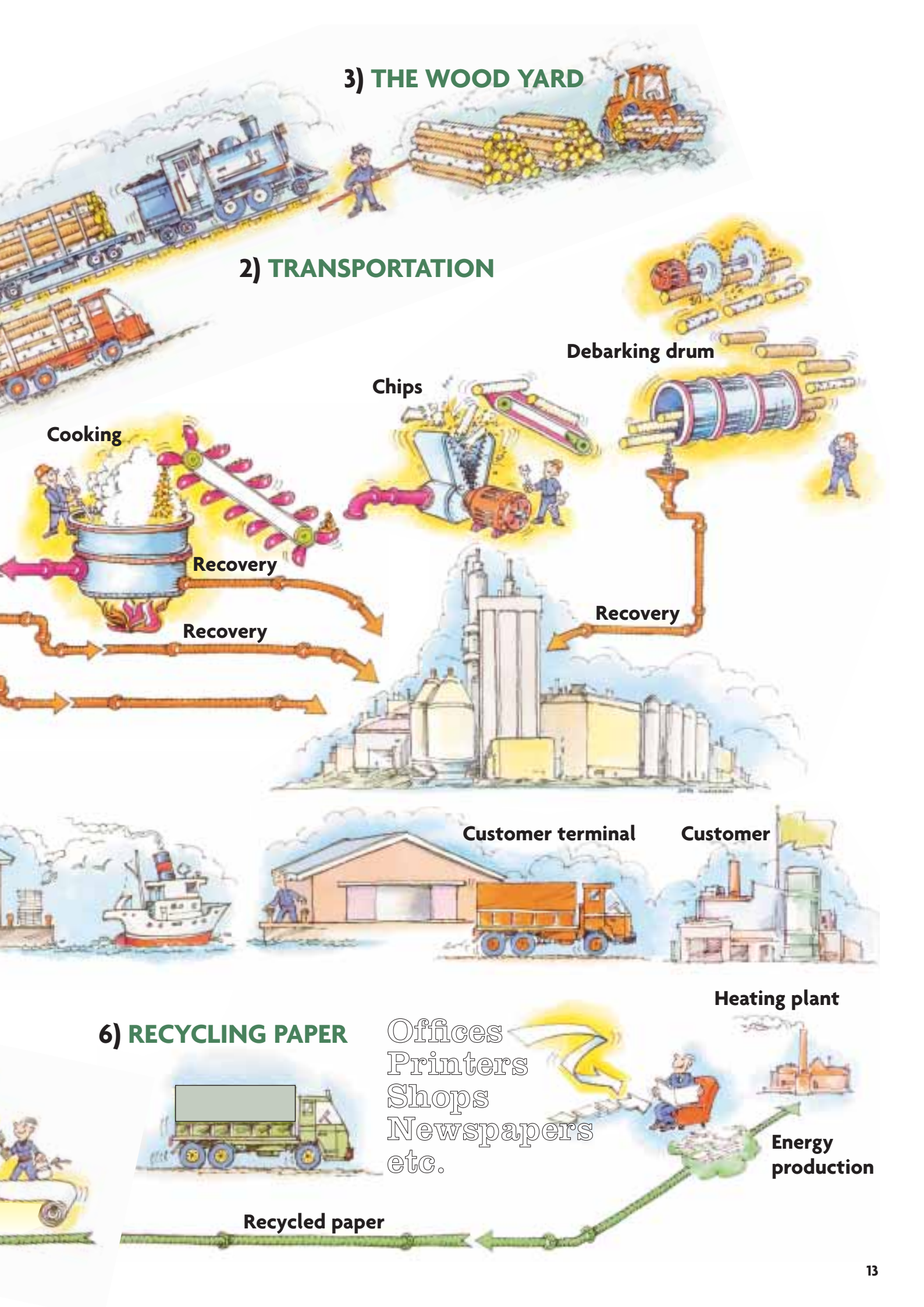


4) THE PULP MILL



5) THE PAPER MILL




3) THE WOOD YARD
2) TRANSPORTATION
Debarking drum
Chips
Cooking
Recovery
Recovery
Recovery
Customer terminal
Customer
Heating plant
6) RECYCLING PAPER
Offices
Printers
Shops
Newspapers
etc.
Energy production
Recycled paper

CHAPTER 4

PAPER PRODUCTION

PAPER CONSISTS of randomly distributed fibres – normally cellulose – that are attached in a network. Various additives can be added, such as adhesive, fillers and pigments.

There are many types of paper. The characteristics of different papers depend on the raw materials, the treatment of raw materials, added substances and the end treatment of the paper. The diverse paper qualities can be used for many different purposes – from strong paper in, for example, grocery bags to soft paper, like that found in kitchen tissue.

The primary material in the production of paper is pulp, which consists of cellulose fibres. The fibres are either fresh fibres from wood of the coniferous and deciduous trees or recycled fibres from collected paper. There are two principal types of pulp, depending on method of the production: chemical or mechanical.

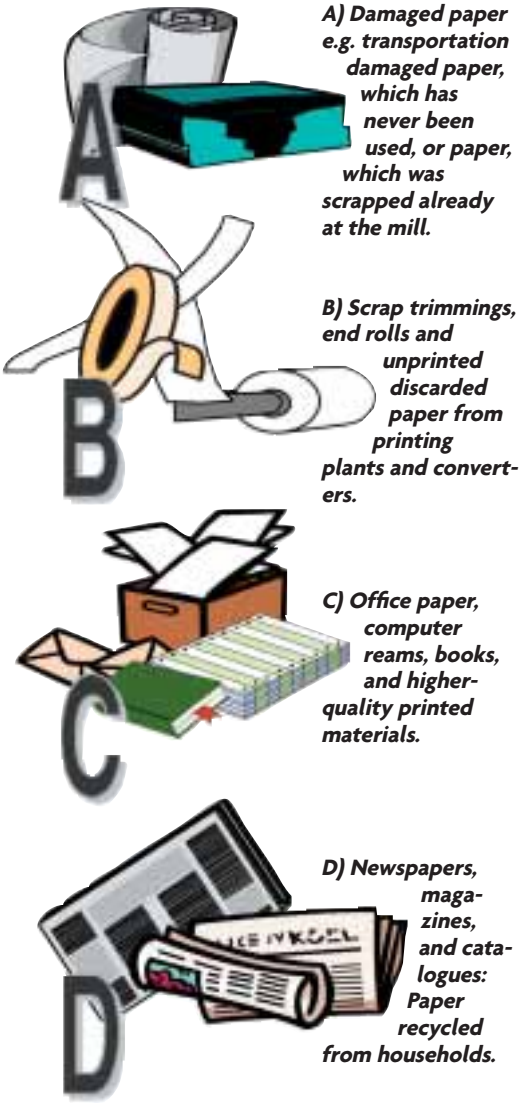
Mechanical pulp is produced primarily from spruce wood and, during production, the fibres are liberated only through mechanical processing of the wood. In the production of **chemical pulp**, cellulose fibres are extracted by boiling with chemical additives. The chemical pulp consists both of long-fibred pulp from coniferous trees and of short-fibred pulp from deciduous trees.

Recycled paper is a type of paper that completely or partially consists of recycled fibres. These fibres can have very different origins and therefore also very different characteristics when it comes to being a component in new paper.

When producing graphic papers based on recycled fibres, the paper mill wants as high quality raw materials as possible. This includes as little ink as possible to facilitate de-inking, or preferably not having to de-ink at all. It also includes a large proportion of paper from chemical pulp, which produces the strongest fibres.

Recycled fibres can be divided into four groups:
A) Damaged paper e.g. transportation damaged paper that has never been used, or paper which was already scrapped at the mill.

Different types of recycled fibres



A) Damaged paper e.g. transportation damaged paper, which has never been used, or paper, which was scrapped already at the mill.

B) Scrap trimmings, end rolls and unprinted discarded paper from printing plants and converters.

C) Office paper, computer reams, books, and higher-quality printed materials.

D) Newspapers, magazines, and catalogues: Paper recycled from households.

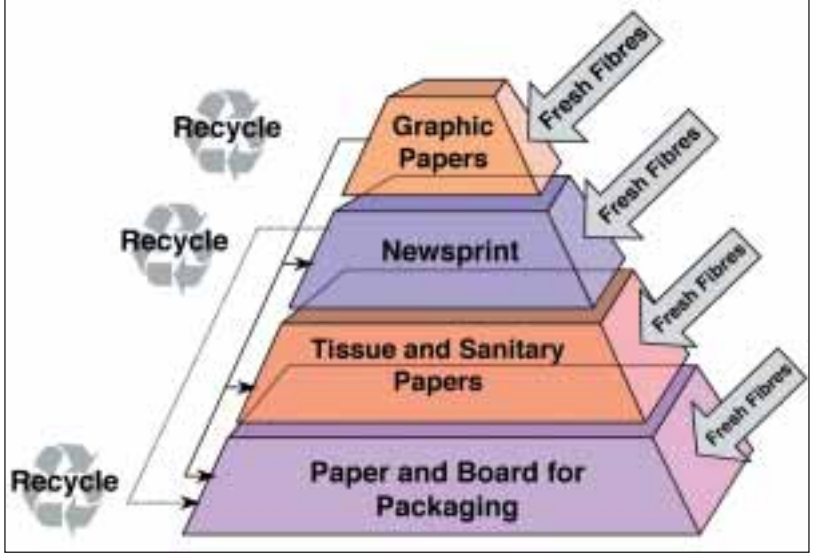
B) Scrap trimmings, end rolls and unprinted discarded paper from printing plants and converters.
C) Office paper, computer reams, books and higher-quality printed materials.
D) Newspapers, magazines and catalogues as well as paper recycled from households.

Fibres from groups A and B are called 'pre-consumer waste', i.e. paper which is recycled before print buyers use it. This type of recycled paper has been used for a long time to replace fresh pulp, often without regarding it as recycled pulp. Fibres from groups C and D are called 'post-consumer waste' i.e. paper that

To produce a ton of the various pulps requires:

Raw material	Amount, tons	One ton of a final product
Wood	1.1	Mechanical pulp
Wood	2	Chemical pulp
Recycled paper	1.1/1.4	Recycled fibre pulp

The recycability and the use of recycled fibres in making new paper



Utilisation of used paper and board in the production process.

has been used by print buyers before being recycled. This type of recycled paper used to be landfilled or incinerated, leading thereby to an environmental impact. Post-consumer waste contains many different paper qualities. So apart from having to remove the ink, the fibre itself is much weaker. It may contain contaminants, (which will be considered later) and have to be excluded before the recycled paper can be reused.

The largest category (by production) of recycled fibre pulps is corrugated/paperboard, followed by printing and writing paper, newsprint and tissue/towel products. The overall recycled content in these groups varies with tissue and towel paper containing the highest percentage of recycled material, and printing paper the lowest.

Graphic paper can be turned into virtually any grade of paper, but it can accept very little fibre from other paper categories into its own production. The most resource-efficient method is to use high grade scrap paper in graphic paper, where the fibres can be reused many times. If printing scraps are turned into tissue and towel, they will not be recycled any further time. Scrap paper cannot be remade into printing paper if it is turned into newsprint or corrugated fibreboard.

Recovered paper cannot be recycled forever since fibres wear out. They can be recycled about 5–10 times. Recycled fibre pulp is different from fresh fibre pulp in several ways. Some of the differences are:

- filler/ash content
- age of fibre (normally recycling of fibres is performed within three or four months after its production time)
- the bonding ability
- mix of fibres, content and origin
- chemical additives from the original paper production and de-inking
- contaminants.

The weakest fibre is found in solid board, which is made from 100% mixed waste. It is not possible to make high quality writing paper from newsprint. The fibres do neither have the necessary optical nor physical properties.

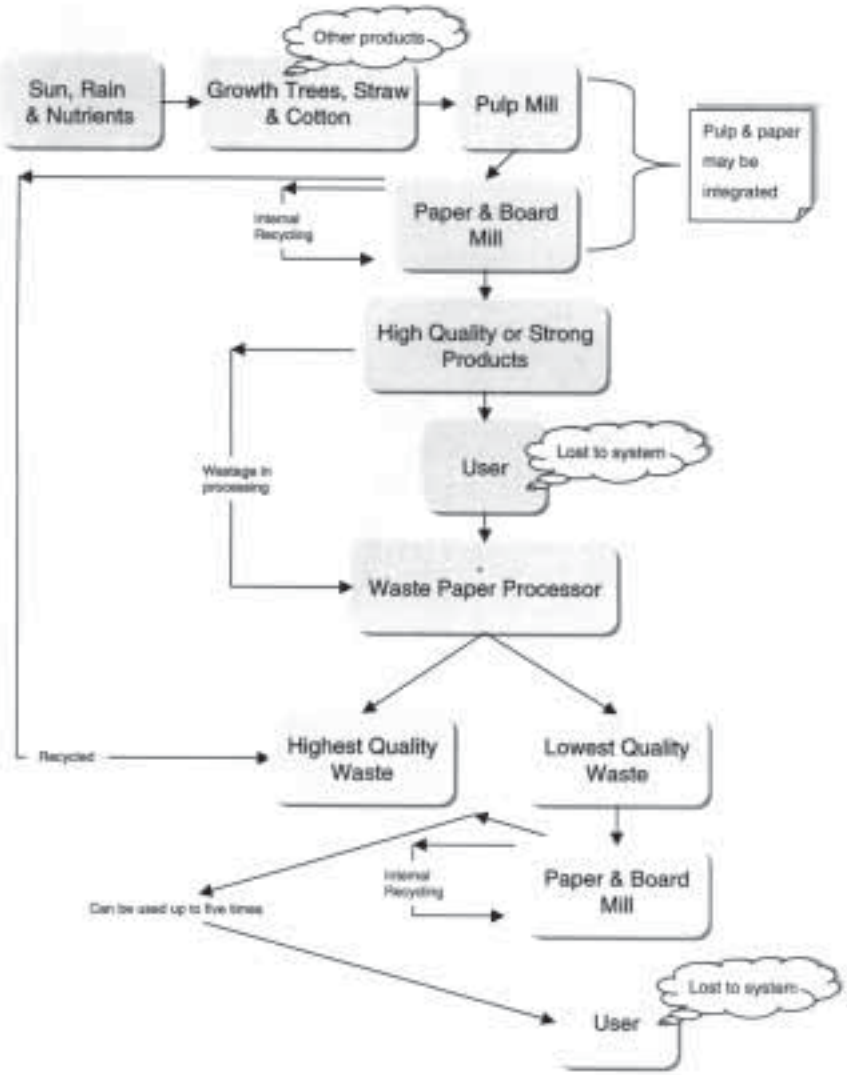
The recycling process for newspapers and magazines generates a process residue (cellulose fibres, fillers, inks) of 10–20%. For tissue the residue is up to 50% of the raw material. Most of the process residue is often burned on site to produce steam and power. This is only possible for big mills. Tissue mills will have it incinerated at a cement mill for example. Course rejects consisting of plastic wrappers, staples, CDs etc. are landfilled.

The finished pulp can be pumped from the pulp mill directly to a nearby paper mill and further to the papermaking machine. If not, the fibres are delivered to the paper mill dried, as pulp-sheet in bale or as pumped pulp.

4.1 PULP PRODUCTION

4.1.1 MECHANICAL PULP

THERE ARE TWO main methods for making mechanical pulp: grinding and refining. There are different varieties of the refining pulp: thermomechanical (TMP) and chemothermomechanical (CTMP). A mechanical pulp consists of a mix of whole fibres and fibre



fragments of different sizes. Paper containing a high level of mechanical pulp and a smaller level of chemical pulp is often called wood containing paper. The level of chemical pulp in wood containing paper varies in different countries. Mechanical pulp gives the paper a yellowish/grey tone with high opacity and a very smooth surface. This is used for newsprint, magazines, and LWC-paper (light weight coated).

Grinding thoroughly soaked wood against a rotating grindstone with water pouring over it produces the grinding pulp. During the mechanical treatment some fibres are torn apart.

The refining pulp is produced by chopping up the wood raw material to wood chips, which are then fed between two plates in a refiner. If the wood chips are treated with steam in a pre-heater under high pressure before they are refined, it is called thermo-mechanical pulp, which is light-coloured and has longer fibres. A further development of the thermo-mechanical pulp is CTMP pulp, in which the wood chips are impregnated with chemicals before the grinding. The end result is an even lighter-coloured pulp with better strength characteristics.

4.1.2 CHEMICAL PULP

CHEMICAL PULP is produced by first chopping the logs into wood chips, which are then cooked with chemicals under high pressure using one of two methods: the sulphate (kraft) or the sulphite process. The difference lies primarily in the cooking chemicals, which in the sulphite process is an acid and in the sulphate process is an alkali. In the cooking process, approximately half of the wood dissolves in the boiling. This part is called black liquor and the other part is the pulp. The pulp is cleaned (the black liquor is separated out) before the bleaching process.

A chemical pulp or paper is called wood-free. (In commercial practice a small percentage of mechanical fibres is usually accepted)

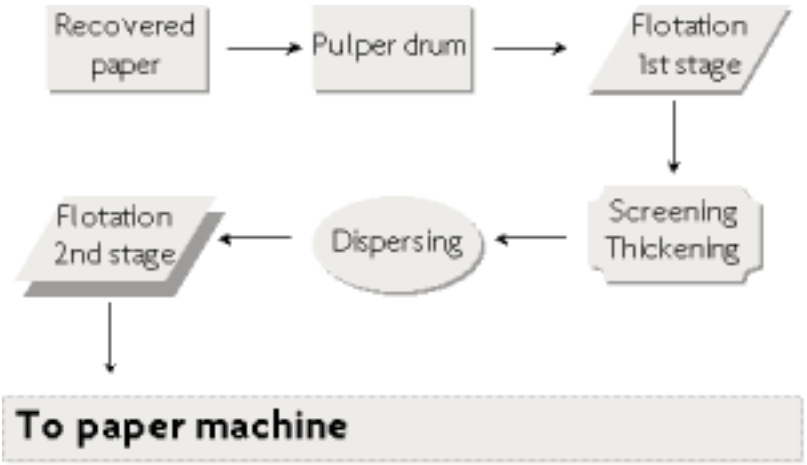
4.1.3 PULP FROM RECYCLED PAPER

QUALITIES SUCH AS newsprint, tissue and paperboard are the products primarily produced using recycled paper as raw material. To best use the collected paper, it must first be sorted into different categories. The sorting can take place either directly in the paper mill or at special sorting stations. How the sorting takes place depends to a large extent on how the collection of the paper takes place, which varies from country to country.

White unprinted paper from printers can, upon arrival at the mill, be dumped directly into a pulper and diluted with water. This is a huge tank that liberates the paper fibres from the paperweb by agitation.

In most cases bales or loose paper waste is transported to the pulper using conveyor belts. The raw material is then transformed into a pumpable state without destroying the fibres. The pulp passes through a rough filtering, where plastic, rope, string, etc. is removed. Thereafter the pulp passes through another filtering, where heavier particles, like staples and stones, are removed, thereby diminishing the risk of damage in the processes that follow.

Before printed paper, such as office waste and newspapers, can be processed into graphical paper grades, the ink needs to be



removed. There are two main processes for de-inking waste paper – washing and flotation.

In the **washing** process the waste paper is placed in a pulper with large quantities of water and broken down to slurry. Staples and other undesirable material are removed by using centrifugal screens. Most of the water containing the dispersed ink is drained through slots or screens that allow ink particles through. The pulp does not pass through. Adhesive particles, known as 'stickies', are removed by fine screening.

In the **flotation** process the waste is made into slurry and contaminants are removed. Special surfactant chemicals are added to the slurry, which produces froth on the top of the pulp. Air is blown into the slurry. The ink adheres to the bubbles of air and rises to the surface. As the bubbles reach the top, a foam layer is formed that traps the ink. The foam is removed before the bubbles break so the ink does not go back into the pulp.

When completed, the clean, useful fibre is piped to a storage chest and consequently to the papermaking machine, while the excess materials are skimmed off or dropped through centrifugal force into a sludge that is then burned for fuel, otherwise used or landfilled.

4.2 PULP PREPARATION

DEPENDING ON the intended use, the pulp is beaten or refined in different ways. The grinding creates increased binding characteristics. After the grinding, the pulp and the additives are mixed in very large chests. Fillers and dyes are added. The end result, which is a very thin liquid with only about 0.5 to 0.8% fibres, is called pulp/stock, and goes on to the paper machine.

4.3 PAPERMAKING

THE PAPERMAKING machine consists of the following parts: wet section, press section, dryer section, calendar and converting section.

The wet section comprises the head box and the wire. The head box is a discharge box for the dilute paper stock and enables the stock to flow on to the wire section through narrow openings. The wire is a woven plastic mesh screen belt, which can be 35 metres long. As the paper stock flows from the head box onto the wire the water drains through the mesh leaving the fibres as a mat on top of the mesh. The most substantial drainage of the pulp takes place in the wire section. It is here the paper is formed and the fibres assume their direction. Most of the fibres line up in the direction of travel (called the grain or machine direction), which results in the paper having different formations and characteristics along and across the web. Because of the drainage method, the paper may also have different properties on the two sides of the web. It may also be given a watermark using pressure from a dandy roll.

The paper web leaves the wire section, where roughly 90% of the water has been removed, and is then led further into the press section. This consists of a number of sets of heavy rollers through which the moist paper passes, like a mangle. More moisture is squeezed out and drawn away by suction. Upon exiting the press section, the dryness level of the paper is such that further mechanical drainage is often not possible.

The paper then passes to the drier section, which consists of a number of steam-heated steel cylinders between which the paper passes. Synthetic dryer fabrics carry the web of paper round the cylinders until the paper is dry. When producing fine paper, starch is applied to the paper surface to improve its strength and prevent loose particles from becoming detached during printing (linting). The final drying of the paper takes place in the after dryer.

The final treatment of the paper, calendering, takes place in the last section of the papermaking machine. In this operation, the paper surface is smoothened, and the paper becomes smoother.

Lastly, the paper is reeled up in large machine rolls, which are then cut down into smaller rolls. This part of the process can also take place in separate facilities after the paper has been further treated.

4.4 FINAL TREATMENT

THE CHARACTERISTICS and appearance of the paper can be supplemented and enhanced by further final treatment.

Paper with high quality demands regarding surface smoothness can be improved through coating, which means that a layer of coating is applied to the paper, either directly in the papermaking machine or in separate facilities. Depending on the amount applied, there are varieties of coated paper from pigmented to cast-coated. The coat consist of a mix of pigments, extenders such as china clay or/and chalk, (PCC, precipitated $CaCO_3$) and binders such as starch or latex. In addition, various chemicals are added to give the paper the desired characteristics. The coating improves the opacity, lightness, surface smoothness, lustre, and colour-absorption ability of the paper.

If one desires an even smoother paper surface, this can be done through supercalendering.

This is done primarily for magazines and coated papers. The paper passes through rollers, which are alternately hard (steel) and soft (cotton- or paper-covered). Through a combination of heat, pressure and friction, the paper acquires a high lustre surface. The paper becomes somewhat compressed during the calendar. The paper therefore becomes thinner than its matt finished equivalent.

4.5 STOCK IN TRADE AND DISTRIBUTION

AFTER THE PAPER has been made it has to be distributed to the publisher or printing trade. Paper is stocked at the paper mill and some orders are distributed directly to the printer, for example to newspaper printers. Other printers buy paper from merchants or wholesalers, who may stock different papermakers' products and offer a local service.

The wholesaler may be totally independent from the paper mills, or owned or in some other way connected with the paper mills. Except in the case of very large orders, it is usually the wholesaler who sells the paper.

There are three main principals to distribute the paper:

- Production order. This involves the paper mill producing a paper for a customer to a special quality, paper weight and size, and is usually a large tonnage. Even the furnish or paper content could be unique. This order is distributed directly from the paper mill to the customer.
- Stock in trade at the paper mill. This stock includes standard quality, paper weight and size. It is distributed directly from the paper mill to the printer. To be able to buy paper like this the order has to be a minimum quantity.
- Wholesaler (merchant) order. In this case the printer buys from the qualities that the dealer has in the stock. The paper is distributed directly from the wholesaler to the printer.

Other methods of purchasing and delivery exist.

To make the distribution of paper more efficient this part of the chain is subject to continuous development.

4.6 HOW WILL THE PAPER BE USED?

THERE ARE MANY kinds of paper with a wide variety of different characteristics. Thus, there are many different classifications of paper, depending on what the paper will be used for, as well as what the characteristics of the paper are, for example, surface structure, surface weight, and type of pulp, such as:

- Graphic paper – special paper – tissues – packaging paper – board
- Mechanical paper – chemical paper (woodfree) – recycled paper
- Uncoated – coated
- Finish, such as gloss – silk – matt – calendered.

To know which paper is suitable it is important to be acquainted with the different printing processes. Shortly they can be explained as follows:

Offset printing is based on the different wetting behaviours of the printing and nonprinting areas of the printing form or plate, which lie almost in the same plane. During printing, the image area's oliophilic surface accepts 'oily' printing ink while the hydrophilic non-image areas reject ink. Before the inking of images areas the printing plate is dampened with water or a solution of water, isopropanol (or a

wetting-promoting substitute) and further additives.
Relief printing which means a printing method using a raised image e.g. letterpress
Flexography printing employs direct rotary printing using resilient relief plates such as rubber, or more likely photopolymers, and fast drying solvent or waterbased inks.
Gravure is an intaglio process, that is, the image is recessed into the surface of the plate or the cylinder. In this process, the cylinder is flooded with ink, and the surface scraped clean to leave ink only in the recessed, images areas. It is then printed on to fairly absorbent substrates
Screen printing: The ink is pressed trough a sheet mounted in a frame (so called stencil), where the image is represented by openings in the sheet.

GROUPS OF PAPER

1) Graphic paper includes printing paper and office paper used for writing, printing, and image production.
1a) *Printing and writing paper* is the largest group. This paper can be used for offset printing and relief methods of printing, such as flexography and letterpress, as well as for gravure if the paper has high surface strength and smoothness. Writing paper must be treated with size to prevent the ink from spreading excessively. Examples of printing papers are:

- *Newsprint*, which is produced in large quantities. It is made mainly from wood containing fibre or recycled waste paper. This is used primarily for offset-printing.
- *Magazine paper* is used both in gravure and in offset where drying is necessary.
- *Art paper* is intended for the printing of illustrations in black and white or colour to give very high quality reproduction.

1b) *Office paper* includes for example:

- *Copy paper*, which is a lightweight grade of good quality paper used for copying. The sheet may be glazed or unglazed.
- *Bond* is a high quality standard business paper. It often carries a watermark. Available in a variety of colours as well as white. It is strong and long wearing paper, and is used for business forms, letterheads etc.
- *Other office papers* include document paper, envelope paper, sized paper, banknote paper and poster paper.

2) Special paper includes for example computer paper, continuous paper, carbon paper, stamp paper, cigarette paper, wallpaper etc.
3) Tissues are various kinds of hygienic papers, such as paper towels, toilet paper, and all kinds of tissues and napkins. In some cases a wet strength additive is added to the pulp to retain strength after moistening the sheet.
4) Packaging paper is generally brown paper and is called kraft paper. This is produced from unbleached chemical cellulose.
Belonging in this group are greaseproof paper, sack paper, bag paper, parcel wrappings, carrier bags, and liner (the raw material for corrugated paper).
5) The limit between paper and **board** is usually set at 170 g/m2. Higher grammages are normally referred to as board. It covers heavy duty materials from cheap paperboard and pulp to paste boards and heavier strawboards, chipboards and millboards. Board can be both coated and uncoated.

- *White lined chipboard* is material used for carton making, made up of various layers. The white side, which is made from bleached chemical wood pulp, goes in the outside of the carton and carries the printing. The various grey layers are composed of waste paper. White lined cardboard is used in the manufacture of cartons for all kinds of articles.
- *Corrugated board:* is made by a conversion process in which three layers of paper or paperboard are corrugated during the process. The outer layers (liners) are glued to the peaks, thus making a liner-fluting-liner sandwich. It is used to make corrugated packaging cases.
- *Packaging board:* This must cut and score, fold, bend or crease without splitting and must have good printability for the process being used.

THE CONTENT

1) Wood containing paper is paper that contains more than 10% (for Sweden) mechanical pulp. It contains lignin, which means that the paper will yellow with age or fade in sunlight. Wood containing paper usually has good opacity and high bulk but less strength and whiteness. This is used primarily for printed materials with a short lifespan.

2) Woodfree paper is paper that contains more than 90% (for Sweden) chemical pulp. The chemical pulp content requirement is different from country to country and depends upon legislation rules. The woodfree paper is often bleached and has high whiteness as well as good strength characteristics. This paper is used for most types of printed products. Since the lignin has been removed, the paper does not yellow. The opacity is normally lower than for mechanical paper.

3) Recycled paper is the raw material for newsprint, SC-B and C grades packaging paper and board.

THE TREATMENT

1) Uncoated paper is paper without coating on the surface. This is used for letterheads, copy paper, or printing paper. Most types of uncoated paper are surface sized for strength. It is used in stationary and lower quality leaflets and brochures.

2) Coated paper is paper which has been covered with a suspension of, most of the time, PCC, china clay, pigment and adhesive. Various blades and rollers ensure the removal of surplus coating and impart a smooth surface. The coating levels the minute pits between the fibres in the base paper, giving a smooth, flat surface for printing. Such paper is coated with different amounts of coating and may be divided into light coated, medium coated, high coated, and art papers. Art paper is used for printed materials such as brochures and art books.

- *Cast coated paper* gives the highest gloss surface of all coated papers and boards. It is used for labels, covers, cartons and cards.
- *Calendered or glossy paper* is paper that has gone through a calender process and can be both coated and uncoated. It is used for colour printing.
- *Machine finished paper* is a paper, which has been finished on the papermaking machine and is smooth on both sides. It is used for booklets and brochures.
- *Lightweight coated* is a thin, coated paper, which can be as light as 40 g/m2. It is used for magazines, brochures and catalogues.
- *Matt finished paper* has not passed through the supercalender and the surface is not polished. The relative roughness of the paper surface prevents light from being reflected. Can be both coated and uncoated. It is used in all kinds of high quality print work and is suitable for colour printing.
- *Machine coated* is a paper that has the coating applied whilst it is still on the paper machine. It is used for all types of coloured print.
- *Silk- or silk matt finished papers* are matt finished coated qualities, where the surface is smooth but without reflections, which means that these papers can combine high readability with high image quality.

CHAPTER 5

ENERGY

ENERGY IS NEEDED to produce both new paper and recycled paper, but much less energy is needed to produce recycled pulp. As a general rule, energy savings normally lie within the interval of 28%–70%. The actual savings depend on paper type, the production process of the paper mill, and transport distances. Production of one ton of thermo mechanical pulp (TMP) normally requires between 1.4 to 2.7 MWh of electric energy, depending on which process is being used. Of the energy added in the production of TMP, about half is in many cases recycled as steam per ton of pulp. In addition to this, burning of by-products such as bark gives approximately 0.4 MWh per ton of TMP in the form of steam.

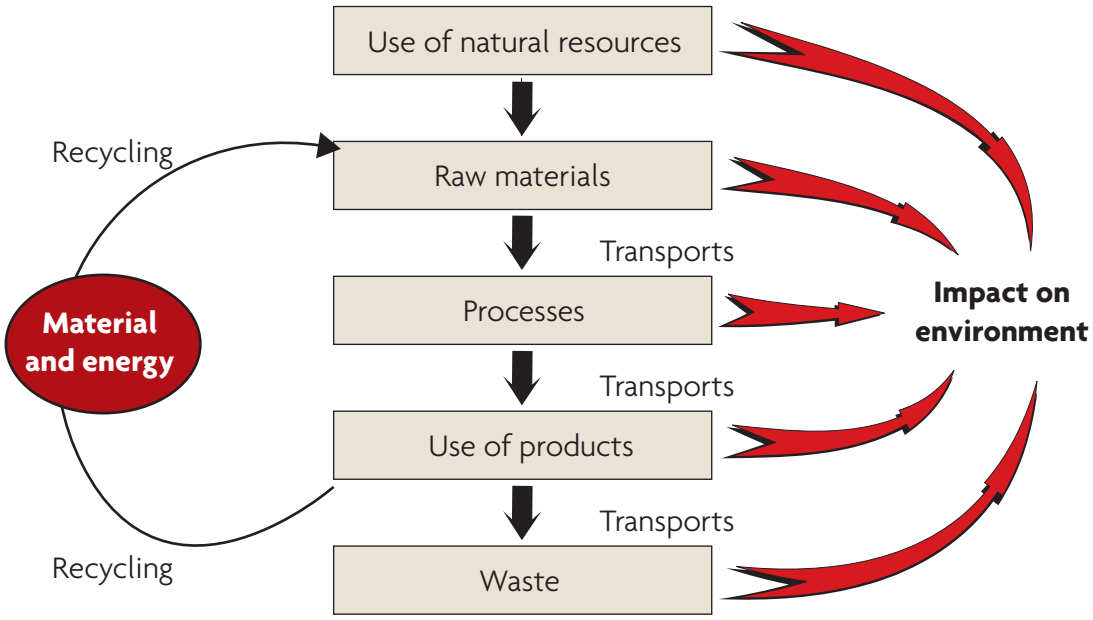
Production of a ton of recycled newsprint DIP (De-inking process) needs approximately 0.8 MWh of electrical energy, but energy consumption varies because of process steps like de-inking and bleaching, which are necessary in the production of recycled paper pulp. During production of DIP a sludge that can be burned later is created; this corresponds to approximately 0.3 MWh per ton of pulp.

The type of energy used in the production of recycled paper is mostly derived from fossil fuels like coal, oil, and natural gas. These can be partially replaced by burning waste from the production process. Fresh fibre production uses mostly bio fuel from the logging process, like bark and wood waste, as well as chemicals from the production of pulp. The amount of bio fuels used varies from country to country, but can also vary from region to region within the same country, and also depending on the type of pulp process used.

All paper cannot be collected for recycling. Some waste paper can be used for burning. Paper is an energy-rich bio fuel. If the waste paper replaces fossil fuel the emissions to the environment are reduced. This applies especially to carbon dioxide.

CHAPTER 6

LIFE CYCLE ASSESSMENT



A LCA (LIFE CYCLE ASSESSMENT) IS A COMPREHENSIVE concept for different methods to judge and describe the total environmental impact on a product, process or material. The analysis contains the whole life cycle of the production process, or activity in question, from the collection of raw materials, transportation, and production process to product use, maintenance, recycling and waste management. A LCA never describes a single product environmental impact. Several alternatives that fulfil the same function are rather compared.

There have been quite a few LCAs made for paper and printed products, and it is difficult to find an objective model. Most of the LCAs have been done at the request of one of the parts in the production chain. However, most LCAs indicate the same features and problems.

A Life Cycle Assessment entails some unavoidable simplifications and limitations. According to ISO 14040, a Life Cycle Assessment consists of the following phases:

1) Goal and Scope Definition
In the description of goals, the purpose of the assessment is given, as well as a description of items included or not.

2) Inventory Analysis
The inventory should be objective and based on facts. It should contain in- and outflows of materials and energy for various process flows or partial steps of what is being studied. This phase includes calculations. For raw materials, all steps should be included, from collection and treatment during the refining stage to final product and emissions that have an impact on the environment.

3) Impact Assessment
The impact assessment phase of an LCA should list and evaluate the results from the inventory analysis in a more easily accessible overview. This phase can include, for example:

- *Classification* (sorting of inventory parameters after potential impact on the environment)

- *Characterisation* (degree of impact on various environmental effects)
- *Evaluation* (weighting of various environmental effects or inventory parameters against each other)

4) Life cycle interpretation

Interpretation is the phase of LCA in which the findings from the inventory analysis and the impact assessment are joined together. It is here that the comparison between different alternatives is made.
The results from this interpretation are made as conclusions or recommendations to decision-makers.

Different LCAs have been made about the benefits of recycled paper compared with incineration of waste paper. The results can hardly be compared because the conditions and restrictions are different. Important factors to consider in the different LCAs about burning or recycling waste paper are how the electricity used in the process is being produced, which source of energy the waste paper is replacing, as well as which type of paper is being produced by the waste paper. LCAs should be done separately for each paper quality.

If the waste paper replaces wood fuel and the electricity is produced in a coal power plant with high fossil fuel consumption the recycling of newspaper paper produces less emissions of carbon dioxide, nitrogen oxide and sulphur dioxide. The transport distance has a certain influence, particularly with regard to emissions of nitrogen oxides.

Newsprint produced from waste paper, collected close to the paper mill, has less influence on the environment than the same quantity of newspaper paper produced in other countries and imported. Production of fluting and liner from recycled fibres is better for the environment than the incineration of waste paper.

CHAPTER 7

OPPORTUNITIES/BARRIERS

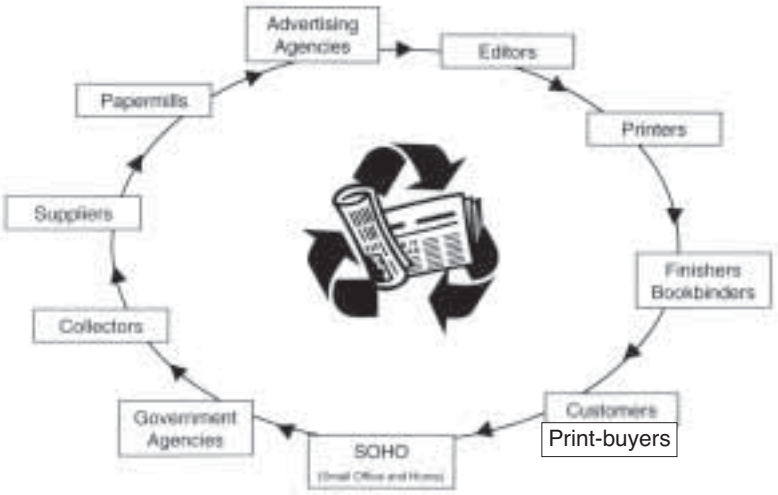
7.1 OPPORTUNITIES FOR DIFFERENT TARGET GROUPS: COMMERCIAL VALUE IN CASE OF WASTE PAPER GOING INTO RECYCLING

7.1.1 DO ENVIRONMENTAL ASPECTS HAVE A REAL COMMERCIAL VALUE?

TODAY ENVIRONMENTAL aspects have a real commercial value for all those involved in the use of products printed on graphic paper, from the customer and designer to the printer and finisher. The environmental aspects cover the manufacturing process itself, just as much as the products produced.

The level of awareness for the environment depends on the role of actors in the graphic production chain. Society as a whole attributes a high environmental responsibility to the paper and graphic sectors, as illustrated by the graph.Part of the commercial interest

Environmental pressure in the paper and graphic area



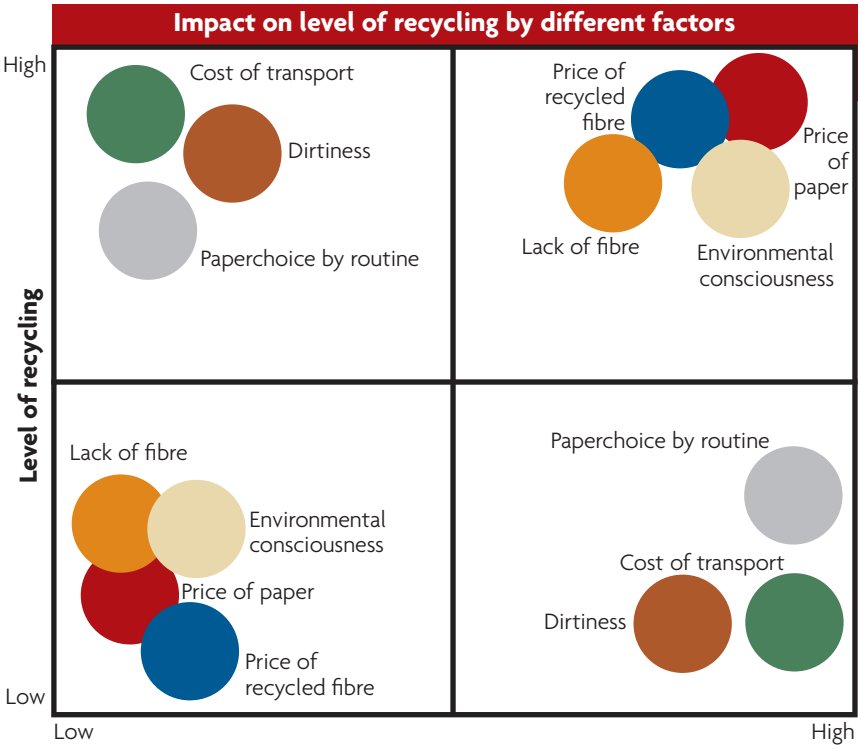
derives from the principle that business may be lost if attention is not given to offer an environmentally friendly product, e.g. the production of recycled paper, or printing on it. The market for such products need the interest of readers and purchasers, who should request that graphic products have as little negative effect on the environment as possible. They must also have confirmation of a product's environmental soundness by some form of environmental certification or labelling, such as the Nordic Swan. The demand for environmentally friendly graphic products so far has mainly come from purchasers of graphic products, (e.g. in Scandinavia) because their customers or readers have developed an environmental awareness. In other countries, the demand is less strong and measures are taken by different authorities which have also enforced a certain degree of environmental adaptation.

Environmental considerations for paper and printed products do not differ substantially from those for other industrial products. Due to (or rather thanks to) an environmental opinion among print buyers, users and purchasers, the paper and graphic industries, just like other industries, have adapted their products and production so that the environmental impact is as little as possible.

Management philosophies place the environment high in the list of issues companies must address and the globalisation of markets contributes towards that need. Although multinational companies are primarily affected, much of the train-of-thought can be carried over to smaller companies as well. The objective is that if a company makes a serious long-term commitment, among other things, to environmental issues, this will make a positive contribution towards creating and developing lasting relationships with both present and potential customers – lasting relationships that also create the prerequisites for sustainable profitability for the company. However, the influence of different types of environmental considerations on the profitability of a company is long-term and often difficult to measure. Nevertheless, under certain conditions and in special situations, it can be absolutely essential to ensure continued production and the generation of business. For certain graphic companies and paper mills, however, an environmental awareness regarding the consumption of resources can lead to increased profit through reducing spoilage and waste of paper, as well as reducing quantities used. Therefore costs of basic commodities, such as IPA, are also reduced.

From a socio-economic perspective, the handling of recycled paper has an intrinsic value. The fact that waste paper is collected

FOR PAPER RECYCLING



and recycled decreases the amount of waste that needs to be stored as landfill or incinerated.

In estimating the worth of handling recycled paper, the costs of collection and transportation need to be taken into consideration. The value of paper recycling will be influenced by such factors as proximity and availability of raw fibre, population size, the geographic dispersion of users, as well as the total volume of paper returned for recycling. For a country that has a small population spread out over a large geographic area, the cost of collection and transportation would be too high to consider recycling.

The different impacts on the level of recycling are illustrated in the above figure.

7.1.2 DO ENVIRONMENTAL ISSUES HAVE COMMERCIAL VALUE FOR PAPER PRODUCERS?

THE ABILITY of a pulp and paper producer to be able to demonstrate that products are produced with adequate consideration for the environment has a very large commercial value. It has become a necessity for a company to prove to its customers and purchasers that its manufacturing process has a minimum effect on the environment. Paper mills use different types of environmental certifications and labelling in order to confirm the environmental aspects of their manufacturing process. One example of environmental labelling of pulp and paper is the Nordic Swan and the EU Flower label for copying and graphic paper.

Nowadays every area from forestry to pulp and paper manufacturing take the environment and environmental aspects into consideration. Environmental requirements are developed through the interplay of interest groups, purchasers, customers, the authorities and the manufacturers themselves.

Certain paper mills base their production on the availability of recycled fibre from paper recycling. The percentage of recycled fibre used depends on how the product is to be used as well as the desired properties of the product.

7.1.3 DO THE ENVIRONMENTAL ASPECTS OF PAPER HAVE A COMMERCIAL VALUE FOR ADVERTISING AGENCIES?

THE TASK OF AN ADVERTISING agency is to formulate a message, to choose the communication form, and to communicate the message to recipients. With an increasing environmental awareness on the part of the recipients, both the message as well as the form of the message will be influenced. A message can be reinforced by a conscious choice of paper and the environmental considerations are very important. Added value can be created for the client by creatively combining different aspects regarding the choice of paper. Paper and its environmental aspects therefore have a commercial value for an agency.

7.1.4 DO THE ENVIRONMENTAL ASPECTS OF PAPER HAVE A COMMERCIAL VALUE FOR THE PUBLISHER?

PUBLISHERS HAVE a decisive influence on the choice of paper. By consciously placing demands on the final product, the publisher can be instrumental in paying attention to

environmental considerations in the choice of paper.

Since the products of publishers are predominately consumer goods, environmental awareness on their part influences considerably the environmental consideration given a book.

It has become common for books to be environmentally marked and include a declaration of the environmental properties of the paper used in the book.

Therefore publishers have been able to create a commercial value by taking into consideration the environmental aspects of the choice of paper. Since more and more paper qualities meet certain types of criteria for environmental marking, it has become more difficult however for publishers to create this added value. Thus, certain publishing companies (magazine publishers) have proposed even more stringent requirements for the environment.

7.1.5 DO THE ENVIRONMENTAL ASPECTS OF PAPER HAVE A COMMERCIAL VALUE FOR PRINTING COMPANIES AND BOOKBINDERS?

PRINTING COMPANIES often participate in choosing the paper on which something is to be printed. Environmental consideration is one of the factors that influence the choice.

A conscious environmental effort to influence the use of resources and thus reduce the waste of paper in proof sheets can lead to very good financial returns. That is why some graphic companies have initiated a reward system in order to decrease the amount of paper and proof sheets that are wasted. Similar results can be attained via adequate routines for the sorting of paper and rational stock management.

By sorting printed waste paper from unprinted, and white paper from coloured, a printing company can obtain advantageous contracts with recycling companies, i.e. better reimbursement for its waste and recycled paper. The price level for recycled paper in relation to new paper influences the incentive of printing companies to sort and take care of waste paper and proof-sheets.

Finishers and bookbinders can accumulate substantial amounts of waste paper in the form of cuttings. Calculations are often carried out in a routine fashion to reduce too generous cutting margins. The same incentives for recycling management that apply to printers also therefore apply to finishers and bookbinders.

Thus, for printing companies the environmental aspects of paper offer the possibility of increasing profits and, perhaps more importantly, the chance to decrease costs.

7.1.6 DO THE ENVIRONMENTAL ASPECTS OF PAPER HAVE A COMMERCIAL VALUE TO THOSE WHO HANDLE RECOVERED PAPER?

THE ENVIRONMENTAL aspects of paper and the management of recovered paper form part of the business concept for most paper recycling companies. Added value can be created for mills using recycled papers by pre-sorting, effective transport, and rational stock management. Sorting can either be done under their own management, by printing companies or by consumers themselves.

7.1.7 FACTS THAT INFLUENCE THE CHOICE OF PAPER

THE FACTORS THAT INFLUENCE the choice of paper to be used can be divided into three main categories. Firstly, one must consider the prerequisites for the target group of customers. How large is the group? What is the current circulation? What are the cost guidelines, and does a budget exist? The prerequisites for the target group influence the idea and planning, text and illustrations as well as the design. These choices influence the method of printing, paper, method of finishing and distribution, packaging, freight and postage as well as the possibility for follow-up and effective measurements.

The requirements for the target group determine the prerequisites for the production of the printed product. Examples of such requirements are; appearance, strength, safety, product longevity, ability to reproduce illustrations and photographs, legibility and general requirements for quality, consideration for the environment, weight, format, and other special properties perhaps.

The requirements include prepress as well as printing and finishing. The choice of finishing influences the printing method to be chosen as well as the printing press to be used. This, in turn, influences the workflow and method for prepress. Finally, function, quality and cost are always weighed against each other. It is also very common that a compromise solution is found with regard to the various requirements.

The figure below lists the factors that influence choice of paper and their relation to each other.

The figure does not try to include all the factors, but rather the most important factors and their respective relationship.

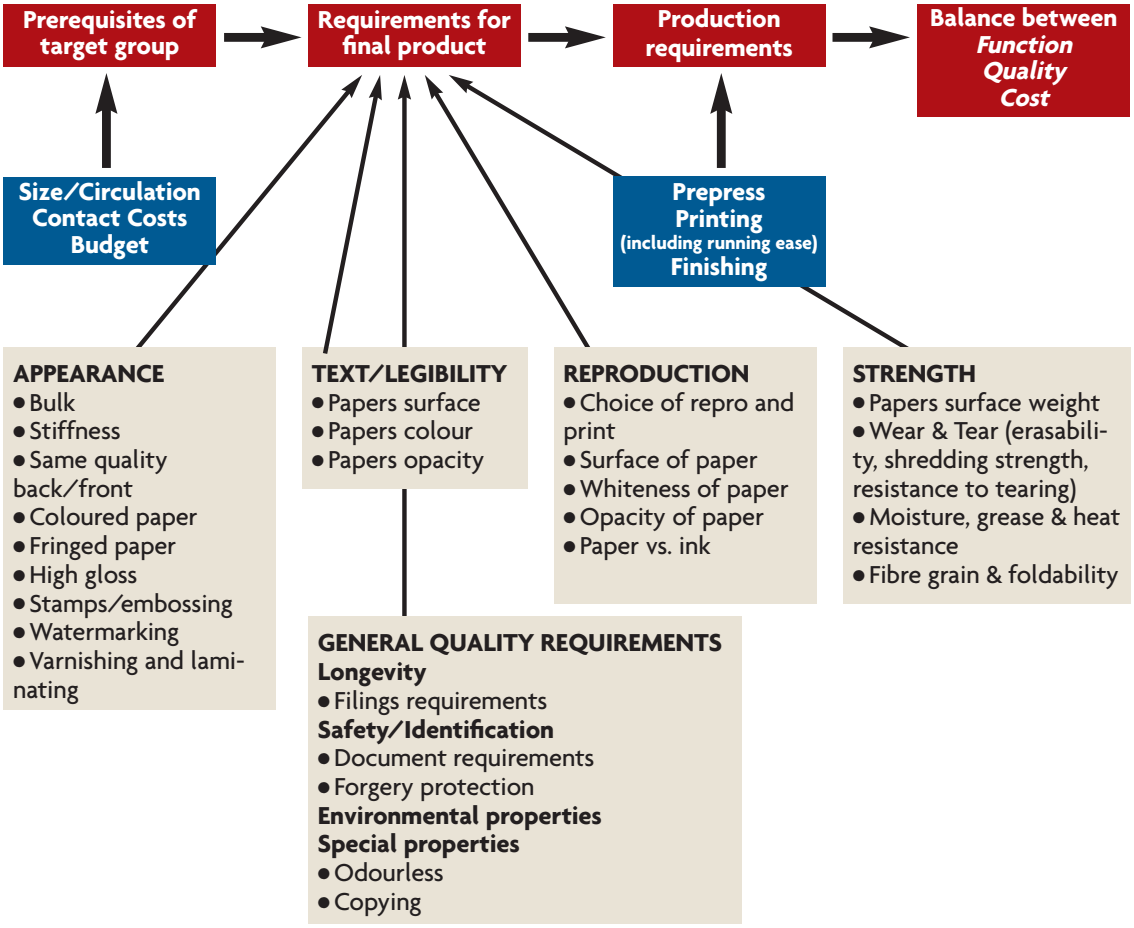
7.2. TECHNICAL BARRIERS: INTERFERENCE WITH THE RECOVERY PROCESS

Regardless of the type of paper to be produced from recycled paper, the quality and strength of the paper improve when more impurities and contaminants can be removed from the collected paper. For best use of recycled paper, all contaminants have to be removed, but this is difficult.

Contaminants reduce the efficiency of the papermaking machine, increase energy consumption, and lower paper quality. The various contaminants are considered differently depending on the type of paper to be produced. For the corrugated kraft and cardboard industries, the need to remove certain contaminants in the recycled paper, such as ink residue, is not as high as when producing printing paper.

Contaminants come mainly from three different sources:

- Paper mills in the form of mineral fillers, chemicals and polymers
- Conversion products, such as printing inks, other chemicals, plastics and foils, adhesives, staples and pins
- Consumers and collection areas, such as food residues, micro-organisms, gravel, and baling wire



Contaminants increase in case of complex compounded papers, printed products, packaging, chemical additives, fillers, new paints, colouring agents, plastics, laminates, and adhesives. Substances can be classified as non-recommended or objectionable materials.

The following list of materials in collected papers has been put together by PIRA International.

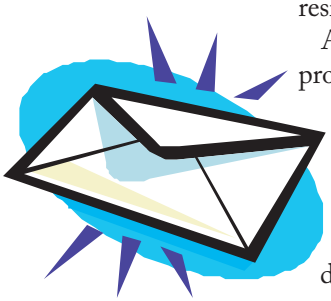
Non recommended materials	Objectionable materials
Greaseproof papers	Metals (excluding pins and staples)
Synthetic adhesives	String
Pins and staples	Glass
Tapes	Textiles
Wet Strength	Wood
Synthetic inks	Sand and building materials
Laser prints	Plastic laminates/plastic materials
Carbon papers	Synthetic papers
	Waxed papers/boards
	Rubbings

Non-recommended materials can exist in the collected paper to a certain extent, depending on which type of paper it is destined to be a part of. These materials are often part of the different types of waste paper intended for recycling. Objectionable materials are those which can cause serious damage in the production of paper, and should not be present in most types of paper production.

The use of recycled fibres rather than fresh fibres has its disadvantages in the final paper product. The disadvantages are that it lessens the strength and smooth running of the paper web, causes linting, lessens the burst strength and the brightness of the finished product as well as leads to variations in whiteness.

7.2.1 STICKIES

THERE IS NOT A SINGLE definition for the term sticky; the concept is rather used for various types of contaminants that cause sticky residues.



Adhesive particles known as stickies cause problems in recycled paper plants since their presence in the papermaking machine leads to interruptions and standstills when the machine has to be cleaned. The problem is greatest for lightweight papers such as tissues and newsprint, which are produced at high speeds.

Stickies come from many different sources. They arise primarily from various adhesives in the waste paper. Primary stickies originate from the adhesives in sticky tapes and labels, self-seal envelopes and hot melt glues. Another source of stickies is latex used in certain coating formulations for printing papers. Secondary stickies can be created as a result of chemical compounds between various soluble substances in the waste paper or chemicals in the paper process. They come from, for example, water-soluble adhesives, waxes, varnishes, paper-coating binders, mineral salts, latex, coatings and printing inks.

Despite efforts to remove stickies, some of them escape the mechanical cleaning and screening in the stock preparation. They end up on the paper machine or in the wire or in the end products, causing machine downtime or downgraded products.

Problems caused by stickies can be separated into two large groups:

1) Quality problems. Variations in the quality of the product coming from holes, stains, reductions in mechanical surface strength, and negative effects during printing. The importance of the different products depends on the end product:

- *Coated board:* problems in coating and printing
- *Multi-ply board:* can cause discoloration in middle plies
- *Printing paper, tissue paper etc:* stains that reduce product quality

2) Process problems. Stickies have a negative effect on the efficiency of the papermaking process. Most problems show up in the papermaking machine and cause interruptions, residue on the wire, felts, press rolls and dryers, and blades. This causes long periods of downtime, primarily because of cleaning and equipment replacement, which increases production costs.

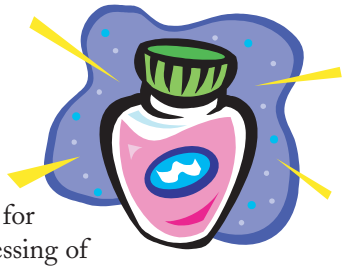
Problems caused by stickies usually result from factors like:

- Increased use of waste paper
- Decrease of applied grammages while introduced contaminants stay equal
- Increased use of hot melt adhesives
- Increased use of self-adhesives
- Increased use of synthetic polymers in paper and cardboard coating

- Higher machine speeds both in papermaking machines and in printing presses
- More closed water systems in pulp production, which means increased amounts of soluble materials in the water

7.2.2 GLUES

THE HOT MELT GLUES are products based on thermoplastic polymers; they do not contain solvents, and are solid at ambient temperatures. They have the property of softening as temperature increases, and hardening when cooling. Once applied, they allow for high production speed according to their cooling speed, which justifies their use in packaging and binding. Depending on the thickness of the layer, the glue passes through the screening stage and is found in the pulping machine. This is responsible for sticky deposits during drying and pressing of the pulp, causing interruptions and other problems.



Water-soluble glues cause problems when the process water is reused again and again, finally reaching too high a concentration of glue in the reused water. There is a risk that this is spread to all parts of the papermaking machine, which would then have to be cleaned, causing interruptions.

Self-adhesives are used for the peel- and stick variety of labels, stamps, post-it notes, tape etc. and do not require moisture to be activated.

Most paper recycling systems use water as the medium to transform recovered paper into pulp. Self-adhesives do not dissolve in water, but rather fragment into smaller particles during the repulping process. These adhesives are estimated to create costs for the recycling industry. Costs include the direct costs for the paper mill and the reduction in prices received by recovered paper collectors and processors because of the contamination by self-adhesives.

7.2.3 WAX

WAX IS USED AS coating material for many kinds of paper, cardboard and similar products as protecting material with higher wet strength. Waxed materials cause the same type of stickies as glues, and behave like hot melt glues.

7.2.4 DE-INKING

THE ABILITY TO DE-INK a printed product depends on different factors:

- Ink type
- Ink properties
- Printing technique and printing conditions
- Aging of the print
- Paper surface

On coated paper, the printing ink does not come into contact with the paper fibre and no real problems occur in the de-inking process. The paper coating disintegrates as the recovered paper is pulped. The ink particles are liberated as fragments. On uncoated paper, the binding of the ink to the paper (the fibre) depends partly on paper characteristics such as surface rawness, fibre type, ash content etc. and partly on the type of drying that the ink has gone through. Ink, which dries through polymerisation (particularly radiation drying), is more difficult to remove in the de-inking process. Even oxidative drying offset inks, which are old, can also reduce de-inking possibilities significantly.

Influence of the printing processes and drying mechanisms on de-inkability (Borchardt 1995)

Printing process	Drying mechanisms	De-inkability
Offset newspaper Letterpress Offset sheet fed Offset heat-set	Absorption (and oxidation) Absorption and oxidation Absorption, evaporation and oxidation	Good if not aged After ageing: Bad ink detachment, smeared pulp, specks
Rotogravure	Evaporation	Good Possibility of coloured pulp (dye)
Flexo	Evaporation	For water-based Bad at alkaline pH
Laser and copiers U.V. and I.R.	Radiation curing	Bad toner detachment Strong speck contamination

During pulp dispersing, ink particles are separated from the fibres. The ink particles are either removed through cleaning or flotation during the de-inking process or a combination of the two. During cleaning, particles that are roughly 5–20 µm in size are removed, whereas flotation works best for particles between 20–150µm, depending on the hydrophobicity of the used ink binder system.

When the ink particles are larger than a certain size, the possibility of removing them decreases. They then become too large to cling to the air bubbles.

The process of flotation de-inking can be divided into three steps:

Collision between the particles and air bubbles

The air pressure decides the amount of air, and the size of the air bubbles is decided by the size of the holes through which the air passes. The small air bubbles and the ink particles enter into contact with each other, a surface-active substance. Air is generally induced by venturi valves (stream pump principle). The bubble size is dependent on surface energy of the pulp and the flow velocity in the venturi. Ink, due to its hydrophobic character, is forced out of the water and onto the bubbles.

Attachment of ink particles and air bubbles

How large the air-ink contact will be is decided by the amount of turbulence that is generated. This will be determined by the ink binder system. Using a mineral oil the bonding will be high. Using a latex binder system it will be low.

Flotation of the ink particles and bubble complex to the surface.

The air bubbles with ink particles float up to the surface where they create foam that consists of printing ink, fragments of paper fibre, fillers and coating pigments. The foam is removed from the surface. Foam that is created with small bubbles is more stable than foam created with large bubbles, and it will not collapse during the removal process.

A) WATER-BASED INK

The de-inking techniques described above are designed to remove solvent based, offset, and rotogravure ink. These ink types tend to cling to the air bubbles during the flotation operation. Water based ink contains a binding agent that is dissolved in alkaline water. In the de-inking process this ink does not break up into ink fragments but into ink pigments, which are extremely small particles of less than 1μm in size. These particles are too small to cling to the air bubbles.

When the water is reused several times, one only needs a small amount of water based ink in the waste paper for the pulp to become greyish.

Paper mills, which often have to take care of water based flexographic inks which account for more than 5% of the total recycled mass, instead use cleaning to remove the ink pigments. During cleaning of the recycled fibres the fillers are removed as well, which results in significant loss of material.

It is now admitted that there are two sorts of water-based inks: one which cannot be de-inked properly, and another one which could be de-inked but which appears to offer very low quality printing properties, and are therefore not usable. Reports are available about unsuccessful tests carried out by large gravure printing plants which were interested in using them, but had to abandon the idea because of the poor printing performance of the water based inks.

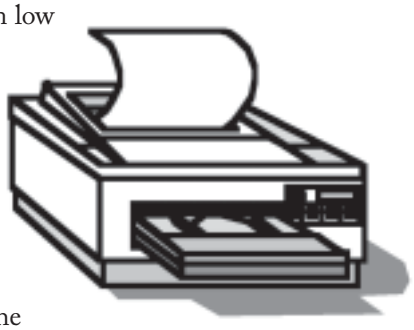
B) UV-CURED INKS AND VARNISHES

Some paper mills do not want to accept waste paper with UV-cured ink since it increases energy consumption in order to remove the ink from the fibre and the paper quality can also be lower.

UV-cured inks and varnishes are very hard and difficult to separate from the fibres. After pulping it forms large flakes and dots. Most of the flakes pass through almost all types of screen. Part of the dots can be removed by dispersing but the UV ink is so hard that many of the dots remain, which can then cause specs in the paper.

C) LASERPRINT

Paper from copiers and laser printers contains ink known as toner, which is a dry, fine powder. Toners are pigmented plastic polymers. They contain low concentration of additives which gives them electrostatic qualities.



When the paper with the toner passes through the high-temperature fixer part of the machine, the plastic polymers melt and fix the ink to the paper fibres. The toner binds together several paper fibres,

which then do not float or sink in the flotation process. They remain as dots in the deinking process and cause the same problems as UV-cured ink. By adding surfactants at the flotation stage, flotation is improved. Toner-based recycled fibres are being dispersed and treated, just as UV-printed fibres, in a post-flotation stage.

D) INKJET INK

Inkjet ink is in many cases a water-based ink solution. The colouring agents are completely soluble in water and cannot be separated in the flotation stage. Instead, the ink adheres to clean paper fibres and discolours the paper.

E) VEGETABLE-BASED INK

Offset inks, which are based on vegetable oils, become hard if they are exposed to heat and sunlight. This complicates the separation of ink from the paper fibre and causes the pulp to have less brightness. This problem is worse during the summer.

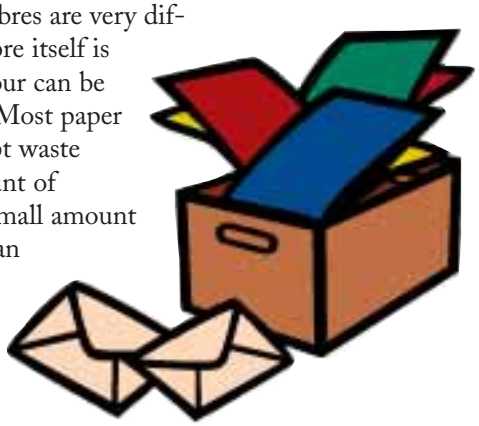
Dispersing helps to separate the ink from the fibres. The problem is that conventional offset inks can be pressed into the fibres during the dispersing. The pulp always contains a mix of different types of ink, which means that it can be difficult to effectively disperse this type of pulp. The recycling of paper with vegetable based inks means loss of fibres and higher energy consumption.

F) FLUORESCENT AND METALLIC INK

Fluorescent and metallic inks cause no problems in the de-inking process, because they are rarely encountered in recovered paper. Technically they are very difficult to recycle. These paints do, on the other hand, contain pigments with various metallic compounds that are more or less toxic. These metallic compounds end up as paper sludge after de-inking. Most de-inking sludge ends up in landfill sites. Some mills burn de-inking sludge, which eliminates volume, but the left-overs still contain the toxic materials. In some cases the waste requires special handling.

The levels of heavy metals in recovered paper, and therefore in recycling mill wastes, have dropped dramatically in recent years as a result of the decreasing use of these materials in ordinary printing inks and pigments.

7.2.5 COLOURED PAPER

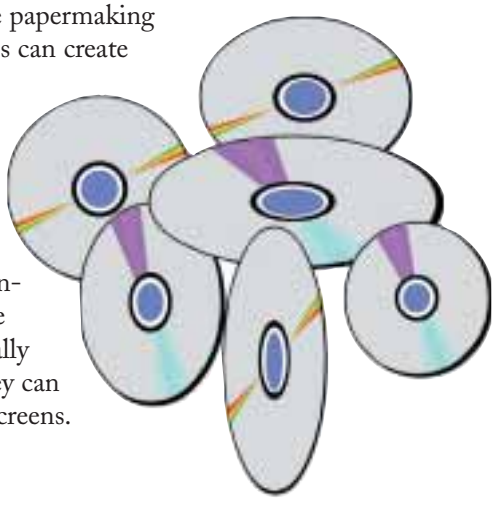


COLOURED PAPER and its fibres are very difficult to bleach. The paper fibre itself is coloured, and part of the colour can be removed through bleaching. Most paper manufacturers refuse to accept waste paper with too large an amount of coloured paper. A relatively small amount of intensely coloured paper can cause pulp to acquire a greyish hue. Modern reductive bleaching technology is able to accept over 15% of coloured paper in the stock. However, only 5% of the total amount of paper used is coloured.

7.2.6 NON-PAPER COMPONENTS

THERE IS AN INCREASING tendency today for printed advertising, magazines and newspapers to contain special sections or various types of materials that are glued to the printed product. Such materials can include lottery scratch tickets, cosmetic samples in plastic or metallic packages, CDs and other product samples.

Some of these materials can easily be separated from the printed material before the paper reaches the first separation stage of the mill. Other materials, such as soft plastics, can cause severe problems in the papermaking process. Smaller plastic items can create stickies, which will follow along with the pulp and become sticky from the machine's heat during the drying process. This can cause interruptions and standstills. In conclusion non-paper components should be dimensioned and mechanically stable in such a way that they can be eliminated via punched screens.



CHAPTER 8

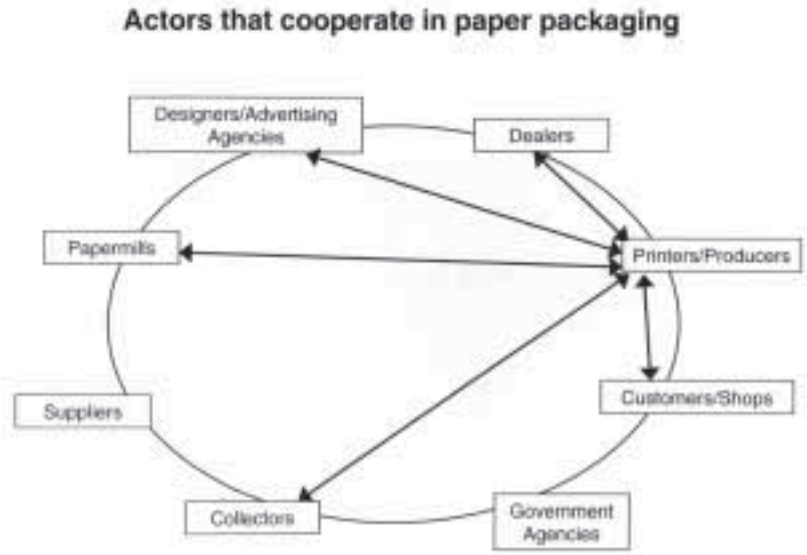
OVERCOMING BARRIERS

ACTION TO BE TAKEN BY THE DIFFERENT TARGET GROUPS

There are different actors in the chain from a concept to a printed product, and it could be illustrated as in the diagram:

It is important for the different actors to know what the obstacles are, and if there are alternatives to using a printed product which makes recycling more difficult.

What can the different actors do?



Advertising agencies and print-buyers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Coloured paper	Makes it more difficult to make white paper	Needs more sorting Needs more chemicals (bleaching agent)	Suggest to the customer • White paper • Tinted paper
Soft plastics	More waste	More waste Needs more chemicals	Suggest to the customer • Do not use it or • Place the product so that removal is made easier
Hard plastics		More waste Needs more sorting	Suggest to the customer • Do not use it • Place the product so that removal is made easier
Metal colours or fluorides	The use of metal pigments has strongly decreased, and is limited to aluminium	Waste with heavy metals will probably have to be sorted out and is not reusable	Suggest to the customer • Use colours with no heavy metal
Lacquer/varnish UV or two components	Produces hard flakes of lacquer, which are difficult to remove from the pulp	Difficult to take away Needs more sorting Needs more energy and/or chemicals	Use a clear water-based varnish
Vegetable colours	Gets hard with age	Difficult to take away Needs more energy and/or chemicals	There are mineral based alternatives but they have other environmental consequences and health risks for employees
Stickies Hot melts Self adhesive materials	The glue will become soft and get lumpy	It will adhere to the paper rollers	There are no simple solutions but other alternative for binding and distribution could maybe be solutions

Editor/publisher			
If you have	**What problem does it cause?**	**Consequences**	**Are there any alternatives?**
Coloured paper	Makes it more difficult to make white paper	Needs more sorting Needs more chemicals (bleaching agent)	Use • White paper • Tinted paper
Soft plastics	More waste Makes it more complicated to make fine paper There is an increased risk from bacteria Affects the washing water at the mill Gets ground into the paper pulp	More waste Needs more chemicals	• Do not use it or • Place the product so that removal is made easier
Hard plastics		More waste Needs more sorting	• Do not use it • Place the product so that removal is made easier
Inserts/foreign materials	Hard plastics Soft plastics Glues	More waste Needs more sorting	• Do not use it • Place the product so that removal is made easier
Metal colours or fluorescent	The use of metal pigments has strongly decreased, and is limited to aluminium	Waste with heavy metals will probably have to be sorted out and is not reusable	Suggest to the customer • Use colours with no heavy metal
Lacquer/varnish UV or two components	Produces hard flakes of lacquer, which are difficult to remove from the pulp	Difficult to take away Needs more sorting Needs more energy and/or chemicals	Use a clear waterborne varnish. Develop glue which can handle the recovery process
Vegetable colours	Gets hard with age	Difficult to take away It will need more energy and/or chemicals	There are mineral based alternatives but they have other environmental consequences for the employees

Printers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Coloured paper	Makes it more difficult to make white paper	In the printing company: Needs more sorting	Needs better sorting in the printing company Put pressure on the customer to use • White paper • Tinted paper
Metal colours or Fluorescent	The use of metal pigments has strongly decreased, and is limited to aluminium	Waste with heavy metal will probably have to be sorted out and not be reusable	Use inks with no heavy metal In some cases, another printing method with different inks could be used Better sorting
Lacquer/varnish UV or two components	Produces hard flakes of lacquer, which are difficult to remove	Difficult to take away Need mores energy and/or chemicals	Put pressure on the customers not to use varnish Use a clear waterborne varnish Better sorting
Vegetable colours	Gets hard with age	Difficult to take away Needs more energy and/or chemicals	In some cases, another printing method with different inks could be used There are mineral based alternatives but they have other environmental consequences and health risks for employees
Stickies Hot melts Self adhesive materials	The glue will become soft and get lumpy	It will adhere to the paper rollers	• Do not use self adhesive labels for addresses • Develop glue which can handle the recovery process • Find alternative for binding • Find alternative for distribution

Bookbinders – finishers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Metal colours or Fluorescent	Introduces heavy metals into the process	Waste with heavy metal will probably have to be sorted out and not be reusable	Use colours with no heavy metals
Lacquer/varnish UV or two components	Produces hard flakes of lacquer, which are difficult to remove	Difficult to remove Needs more energy and/or chemicals	Use a clear waterborne varnish or more sorting
Stickies Hot melt glues Self adhesive materials	The glue will become soft and get lumpy	It will adhere to the paper rollers	• Do not use self adhesive labels for addresses • Develop glue which can handle the recovery process • Find alternative for binding • Find alternative for distribution
Laminating	Behaves like soft plastic Introduces both plastics and adhesive	More waste Needs more energy and/or chemicals	For some printed products, use water based alternatives

Collectors

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Coloured paper Stickies Inserts	Affects the recycability	More boxes to put paper in	Have a better sorting and collecting system

Paper mill

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Coloured paper Stickies Inserts	Affects the recyclebility	More chemistry More energy	Only produce white paper or painted/coloured paper Improve sorting/collecting Information to the employees Put pressure on the suppliers Improve the production process

Suppliers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Better raw material Better equipment to handle the possible remaining problems	Introduce alternative to the market Through the price of the product, support alternatives that have a good recyclability		

Government/national agencies

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Support voluntary agreements	Stimulate and put pressure on the whole chain	Which will make a better product and better collecting/sorting	If not prohibition or/and regulations Support different ways of giving information to the general public

Customers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Apply pressure to change the product Sorting and collecting	Put pressure on the publisher and the advertising company More sorting into more groups	Put pressure on the printer and the bookbinder Better price for the recovered paper could result in a better price for the original product	Better product in the end

Printbuyers

If you have	What problem does it cause?	Consequences	Are there any alternatives?
Apply pressure to change the product	Put pressure on the publisher and the advertising company	Put pressure on the printer and the bookbinder	Better product in the end

Sorting and collecting

If you have	What problem does it cause?	Consequences	Are there any alternatives?
More sorting into more groups	Better price for the recovered paper could result in a better price for the original product		

CHAPTER 9

DIFFERENT PRODUCTS

AND THEIR IMPACT ON RECYCLING

The grade is from 1-5 where 1 is bad and 5 is good.

Product	Good to recycle	Alternatives
Self adhesive labels	1	Burn instead of recycle
Business forms	4–5	
Carbon paper	1	Burn
Cartons	5	
Catalogues	5	
Tinted paper	3	Burn or use in small quantities in the recycling process
Coloured paper	3	Burn or use in small quantities in the recycling process
Copy paper	4	
Corrugated boards	5	
Daily newspapers	5	
Envelopes – self adhesive	3	Burn or use in small quantities in the recycling process
Envelopes – water moistened	5	
Filter paper	1	Burn if contaminated
Food packaging	4–5	
Label paper	5	Use in new cartons or corrugated board
Laser-printed paper	4	
Magazines	5	
Paper packaging	5	
Photographic paper	1	Should be collected as special (hazardous) waste
Plastic laminated products	2	Burn
Postcards	5	
Printed promotional material	5	
Sack paper	5	Use in new cartons or corrugated board
Sticky notes	1	Burn instead of recycle
Thermal paper (used in some fax machines)	2	Burn
Waxed paper/cartons	3–4	
Wet strength paper	5	Use in new cartons or corrugated board
Window envelopes	3	Burn or use in small quantities in the recycling process

CHAPTER 10

SUMMARY

Interferences with the recovery process

What are the obstacles?

DE-INKING

Waterbased

Where are the problems?	The ink does not separate using current technology. Will lead to a poorer paper quality. Water based inks do not attach to air bubbles in the flotation de-inking process. As the dissolved air flotation is not able to remove these inks they build up in the water stream at the paper mill. As the water is reused over and over again, only a small percentage of waste paper printed with water based inks will result in a very grey motley pulp.
How do we solve this problem?	Information Change the process. Apart from flotation, washing can be used to remove the pigments. When washing the recovered fibres most of the filler and fines are also removed, resulting in excess stock loss. Still, the washing water has to be cleaned by a dissolved air flotation unit, creating the same problem as above. Use other chemicals.

UV – laser print

Where are the problems?	They are hard but brittle, and adhere strongly to the paper sheet. It takes energy to loose them from the fibre.

UV curing inks

Where are the problems?	Will not lead to a poorer paper quality but influences the paper production process UV-curing inks are very hard, and difficult to detach from waste paper. After pulping they form big flakes and specks. As the flakes are very flat they can pass almost any screen. Some of the specks are removed by the disperger, but some UV-inks are so hard that a lot of specks remain.
How do we solve this problem?	Post-flotation, which needs a mill twice the size of a single loop flotation mill. Sort the paper more individually

Vegetable based ink

Where are the problems?	Will not lead to a poorer paper quality but influences the paper production process. The vegetable oils become hard due to sunlight and the atmosphere. Compared with traditional offset inks,

	detachment from the fibres is poor. Most newsprint mills have for this reason in the summer (more sun) a lower brightness pulp than in winter.
How do we solve this problem?	Dispersion should help to detach these inks from the fibres. The problem is that the traditional offset ink can be pressed into the fibres during dispersion (so a non-reversible brightness drop can be seen). Since the pulp is always a mixture of all types of ink it can be difficult to effectively disperse this type of pulp. So sorting this type of waste paper can be beneficial.
Metallic colours i.e. gold	
Where are the problems?	There are no problems removing them from paper. Only the sludge (heavy metals like copper and zinc) may be a problem
Stickies – glue – hot melt – others	
Where are the problems?	Will not lead to a poorer paper quality but influences the paper production process. Books and magazines are glued together using hot melts. These hot melts become soft and ductile in the pulp (like chewing gum). Because of this they can pass through very small slots and holes of the screens. On the paper machine they become sticky during the drying and pressing, causing web breaks etc. The best binder is supposed to be non pulpable and not dissolvable (though the discussion on this subject is not yet over!). The problem of dissolvable hot melts is that they build up in the water stream, and as the water is reused again and again there is a moment that the concentration reaches a point where they become un-dissolvable. At this point the paper machine has to be cleaned causing a loss of production and process water.
How do we solve this problem?	Sorting/classification. Other glues. Put pressure on the suppliers.
Are there any alternatives?	Using other form of distribution instead of envelopes. Inkjet.
Grease- and waterproof papers (so called wet strength paper)	
Where are the problems?	Due to additives in the paper the water- and degreasing resistance is increased. In 'normal' paper the paper structure is caused by hydrogen bounds. These bounds are easily removed when the paper is wet. The additives in grease- and waterproof paper will substitute the hydrogen bonds and make the paper less sensitive to water.

Coloured paper	
Where are the problems?	Remove colour from the process. Will lead to a poorer paper quality. Coloured paper is very hard to process into white grades. Depending on the colour intensity of the coloured paper only a small percentage can make the pulp grey.
How do we solve this problem?	Reduce the quantity Sorting/classification. Though bleaching some of the colour can be removed. Relatively small amounts of highly coloured papers can spoil a complete production run
Fillers	
Where are the problems?	Will not lead to a poorer paper quality but influences the paper production process. Processing of this waste paper causes a very big amount of de-inking sludge (some mills produce the same amount of sludge as paper!). Heavily coated waste paper is not positive from economic and environmental viewpoints although the de-inking is not a real problem. The fillers (sometimes up to 30% of the waste paper) have to be removed, as they are detrimental to the paper quality.
How do we solve this problem?	At this time this is the normal practice for a paper mill with a flotation de-inking installation. Technically it is possible to use heavily coated recovered paper but an increase in fillers will lead to more stock loss.
Inserts /foreign material	
Coloured paper.	If not sorted out – see above.
Stickies.	If not sorted out – see above.
Plastics and other soft material.	Sorting/classification individually.
Hard plastic and other hard material like CDs, golfballs.	Could be sorted out in the process.
Chemical product.	Will come out in the process.

CHAPTER 11

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Personal contacts:

- Swedish Paper: *Christina Nordfeldt.*
- SCA Graphic Paper: *Roine Morin.*
- SCA Graphic Paper: *Göran Svensson.*
- UPM Kymmene: *Petri Ruusu.*