Miljøprojekt nr. 179

1991

Eco-labelling of Paper Products

Ministry of the Environment, Denmark
Danish Environmental Protection Agency

Miljøministeriet **Miljøstyrelsen**

Miljøprojekt

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Eco-labelling of Paper Products

In this report is discussed the possible use of eco-labelling of paper products as a means to improve the environment. All aspects of environmental impact should be considered based on the "cradle to grave" concept. Possibilities as well as problems involved with eco-labelling of paper products are highlighted. A possible methodology for setting criteria is outlined. Methodology is exemplified for 2 product groups: xerographic copying paper and kitchen rolls, but should be applicable to most paper products.

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Miljøprojekt nr. 179

1991

Eco-labelling of Paper Products

Possibilities and Problems

Drafted by consultant
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Miljøministeriet Miljøstyrelsen

Contents

Forord

I det følgende gives en beskrivelse af muligheder og problemer i forbindelse med tildeling af et miljømærke til papirprodukter. Rapporten er udarbejdet på grundlag af drøftelser i ad-hoc arbejdsgruppen om miljømærkning af papirprodukter, som er nedsat på initiativ af EF-Kommissionen. Danmark har haft formandskabet i arbejdsgruppen, som har holdt fire møder i København i perioden januar-maj 1991.

Det har været hensigten at udarbejde rapporten, så den er forenelig med indholdet i forslag til Rådets Forordning om et fællesskabssystem for tildeling af miljømærke.

Grundlaget for fastsættelse af kriterier for miljømærkning af papirprodukter er meget komplekst. Først og fremmest er papirprodukternes påvirkning af miljøet stærkt afhængig af råstofleverancerne og fremstillingsprocesserne, snarere end af produktets anvendelse og bortskaffelse efter brug.

Råmaterialerne kommer fra mange forskellige kilder. De fleste papirprodukter består af træfibre, og hermed er miljøaspekterne ved skovbrug inde i billedet. Produktion af papir og papirmasse sker på grundlag af forskellige teknologier, hvoraf nogle er meget energikrævende. Både mængder og typer af udledninger fra fabrikkerne varierer, og dermed vanskeliggøres sammenligningen af de forskellige teknologier. En yderligere vanskelighed består i, at det brugte produkt – papiraffald – indgår som råstof i mange papirprodukter.

Denne rapport sætter fokus på såvel muligheder som problemer i forbindelse med miljømærkning af papirprodukter. Der er ikke tale om en gennemgang af en enkelt fremgangsmåde for fastsættelse af kriterier, derimod gives en beskrivelse af en mulig metode, som eksemplificeres i to produktgrupper: xerografisk papir og køkkenruller. Metoden skulle være anvendelig for de fleste papirprodukter.

Der var blandt arbejdsgruppens medlemmer enighed om, at den relative betydning af de forskellige miljøaspekter ikke kunne bestemmes alene ud fra en teknisk eller videnskabelig synsvinkel. Den foreslåede metode skal ledsages af en afvejning af de forskellige miljømæssige virkninger, som opstillingen af miljøkriterierne medfører. Gruppen bestemte dog, at sådanne vurderinger ikke var nødvendige i denne fase af undersøgelsen.

Disse vurderinger vil dog være nødvendige, når der skal træffes beslutning om de præcise kriterier efter modellen, som arbejdsgruppen foreslår.

Efter at Dr. Per Olof Bethge og arbejdsgruppen havde færdiggjort rapporten i sommeren 1991 har formanden for arbejdsgruppen cand.techn.soc. Poul Wendel Jessen i samarbejde med cand.polyt Heidi K. Stranddorf færdiggjort rapporten med henblik på udgivelsen af denne i Miljøprojektserien.

Der er i denne sammenhæng tilføjet et nyt bilag, som er udarbejdet af Skov- og Naturstyrelsen om "Retningslinier for et bæredygtigt skovbrug".

Resume

Rapporten diskuterer mulighederne for med et miljømæssigt sigte at anvende miljømærkning af papirpodukter. Alle aspekter af indvirkningerne på miljøet bør overvejes, og produkterne bør således anskues "fra vugge til grav".

I tidligere publikationer har et bredt spektrum af aspekter i relation til de miljømæssige virkninger været behandlet. Der har imidlertid kun i ringe grad været foretaget en afvejning af de forskellige virkninger i forhold til hinanden med henblik på at fastlægge kriterier for tildeling af miljømærke.

For at kunne fastlægge objektive kriterier må der ske en matematisk kvantificering og afbalancering af flere miljøvirkninger i forhold til hinanden. Hertil skal der bruges data. For en lang række miljøaspekter foreligger der kun kvalitative oplysninger, og ofte er miljøvirkningerne stadig genstand for uenighed. Et operativt system af kriterier kan ikke inddrage alle miljøaspekter, men bør på den anden side ikke forenkles så meget, at der kun tages hensyn til et enkelt aspekt. Et brugbart system af kriterier kunne omfatte et begrænset antal aspekter, udvalgt med henblik på verificering af miljømæssige virkninger af større betydning.

Et operativt system af kriterier for papirprodukter kunne begrænses til en vurdering af følgende aspekter:

- energi og naturressourcer
- anvendelse af returfibre
- udledninger fra papirmassefabrikker
- udledninger fra papirfabrikker
- produktets brugsegnethed.

Anvendelse af "black box"-princippet betyder, at den teknologi, der anvendes i papirfremstillingen, bedømmes ud fra energibehovet og miljøvirkningerne. Al produktionsteknologi kan være ren eller snavset, afhængigt af fabrikkens indretning snarere end af tekniske principper. Ethvert forsøg på at udskille en bestemt teknologi på grundlag af historiske data vil modvirke teknisk udvikling. Anvendelse af "black box"-princippet betyder, at miljøvirkningerne vurderes ud fra den faktiske ydeevne i den virksomhed, der fremstiller produktet.

"Black box"-princippet betyder, at fabrikkens udledninger skal måles. Den nødvendige teknik hertil findes. Der er vedtaget internationale standarder for en række parametre. Antageligt er det kun nødvendigt at inddrage nogle få af dem, for at kunne få en kvantitativ bestemmelse af den samlede udledning fra en bestemt operation, f.eks. for spildevands vedkommende, opløst og opslæmmet organisk materiale (COD), organisk bundet chlorin (AOX) og næringssalte, og, for udledninger til luften, svovldioxid.

Udledninger udtrykkes i enheder, som korreleres med produktmængde, som kilogram pr. ton. Gramvægt-effekten bruges til at beregne produktets

kvalitet eller brugsegnethed. Også fyld- og farvestoffer skal indgå i vurderingen.

Ofte kan der foretages en bestemmelse af produktets kvalitet, og således beregnes, hvilken produktkvalitet, der er behov for til en bestemt funktion. For eksempel kan man måle vandabsorptionsraten for blødt papir (som afhænger stærkt af fibertype, men også af fremstillings- eller behandlingsproces), og således bedømme brugsegnetheden. Resultaterne af beregningerne kan dernæst omregnes til korrektionsfaktorer for udledningstallene.

Anvendelse af genbrugspapir betragtes som positiv. I den ovenfor beskrevne matematiske model vil genbrugspapir automatisk blive godt bedømt på grund af det lave energibehov og de lave emissioner fra behandling af papiraffald. Det er et skønsspørgsmål, om genbrugsfibre skal fremmes mere, end disse faktorer giver grundlag for. I den diskussion må der ske en afvejning af flere faktorer, f.eks.:

- ressourcebesparelser
- energibesparelser
- minimering af affaldsmængden
- alternativ anvendelse af papiraffald som brændstof.

Særlig omhu skal udvises ved tildeling af miljømærke til produkter, hvor papir kombineres med andre materialer, f.eks. imprægneret papir, belagt eller ekstruderet papir, papir med bestanddele af andre materialer som plasthåndtag på papirposer og rudekuverter. Det er nyligt oplyst, at sådanne fremmede bestanddele ikke giver anledning til problemer i moderne papirfabrikker, der arbejder på grundlag af papiraffald.

Preface

This report is a presentation of the possibilities and problems involved with awarding an eco-label to paper products. It is based on the discussions within the ad hoc working group for eco-labelling of paper products set up on the intiative of the Commission of the European Communities. Denmark was appointed the lead country for the working group which has held four meetings in Copenhagen within the period January to May 1991.

The presentation is intended to be compatible with the Proposal for a Council Regulation on a Community award scheme for an Eco-label.

The task to find criteria for eco-labelling of paper products is complex, mainly because the relative environmental impact of paper products are closely linked to the provision of raw materials and the manufacturing process rather than the use and disposal of the used product.

The raw materials are obtained from many different sources. The bulk of paper products consists of fibres from wood, which brings environmental aspects on forestry into the picture. The mills producing pulp and paper apply various technologies; some require a substantial input of energy, some not. The discharges from the mills vary not only in quantity, but also in nature, which makes it difficult to compare various technologies along a single linear scale. A further complication is the fact that the used product – waste paper – is used as a raw material in many paper products.

The presentation highlights the possibilities and also the problems involved with eco-labelling of paper products. A possible methodology, rather than a single procedure for setting criteria, is outlined. The methodology is examplified for two test cases, the product groups xerographic copying paper and kitchen rolls, but should be applicable to most paper products.

The members of the working group were in agreement that the relative importance or weight of the various environmental aspects adressed could not be established on technical or scientific grounds only. When using the proposed methodology, the various environmental impacts resulting from the establishment of environmental criteria should be weighted against each other. However, the group decided it was unnecessary to determine these judgements at this stage of the pilot study.

However, such judgement will be required when decisions are taken with respect to the exact criteria in accordance with the model proposed by the working group.

After the report was finished in the summer of 1991, the chairman for the working group cand.techn.soc. Poul Wendel Jessen and cand.polyt Heidi K. Stranddorf have edited the report with a view to publication in the "Miljøprojekt"-series ("Environmental Projects"-series).

In this connection a new annex on "Guidelines for sustainable forestry" have been written by the Danish National Forest and Nature Agency.

1. Objectives

In chapter 1 of the proposal for Council regulation (EEC) on a Community award scheme for an Eco-label the objectives and field of application are laid down.

The function of an eco-label is to advise the user or consumer of the product in situations of choise or when selecting. The advice addresses not solely the environmental impact of the product, but also its fitness or function when in use.

The positive effect of an eco-label is to increase the consumption of products which are as environmentally friendly as possible and therefore have an overall impact significantly less than that of other products in the same group. The immediate effect of this is to encourage the manufactures to develop manufacturing processes and products that minimise the environmental impact. In doing so they will in the first place look for the requirements associated with the eco-label.

The reactions of the consumer to the label are immediate and easily changed, for example when reconsidering price and quality. The producer has to consider his manufacturing process and the design of the product. Changes in this respect are often costly and of long-term consequence. In exstreme cases this can lead to closing down of some production lines or even whole mills.

Conclusion: The requirements for the label must be carefully selected to ensure that changes induced in the manufacturing process or in the product really lead to positive environmental effects – taking all aspects thereof into consideration.

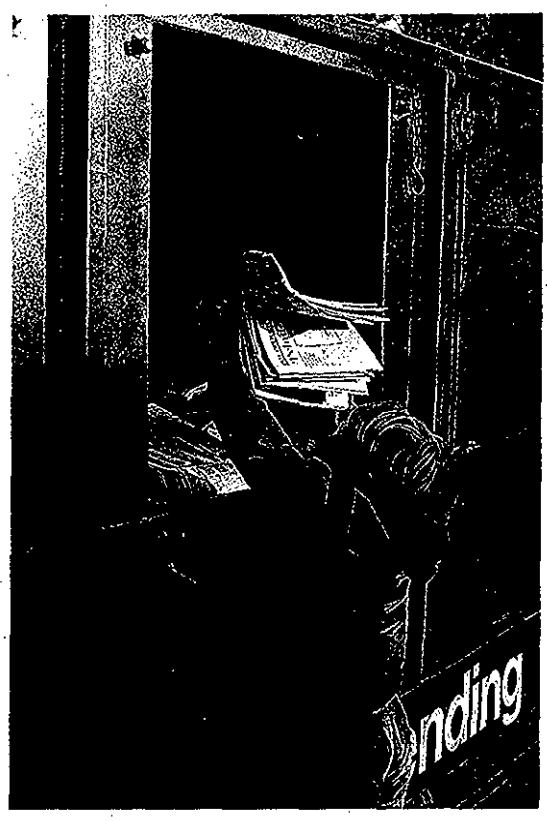


Fig. 1.
Changing of consumer behavior is one of the aims of "Eco-Labelling". A child returns newspapers for reuse.

2. General principles

The Regulation (Article 1, Section 3) defines environmental impact in the following way: "The reduction of environmental impact will be achieved through the minimisation of:

- use of natural resources and energy resources
- emissions into air, water and to soil
- generation of waste and noise

and through the maximisation of product life and, where applicable, through the use of clean technologies to ensure a high level of environmental protection."

2.1. **Cradle to grave**

The requisite that all aspects of environmental impact have to be considered leads to the "cradle to grave" concept. Generally the life-cycle can be divided into four stages:

1. Raw materials
2. The manufacturing process
3. The use of the product
4. The disposal of the used product

In each of these four sections the use of natural resources and energy; the emissions to air; to water or to soil; the disposal of waste; the generation of noise or odeur etc. have to be considered. In addition to the four sections, the transportation from one section to the next has to be taken into account.

The study thus begins with the first production stage, which for fibrous raw materials is the planting of a new tree or sowing of a field. For minerals like pigments the study starts with the mining, etc.

The study then goes on with the manufacturing process, including pulping and papermaking, the use of the product by the end customer and finally the disposal of the used product.

In this context it should not be forgotten that recycled fibre is in fact virgin fibre that is recycled, i. e. the cradle and the grave are the same for both virgin and recycled fibre.

The interpretation of the cradle/grave concept for a paper product is different from that of a fibre. In this study the cradle for recycled fibre pulp is considered to be the waste paper collection. This is illustrated in the diagrams on pages 18 and 19.

Conclusion: The cradle to grave principle means that all aspects of environmental impact have to be considered, from the forests, the fields or the mining sites from where the raw materials are obtained to the final disposal of the used product.

A detailed discussion of the environmental impacts in each one of the four stages is the subject of Sections 5-9 in this presentation. See also the Assessment Matrix in Annex 1.

2.1.1. **Narrow product groups**

The evaluation of all the different aspects of environmental impact is obviously complex. It is also obvious that a comprehensive, quantitative system for measuring environmental impact cannot be achieved. The complexity is reduced if each group of products is treated separately. In doing so, environmental impacts that are equal or nearly equal for the whole group can be disregarded since they cancel each other in a quantitative treatment.

Such an approach is in line with the consumers situation of choise; the choise is between, for example, different makes of toilet paper not between toilet paper, writing paper or napkins.

In practice a study for eco-labelling has to start with the definition of product groups. The procedure includes a functional analysis of the products under consideration, which means a study to establish that the different products in fact are used in the same way and thus competing with another.

A comprehensive functional analysis in this context means a careful consideration of the way the products are used, their technical qualities and their field of application, taking into account the different patterns in different EEC countries.

A simple test for deciding whether two products belong to two different product groups, or to the same group and thus compete on the market, is to ask the question: "will the customer select one single product or will he buy both products?"

Conclusion: Eco-labelling should only be considered for well defined and very narrow ranges of products. The basis for defining these groups is a careful analysis of the function of the products.

2.2. **Local, regional and global impacts**

Environmental impacts may be local, regional or global. "Indoor climate" and the emission of noise and odour are typicallly local. Emissions of biodegradable organics are of local or regional importance, nutrients are considered as regional, emissions of PCBs and carbon dioxide are examples of global impacts etc.

It follows from the cradle to grave concept that an environmental impact has to be considered wherever it occurs, outside or inside the region under consideration, for example the EEC. It seems unfair to disregard emissions only because they take place outside the region under consideration. Products imported from "outside" would then receive a higher rating than those produced "inside".

Conclusion: Environmental impacts should be considered regardless of where the emission takes place, outside or inside any type of geographical borderline.

2.3. **Local impacts**

The environmental impact of a certain amount of emission (taken in a broad sense, for example including noise or odour) may vary greatly according to where it occurs. Some emissions are serious if they take place in an urban area but are bearable or marginal in a sparsely populated area. In other cases the presence or absence of af appropriate recipient (lake, river, sea etc.) makes a great difference. It seems as if it would be very difficult to pay attention to extremely local environmental effects, which would require a system for weighing that takes into account the local circumstances.

On the other hand, local environmental impacts are generally under careful observation by the local authorities. Various kinds of restrictions are enforced by law or otherwise in order to minimise effects that are considered unwanted from an environmental point of view. The restrictions embrace all sections from the cradle to the grave, not only mill operations, but also operations such as forestry or waste disposal.

Conclusion: No product should be considered for eco-labelling unless all the regulations enforced by the relevant local authorities concerning environmental issues are followed.

It has to be discussed what parameters are of "local character". Certainly all aspects of "indoor climate" in the mills concerned fall in the category of "local impacts". The duration of an impact, expressed by the time required for the impact to be halved may be a useful measure. A list covering typical local impacts could be based on such a concept.

2.4. **The grammage effect**

All paper products are characterized by their grammage. (The grammage is mass per area). It is typical for papers that the raw material (e.g. the pulp) is measured by mass (tonnes) but the product by area. This is quite obvious for printing and writing papers, for envelopes and for many kinds of wrapping paper, it is less obvious for soft tissues. Nevertheless, for example envelope paper made of a weak fibre has to be made heavier (higher grammage) than a paper made from a strong fibre (lower grammage) if envelopes of equal strength are required.

Conclusion: For each product the grammage effect should be considered and, if relevant, taken into account.

2.5. **The quality aspect**

Most paper products are produced in different qualities. Generally the higher quality requires more processing and is thus also connected with a greater environmental impact. In numerous cases a higher quality than

required by the function of the product (excess quality) is chosen. An attractive appearance of the product not only appeals to the buyer, but many times also to the ultimate consumer, for example the person who receives a letter in a nicely designed envelope. A high quality strengthens the image of the sender. The eco-label may restrict or eliminate the use of excess quality products and thus improve the environment. This would be a positive effect of the label.

But there is a danger involved. If the label – in public opinion – invariably is connected with inferior quality, the label may aquire bad reputation and the effect may be the opposite to its object. Example: Do not use eco-labelled envelopes if you want your letter to arrive undamaged.

Conclusion: The eco-label may well discriminate excess quality but care must be taken so that the label is not given to products of such low quality that its intended function is endangered. A minimum degree of equivalence of performance must in each case be considered.

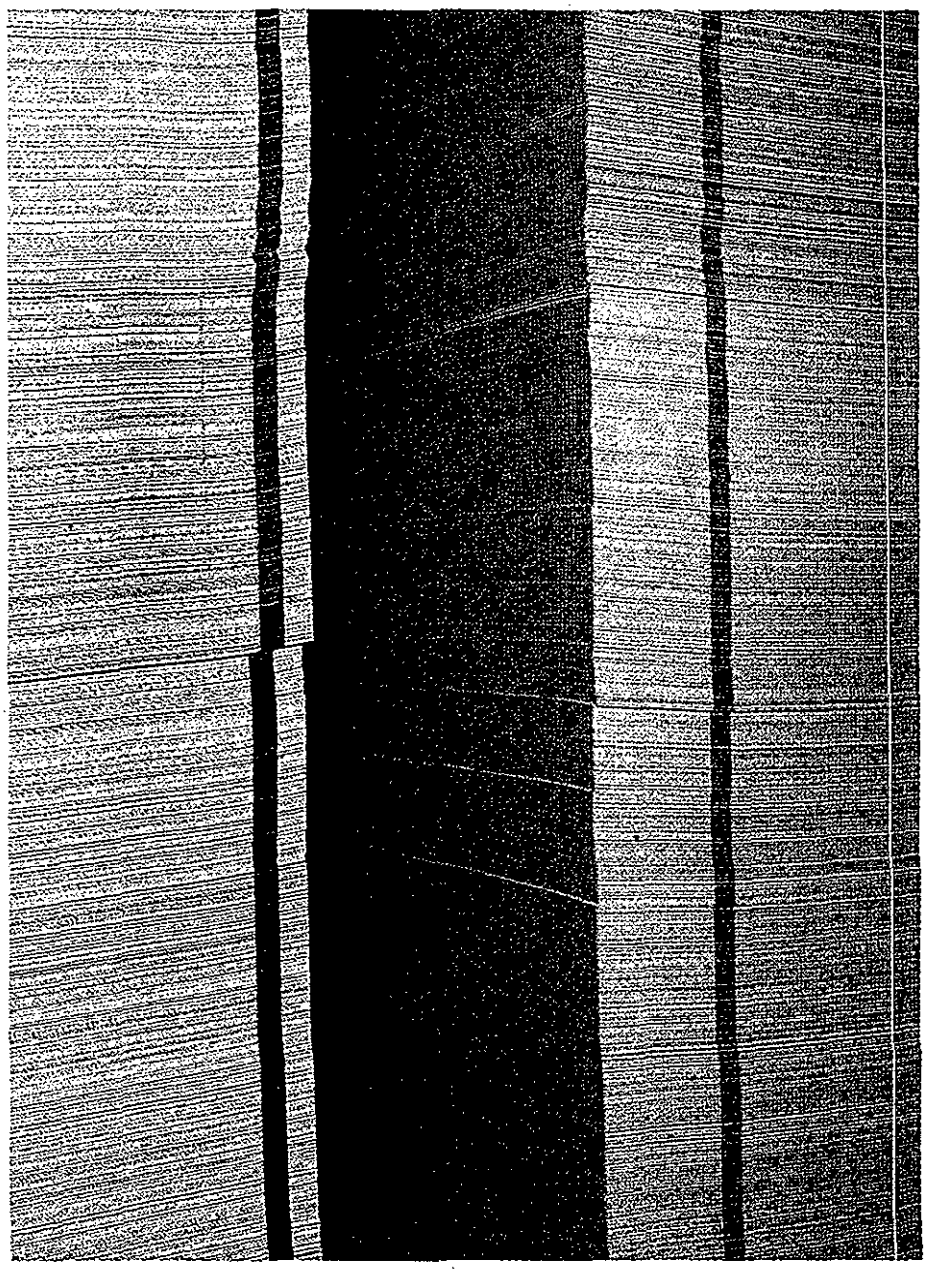


Fig. 2
Pallets of crude paper.

3. Paper-making, an overview

Paper is by definition a material in the form of sheets or reels consisting mainly of randomly distributed natural or artificial fibres with or without the addition of size, pigments, fillers, dyes etc. In a generic sense the term paper includes board (paper board).

Paper is made from pulp (paper pulp). Pulp is made from natural, fibrous raw materials, mostly wood, or from wast paper.

The paper making process as a whole is thus divided in two steps. The two steps are, principally and technically, entirely different. In the first step (the pulping) the raw material is disintegrated to produce well separated fibres. In the second step (the paper-making) the fibres are recombined to produce a coherent sheet, the paper.

A number of technically different pulping processes are in use. The natural raw material is disintegrated either by mechanical or by chemical means, producing and mechanical and chemical pulps respectively. Both groups can be subdivided according to process characteristics.

If waste paper is disintegrated the product is referred to as recycled fibre, in contrast to virgin fibre.

The following pulps are common in Europe:

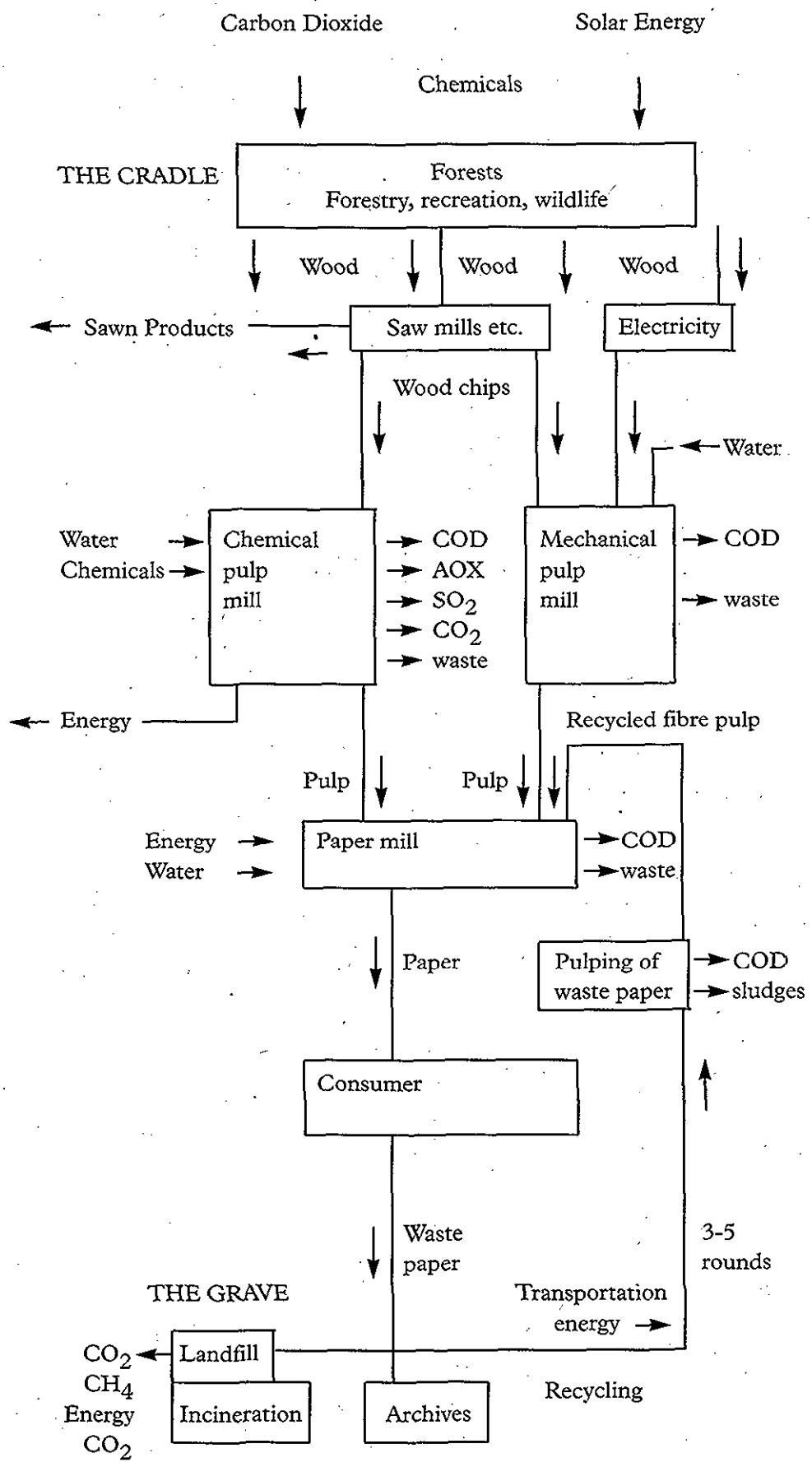
Mechanical	Groundwood (SGW) Refiner pulp (GW)
	Thermomechanical pulp (TMP)
	Chemothermomechanical pulp (CTMP)
	Bleached CTMP
Chemical	Unbleached kraft
	Bleached kraft
	Unbleached sulphite
	Bleached sulphite
Recycled fibre	Many types, depending on source

Pulp mills are designed to produce a certain type or range of types of pulp. They are often large and cannot easily be redesigned for the production of other types of pulp than those they were built for.

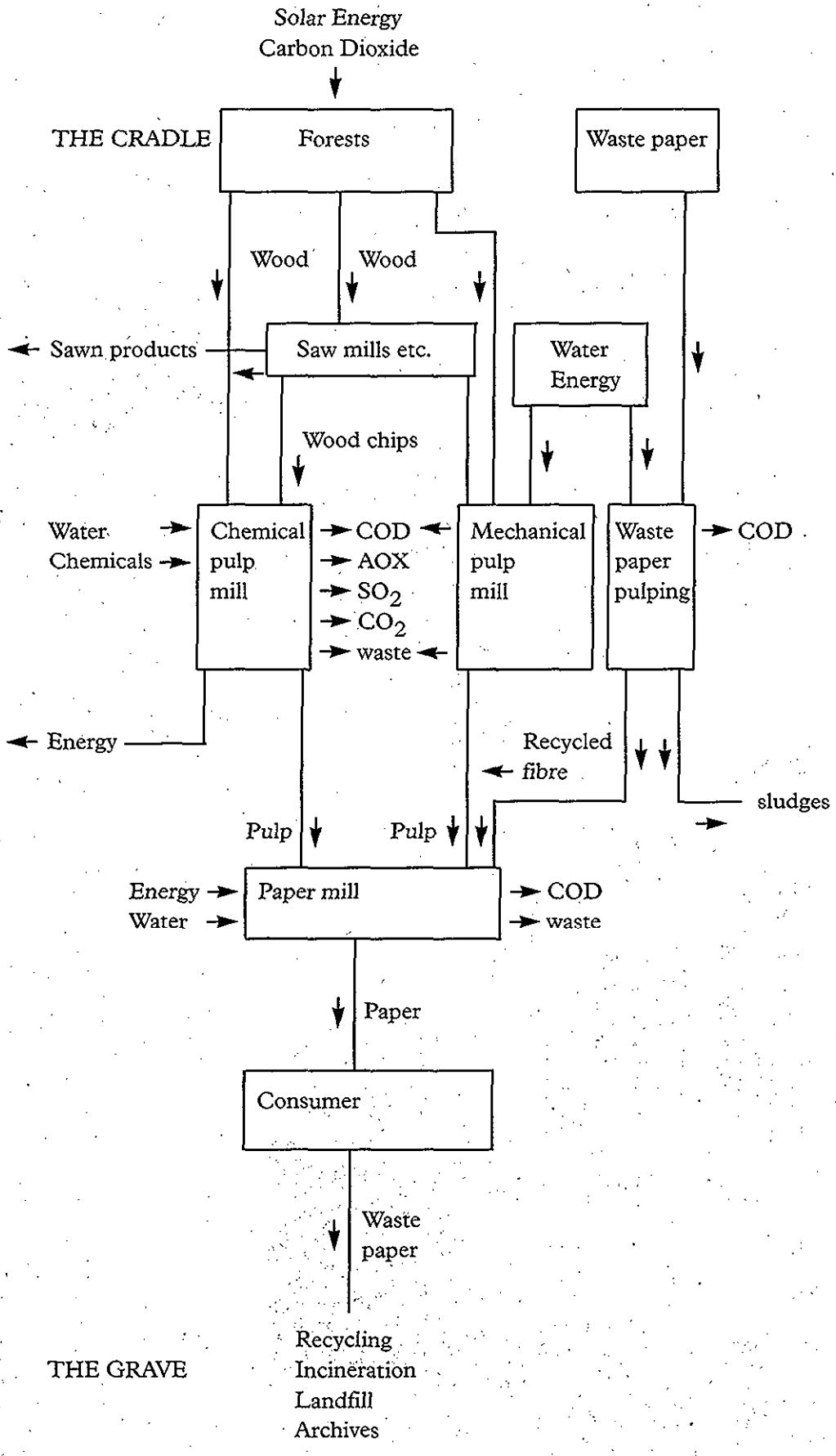
The various types of pulp have different characteristics and use. It is inherent in the art of paper-making to select the mix of the various pulps that gives the optimum result in the paper mill.

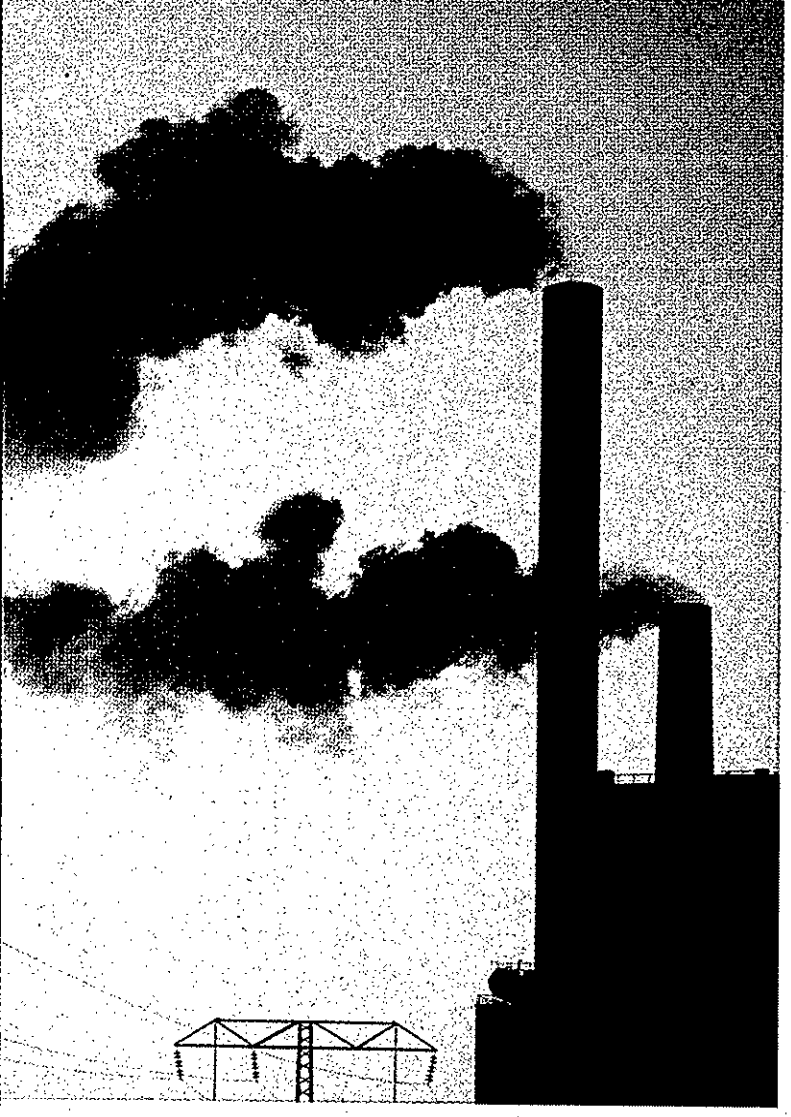
The processes for paper-making are much more similar to each other than the pulping processes. The major part of the paper-making takes place on the paper machine. Paper machines are designed to produce a rather narrow range of similar products. For the purpose of eco-labelling this means that the most important differences in terms of environmental impacts between competing paper products are to be found in the pulping step.

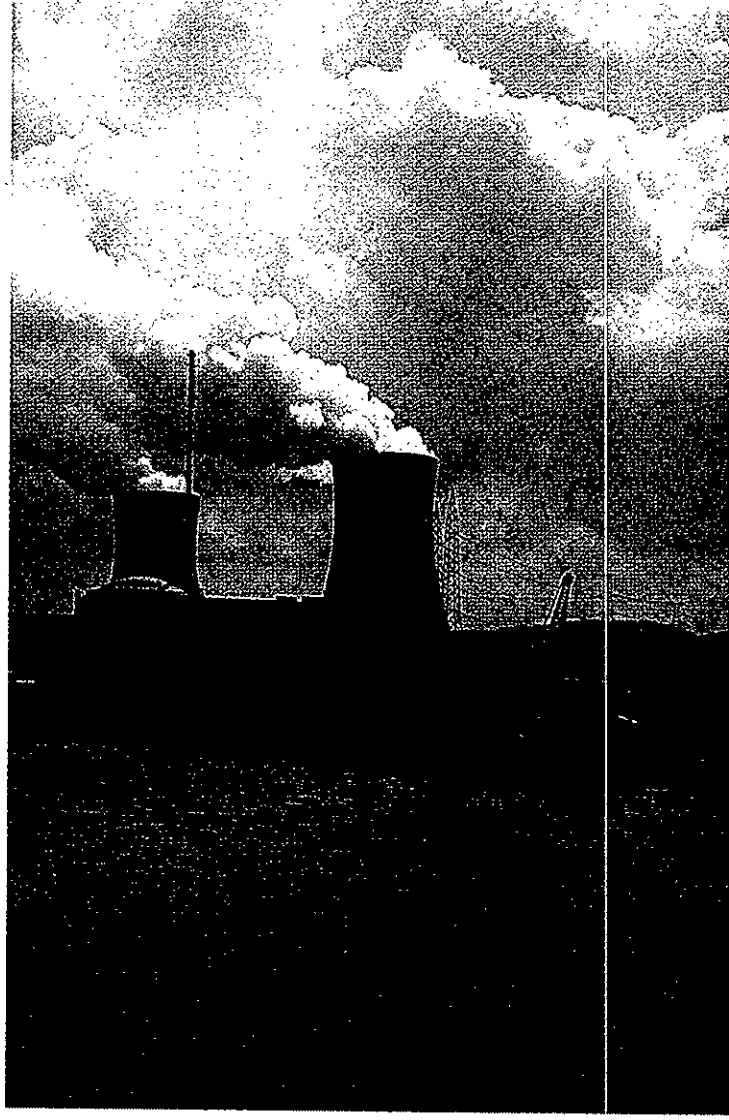
Paper fibres from the cradle to the grave

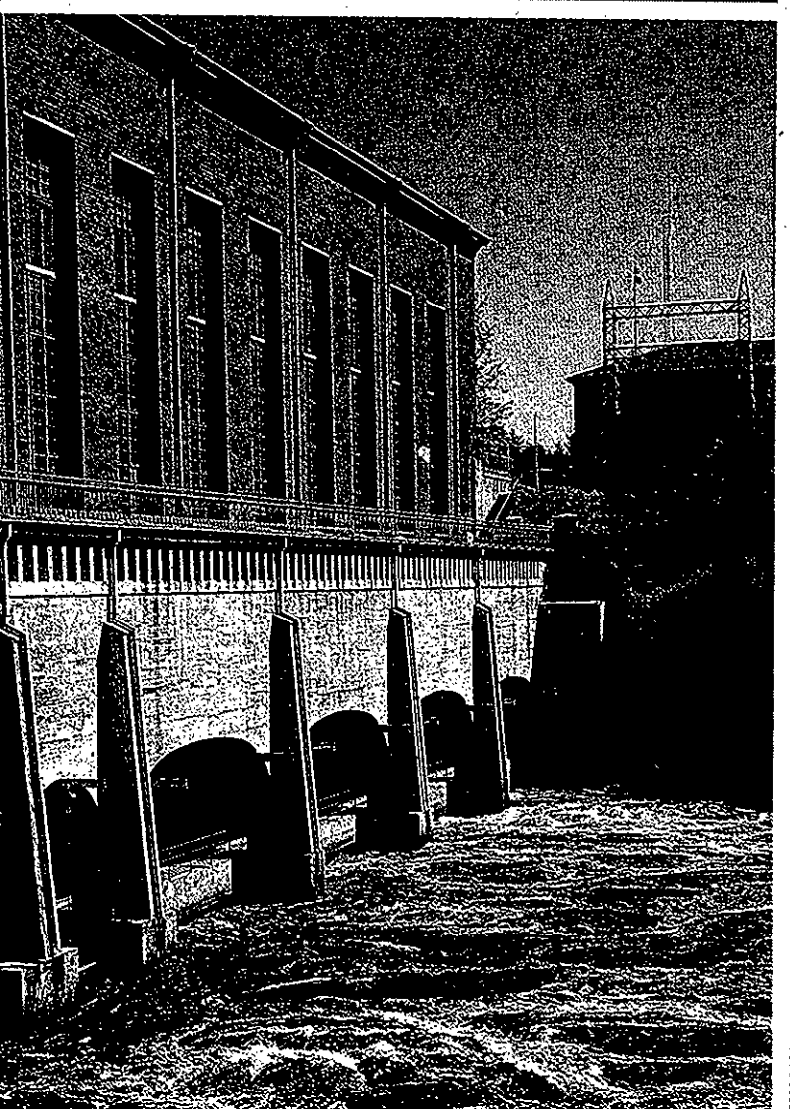


Paper products from the cradle to the grave









4. Energy and natural resources

Fig. 3
Non-renewable energy from coalburning electricity plant.

All products require energy and natural resources for their production. The production of energy depends also on natural resources. The two issues should therefore be considered in parallel. Many resources are limited and it has been generally accepted as positive to convey industrial production as well as other manifestations of human life so that the use of energy and natural resources is minimized.

Natural resources can be divided into renewable and non-renewable. Considerable concern should be given to the use of non-renewable resources, both for energy production or as raw materials.

There is no single and undisputed way to transform the above, generally accepted statements into quantitative measures, such as would be required for comparing various products considered for eco-labelling. When looking at a complex production system like that required for paper products, a number of difficult questions ask for answers.

Fig. 4
Non-renewable energy from newclear power plant.

Electricity, for example, is a major energy input in the production of some paper products. A complete analysis of the natural resources required for the production of such papers would therefore include a study of the source of the electricity.

Such a study is complicated because the electricity is taken from a national or an international network with several powerstations, some using renewable resources and some using non-renewable sources.

There is no single way to compare raw materials of entirely different composition. A comparison by mass is obviously not relevant in this context. For energy analysis of paper production the heat value, not only for fuels, but also for raw materials is taken into account, as well as the heat value of the products. This means that of all kinds of natural resources are measured as energy. This approach may be disputable, however, it has the merit of making possible comparisons of energy and natural resources.

Fig. 5
Renewable energy from hydro power electricity plant.

Complete energy analysis for pulp and paper products has been carried out for some special cases and the methodology and some results have been reported by the International Energy Agency (IEA): "Energy input analysis in the pulp and paper industry" Stockholm 1984). An energy input analysis is the calculation of the total energy demand needed for the manufacture for a certain product. The calculations start at the source of the different raw materials. The analysis includes the energy in the fuels, energy requirement for production of chemicals, energy used in transportation, energy for construction and maintenance of vehicles and mills in addition to the energy used directly in the manufacture of the product. Credit is given for energy in products and by-products.

Fig. 6
Renewable energy from windmills.

A complete energy analysis requires a large number of input data and also uses a set of conversion factors since the various input data are given in different units, like cubicmetres of wood, oil equivalents, Watts, joules etc. All data are eventually recalculated to so called primary energy, i.e. the

energy at the source. This means that losses involved in bringing the energy to the mill site are included.

A complete energy analysis is reasonably precise when all the data are at hand and the details of the manufacturing proces are well mapped. It should be borne in mind that the result reflect the situation prevailing when collecting input data. A change in the mix of input raw materials or the selection of energy resources also influences the result of the analysis.

For the purpose of finding criteria for an eco-label it is presumably unnecessary to ask for a complete energy analysis.The examples given by IEA show that about 10 % of the total energy input relates to the paper-making itself if virgin fibre is used. Even if this factor may vary between various types of papers, it is reasonable to assume that the factor is fairly constant for a particular paper type. This means that the main energy consumption has to be ascribed to the steps preceding the paper-making.

It is then permissible to disregard all energy consumption in the paper mill and in the following steps (use and disposal) – not because it is nil – but because it is nearly the same for all products in the same product group.

For certain pulp types data have been published (Swan, Allg. Papier Rundschau, 1984:4, p 36):

Primary energy requirements	total	renewable
Bleached softwood kraft, dry	48,0 GJ	32 GJ
Bleached softwood kraft, wet	46,4	32
Unbleached softwood kraft, wet	39,0	29
Bleached mechanical (TMP), wet	36,8	14
Unbleached mechanical, groundwood, wet	29.1	14
Deinked pulp of recycled fibre, wet	16,8	13

The data are expressed as Net Energy requirement (NER), in GJ. per tonne. The term NER must not be confused with the energy requirement at the mill; it includes the net heat value of the raw materials and the energy revenues due to either incineration or material recycling.

More recent data (unpublished) indicate that unbleached chemical (kraft as well as sulphite pulp) and mechanical pulps have about the same NER, whereas recycled fibre has about one third of that NER.

> Note – Swan has recently informed that the data given in the table above – on recalculation using current inputdata – would show values that for virgin pulps would be slightly less, but not more than 10 %. The reason for this is that technical improvements in the mills have resulted in reduced electricity consumption, i. e. partly non-renewable resources.

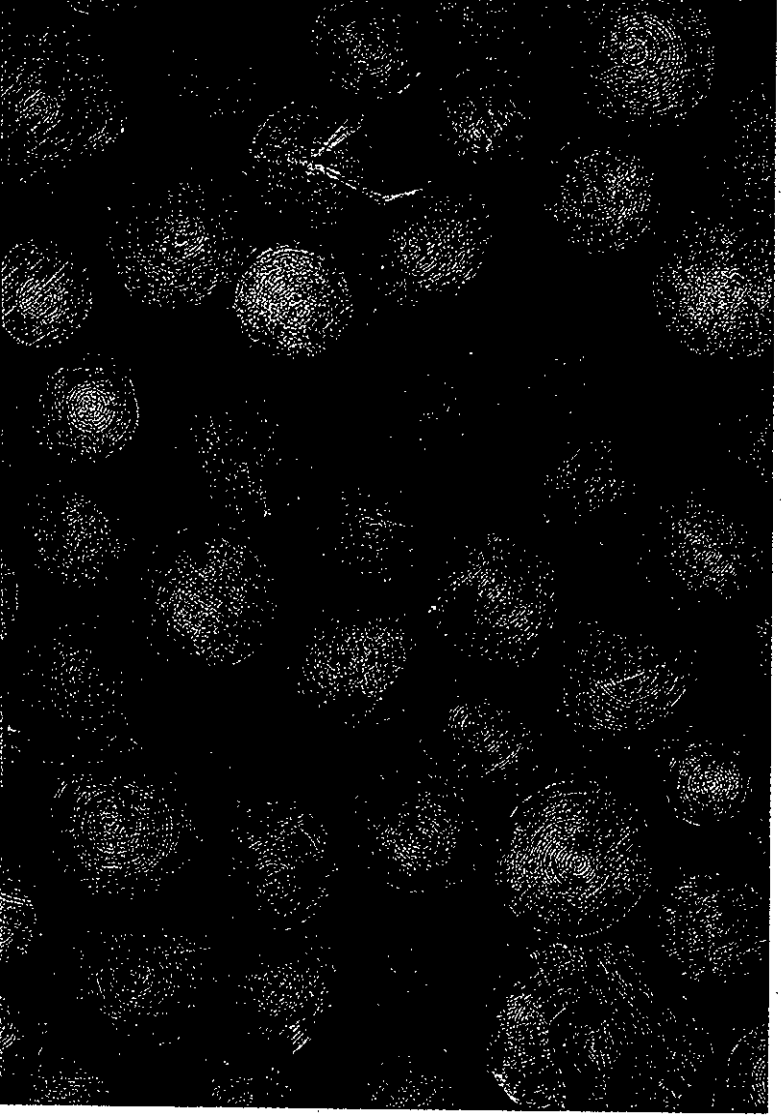
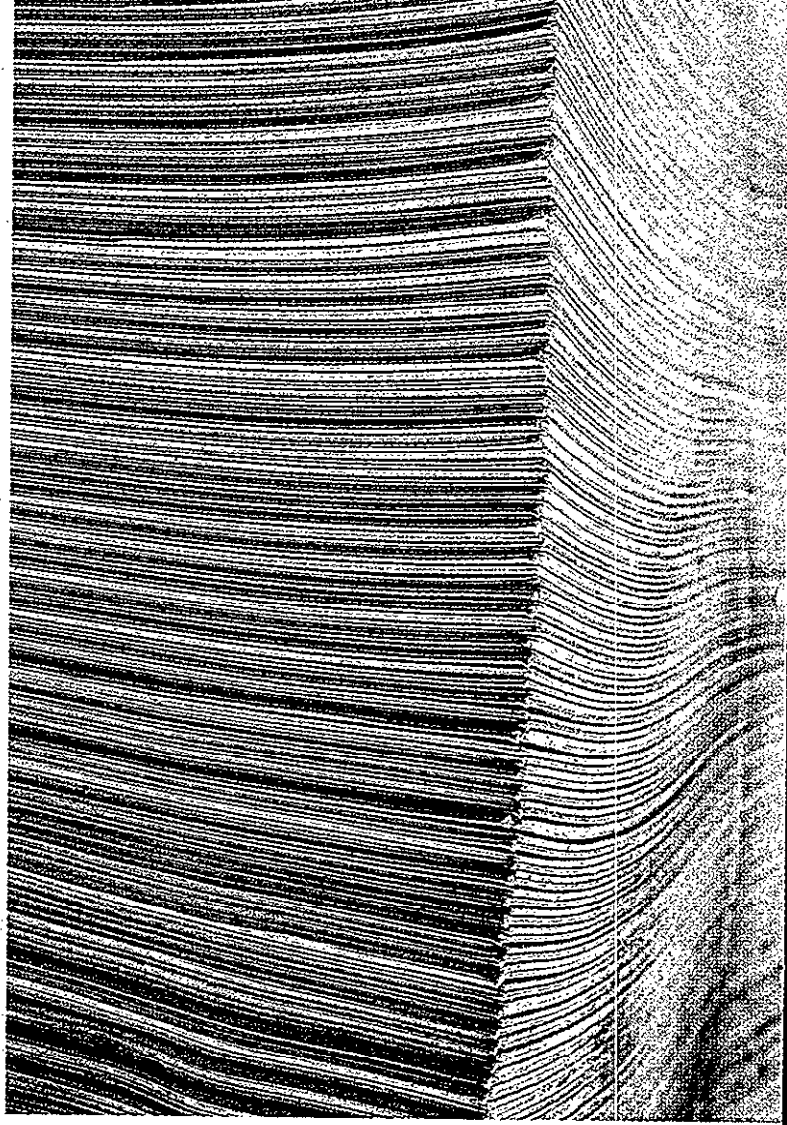
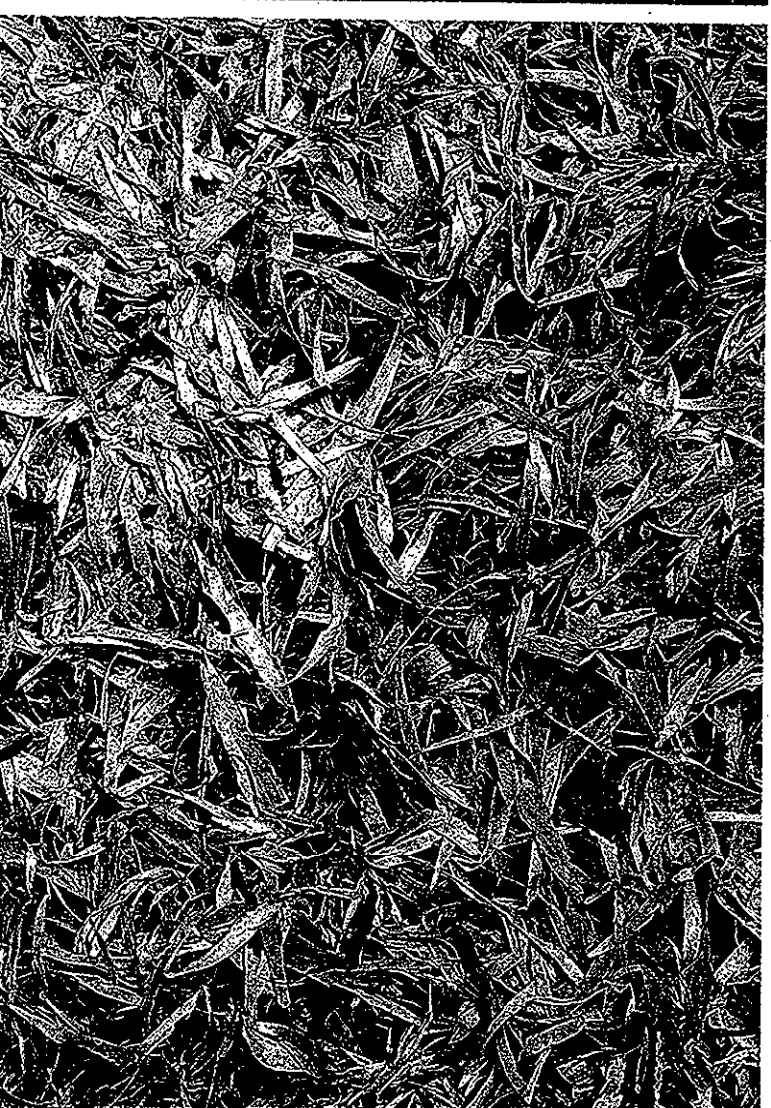
An energy analysis, carried out as outlined by IEA, includes the value of the raw materials (natural resources) which are valuated by their heat con-

tent or combustion value. The energy requirement for the manufacture of chemicals is also included as well as the energy required in all forms of transportation. The NER value can therefore be taken as a combined meassure of energy requirement and natural resources.

The figures in the table reflect the situation at the end of the pulping. The additional energy input at the paper mill is comparatively small and – for a particular type of paper – of the same order of magnitude in all mills.

From an energy point of view and for the purpose of eco-labelling it seems reasonable to disregard the energy consumption at the paper mill and focus on the NER for producing the pulps. Considering the fact that a large fraction of the paper mills rely upon purchased pulps for which it is not feasible to obtain precise NER data, only rough averaged data can be applied to the pulps.

Conclusion: For the purpose of eco-labelling the use of energy and of natural resources can be roughly estimated. The decisive contributions are from the pulp production. The difference between mechanical and chemical pulps is minor whereas recycled fibre has a considerably less energy requirement than any kind of virgin fibre.


5. The raw material

5.1. **The fibrous raw material**

Fig. 7
Wood can be the *raw material.*

The raw material for paper production is pulp. The pulp in turn can be produced from various primary raw materials. The cradle to grave principle requires the pulp production to be considered, regardless if the pulp is produced at the paper mill, or in a separate pulp mill in the same country or elsewhere.

The pulp may be produced from wood, grass and other vegetable fibres, by chemical or mechanical means, or from waste paper.

Fig. 8
Cellulose-fibrous made of wood for paper production.

The wood may be logs taken from a forest, cultivated (as is normally the case in Europe) or virgin forest. A large portion of the wood used in pulp mills is waste from saw-mills. Grass is sometimes cultivated as a paper-making fibre (separto, sisal) or agricultural waste (straw, bagasse). For some paper qualities (fine papers) textile waste (rags) are used as the fibre source. Paper waste collected from households and offices is a raw material used in large and increasing quantities. The environmental impact of producing these raw materials and bring them to the mill varies from one region to the next. In some areas fertilizers are used to enhance growth, in others no chemicals are used. In some areas deforestation is a problem, in other not.

Fig. 11
Floating of logs.

Fig. 9
Woodchips can be used as raw material.

Transportation systems (floating, shipping by sea, trains, cars etc.) vary from one region to another. Most pulp mills obtain their raw material form different sources and by different transportation systems.

Fig. 10
Waste paper can also be used.

It seems very difficult to measure, or even compare qualitively, the environmental effects involved in the process of producing the primary raw materials and in transporting them to the pulp mill.

However, attemps have been made to calculate the energy requirement for

harvesting the raw materials and to bring them to the pulp mill. This is discussed in Section 4.

Other environmental impacts of local nature, like the impacts on the landscape and wildlife, the noise and odour involved in harvesting and transportation etc. have to be disregarded in this context. The reservation of certain forests as national parks or similar is another issue that has been forwarded. Conflicts between various interests regarding issues of this type are clearly local and it seems very difficult to handle them within a general system of criteria for eco-labelling.

Conclusion: Including environmental aspects, other than energy aspects, on the production of the fibrous raw material in the requirements for eco-labelling is too variable from location to location to be included in the evaluation of products for eco-labelling purposes.

5.1.1. **Waste as raw material**

The use of waste (in pulp production: waste paper, wood trimmings, saw dust, straw, rags) is generally considered as positive and environmental-friendly because natural resources and energy are saved.

However, alternative uses of waste should also be borne in mind. Many waste products, including waste paper, can be used as fuel for heat generation.

Recycling of waste paper has become a special issue. The main reason for recycling is to reduce the amount of garbage to be handled. This is considered as an environmental issue and efforts should be made to find those products in which recycled fibre can be re-used.

The eco-label should take recycled fibre into account for such products, but not necessarily for the whole range of paper products. A balance between the use of wood or of waste paper for paper production or for energy generation should be aimed at.

Fig. 12
Crude of waste paper and transportation by railwaycarriage.

A wide spectrum of waste paper qualities are on the market. When discussing waste paper in relation to eco-labelling it should be borne in mind that the object is to encourage reuse of used fibre. This means that the waste paper in fact should have been in use, such as newspaper. For the purpose of this study all paper products that have been shipped out from a paper mill and then are returned are considered as waste paper. Trimmings from book-printers should thus be considered as waste paper.

Note – Within CEN/TC 172 (on standardization of pulp, paper and board) work is in progress with the aim to establish a classification system for various types of waste papers. This system, when completed, may prove useful to describe the optimal use of various types.

In the energy analysis waste paper is compared to virgin fibre on equal basis, i. e. ignoring the fact that virgin fibres are required to obtain and maintain a source of waste paper. Cellulosic fibres are "worn" each time they are recycled. Figures have been presented showing that a fibre of mechanical pulp can be recycled two to three times before it is "worn out" and that a fibre from chemical pulp stands about twice as much recycling. These figures may be disputed, but the fact remains that recycling of waste paper has an optimum. The system needs a mechanism by which "worn out" fibres are removed and consequently an input of virgin fibre.

5.1.2. **Saving of trees**

The public in many countries has been given the impression that the main reason for recycling is to save trees. The main reason is the waste problem. At present there is no lack of pulpwood in Europe and, for example in the Nordic countries, the volume of living and growing trees is larger than ever before in historic times. Forestry is part of the economical life and, *when performed according to modern principles*, it gives us healthy forests for wood production as well as for wildlife and recreation.

Fig. 13
Modern principles is to combine use and protection of the forests in a versatile and sustainable forestry.

Modern principles include restricted use of chemicals in the forests, the maintenance of ecological processes, avoidance of erosion. They secure a persistent, long term use of various species with the aim to maintain genetic variation.

The cutting of tropical rain forests has nothing to do with European paper production. When rain forests are cut most of the wood is burned on the site to promote agriculture. Some preciuos species are exported for special purposes, but not for pulping.

Most countries have national parks and similar reserved areas where nature to a maximum extent is allowed to develop freely. In such areas no cutting of timber or pulpwood is allowed, nor is any form of agriculture. It is, however, a false conclusion to say that recycling to save trees would automatically contribute to the establishment of such reserves.

The use of land is governed by economical facts. If a land area is best used for forestry, forests will be grown and the trees will be used and not wasted. If the land is best suited for agriculture, crops will be grown and harvested. If no trees are used as pulpwood, they will be used otherwise, as timber for construction of houses etc., as fuel or as raw material for other products, such as ethanol.

Conclusion: A sustainable forestry based on modern principles should be a requirement for the raw material used in the manufacture of eco-labelled papers. A criterium for such forestry is that there is no decrease in the volume of growing wood under bark in the region from which the wood is obtained.

It has been argued that modern forestry leads to unwanted monocultures because only one specimen is planted. In the northern parts of Europe a forest, left untouched by man, by the natural rule of survival of the fittest, develops into a mixture of species where one or a few dominate. A planted forest develops in a similar way, the planted species dominate, but only in rare cases it develops into a real monoculture.

Fertilization of forests has been presented as environmentally negative. Compared to fertilization in agriculture the effects on the environment are unsignificant. A forest is fertilized once or twice in a life cycle and the run-off from a forest is negligible compared to that from an open field.

5.2. **Process raw water**

In conventional pulp- and papermaking processes large quantities of water are used; figures up to several 100 cubic metres per tonne have been reported for older mill operations. Recycling of water is used extensively, primarily in order to save fibrous material, energy and chemicals. The water is always returned to the environment, usually to the same watercourse from which it was taken.

It has been argued that the withdrawal of water from the environment is an environmental impact. As the water is returned, and not "consumed"

as for example in agricultural irrigation, this has no environmental impact other than possibly in the close vicinity of the mill. The fact that the returned water contains contaminants from the mill is another issue (dealt with as emissions to water, see Section 6 and 7).

A few paper mills use ground water from drilled wells or tap water form such wells. This is an environmental impact because the groundwater level is affected. For the purpose of eco-labelling these rare cases must be classified as typical local impacts, see Section 2.3.

5.3. **Process chemicals**

Bulk chemicals are used in the production of pulp, not only for chemical pulping but also for all other types of pulp, including recycled pulp. Mills producing chemical pulps have recovery systems by which the chemicals are recirculated. The energy and the natural resources required for the production of the chemicals are included in the energy analysis described in Section 4. Other environmental impacts involved are – for the purpose of this study – considered as local and governed by local laws and regulations.

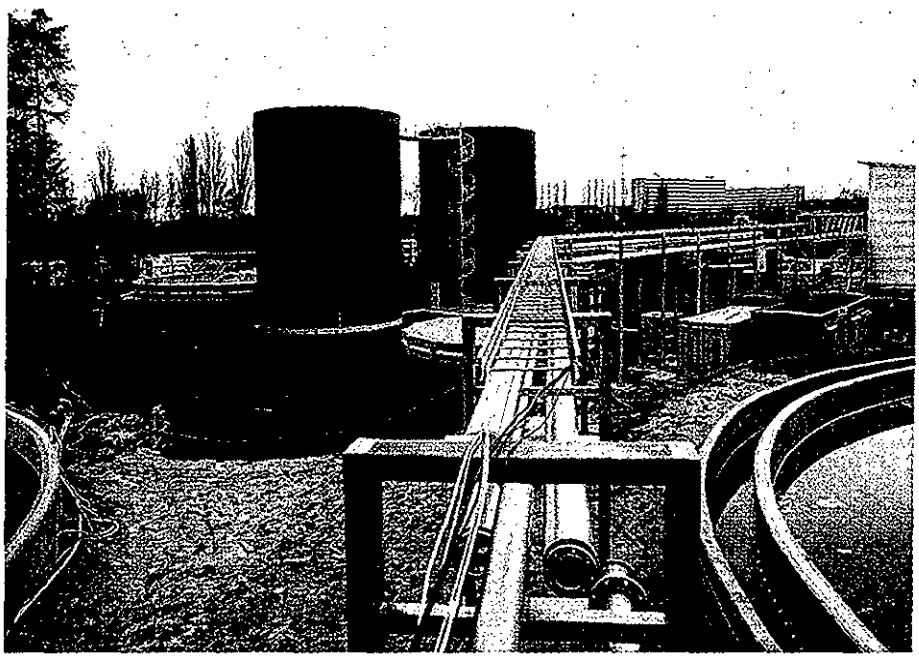


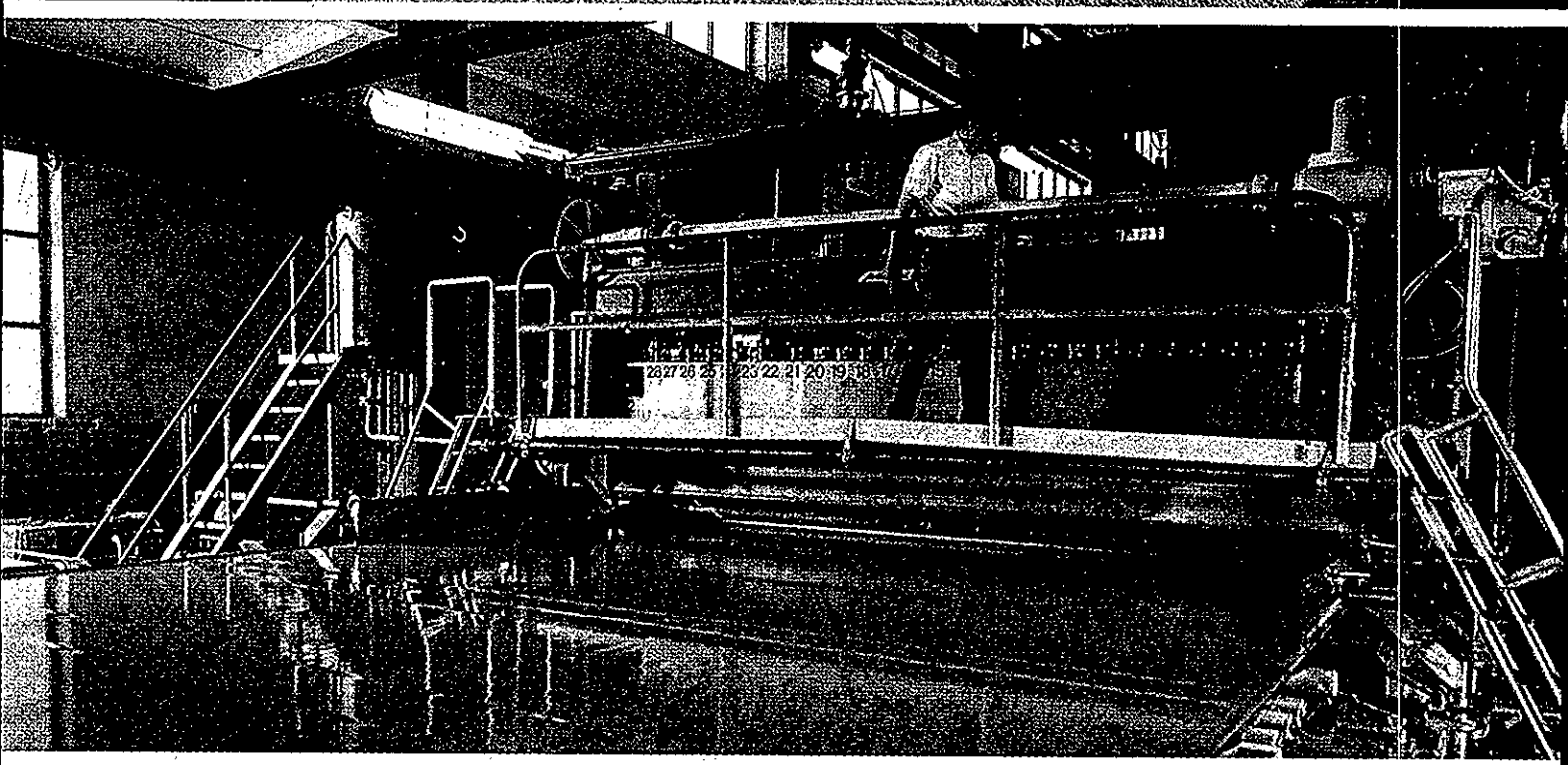
Fig. 14
Biological purifying plant for process water.

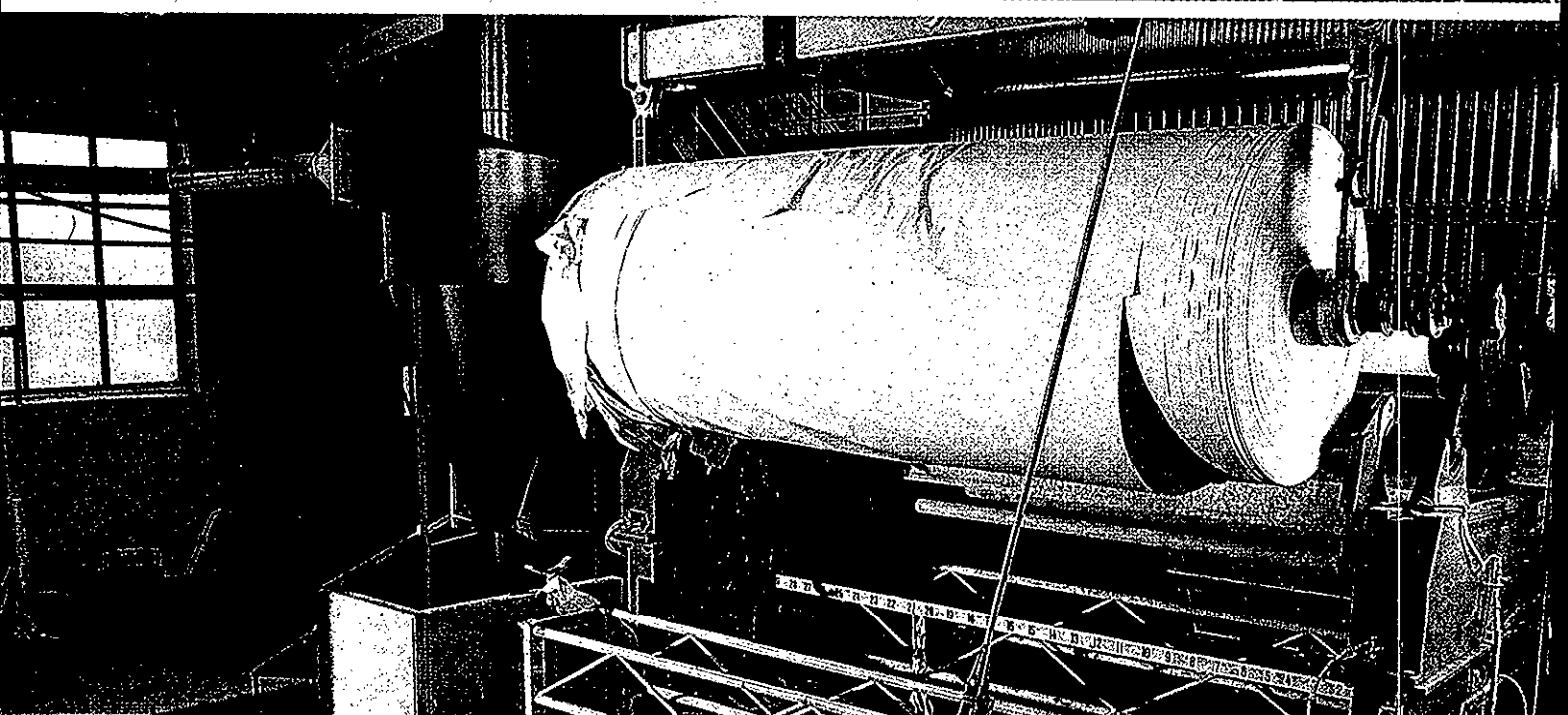
5.4. **Fillers, pigments and other raw material**

In some papers fillers and pigments are added to the paper furnish to increase the opacity of the paper and to decrease the amount of fibrous material required. Certain types of papers are coated to increase the printability of the paper. Many papers contain no fillers or pigments whereas other types may contain up to 30 % of mineral fillers. In such cases the amount of fillers has to be taken into account when relating environmental impact to the weight of the products.

The production of pigments and fillers for paper production generally cause little environmental impact. Clay and various forms of calcium carbonate dominate. In rare cases titanium dioxide is used, and the emissions from the production may have environmental impacts which should be observed and, if relevant, taken into account.

In paper production raw materials other than fibre, water, fillers and pigments are used in comparatively small amounts. The environmental impact caused by the production of these other materials adds little to that involved in the fibre production and is therefore disregarded in this study. However, the rule that all relevant laws and regulations should be obeyed is extended to cover all kinds of addititives.





6. The pulping process

Fig. 15
The pulping process.

Papers are produced in two steps – the pulping and the papermaking. Pulping and papermaking are either combined at one mill (integrated mill) or divided on two mill sites. Pulp as an intermediate product is a commercial commodity on the international market.

Several types of pulp mills are in operation. Technically these are divided into two main groups – mechanical end chemical. The purpose of the pulping process is to free the cellulose-based fibres from each other so that they can form a fibre mat, the paper. In the wood the fibres are held together with the aid of a substance known as lignin. In mechanical pulping processes the fibres are separated by mechanical means which means that the lignin remains in the fibres. These become often damaged and mechanical pulps contain a large portion of small particles. In chemical pulping the lignin is dissolved and the fibres are retained intact to a high degree. The waste liquor, which contains the dissolved lignin, is recirculated to recover chemicals and energy.

Mechanical pulps are groundwood (SGW), refiner pulp (RGW), thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP). Each of these may be unbleached or bleached, the bleaching agent commonly being hydrogen peroxide.

Fig. 16
The paper machine.

Chemical pulps are kraft (or sulphate) pulps, sulphite pulps and to some extent soda pulps. These pulps may be used unbleached or bleached. Kraft pulps are superior in strength compared to all other pulps made from wood. Unbleached kraft pulp has a brown colour and is not suitable for printing or writing papers unless it is bleached. The bleaching of kraft pulps requires the use of chlorine, hypochlorite and/or chlorine dioxide. No full-scale bleaching process has yet been developed that allows softwood kraft pulps to be fully bleached without the use of chlorine-containing agents. In modern mills the use of such agents has recently been reduced considerably, for example by introducing oxygen as a bleaching agent.

Sulphite pulps generally have less strength than kraft pulps. They can, by modern technique, be bleached to a certain degree without the use of chlorine-containing agents.

Mechanical pulps have considerably less strength than chemical pulps. They are normally used (unbleached) in papers of low durability and permanence, like newsprint. Their brightness can be increased somewhat by bleaching with chlorine-free agents. So far, no process has been invented that prevents their tendency to turn yellow or brown when aged or exposed to light. The yield per unit mass of wood is considerably greater than for chemical pulps. Mechanical pulp mills require much more externally generated energy (electrical power) than chemical pulp mills.

Fig. 17
The paper after end of production.

Waste paper is mostly pulped at the paper mill by mechanical means. The cleaning of the pulp from printing inks and other impurities requires energy and some use of chemicals.

The environmental impact of pulp mills varies greatly from one mill to another, depending on the raw material used, the type of process applied, the recovery system and the external cleaning systems.

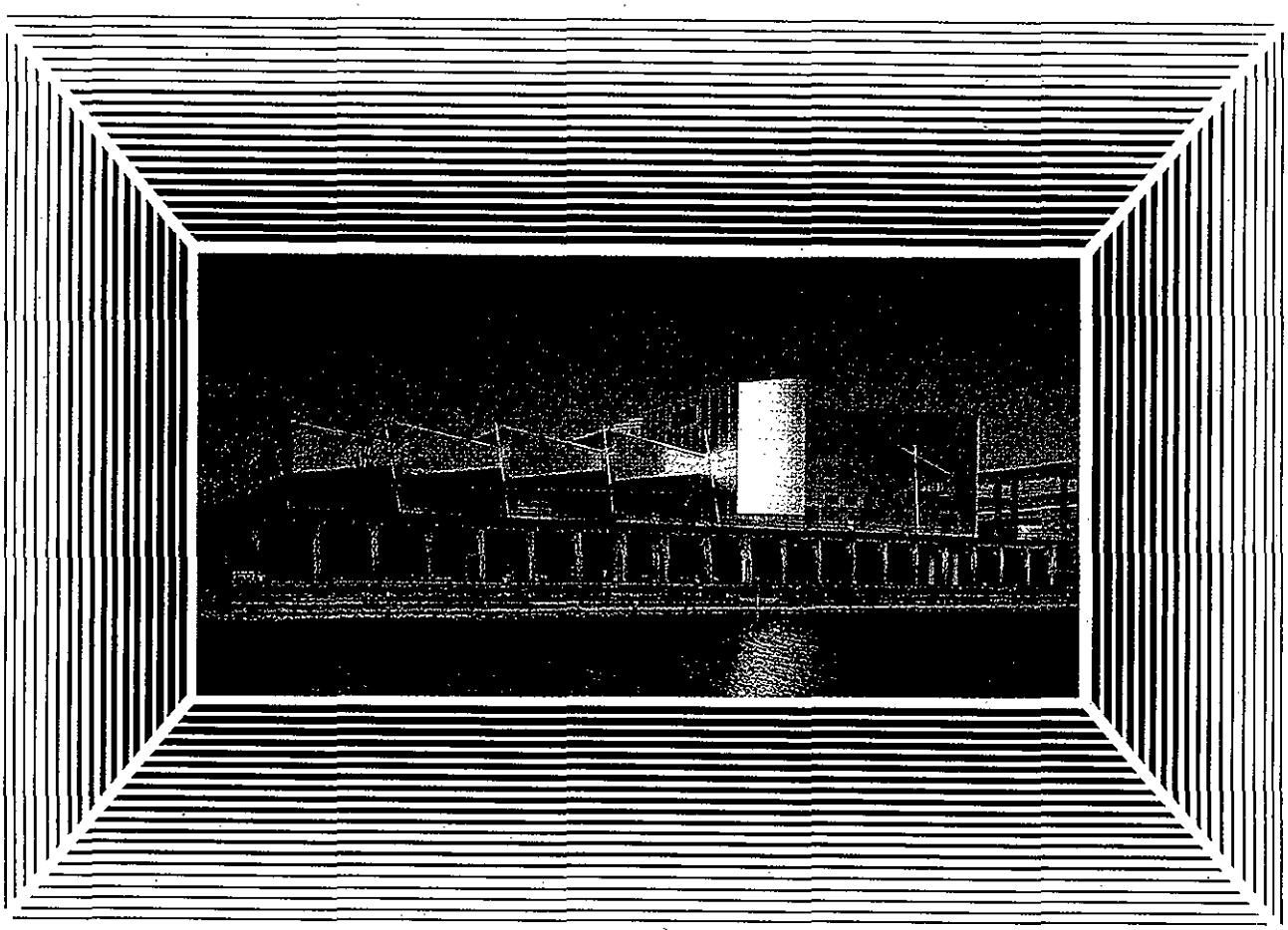
A comparison of different types of pulp mills in order to promote "clean technology", based on the various technologies applied, is no doubt a very complicated undertaking. Furthermore, any position taken in this respect has a steering effect on the design of the mills. The risk that the positive effect aimed at is balanced by a negative effect in some other respect is great.

Example: Regulations to minimize the emission of black liquor residues from kraft cooks had the ultimate effect that the concentration of some dissolved organics in the bleach plant increased and that some chlorinated organics appeared in the bleach plant effluent that otherwise would not have been there.

Any attempt to use the eco-label directly to promote a certain technique *per se* may lead to sub-optimal technical solutions. The number of techniques to be considered is great, in fact there are no two pulp mills that use exact the same technology.

Conclusion: The eco-label should not be given to a product only because a certain pulping process or type of raw material has been used.

6.1. **The black box principle**



The principle to be preferred when promoting clean technology, as argued above, should not be based on the assumption that some technical solution as such has less impact on the environment than any other. The alternative is the principle often applied legally when permitting a certain mill operation, i. e. by enforcing maximum limits of emission. This means that the pulp mill should be considered as one unit (black box). The technology inside the mill will not be considered, what is considered is what goes in to the mill and what comes out of it. This is here called "the black box principle". For a mill, pulp mill or other, the following inputs and outputs exist:

In:	Raw materials	Out:	Products
	Energy and fuel		Emissions to the air
	Chemicals		Emissions to water
	Process water		Energy and fuel
			Solid waste

In applying the black box principle one has to consider the presence of cleaning works for treatment of waste waters as well as special arrangements installed in order to reduce atmospheric pollution. These may be more or less integrated in the mill operation. If the cleaning takes place on the mill site, it is common to recirculate some streams, for example fibres, or to use sludges as fuel. In such cases it seems reasonable to consider only those streams that leave the mill site, including solid waste and sludges. If solid waste and sludges are deposited on the mill site, this should be considered as an outgoing stream.

It has been felt that a "clean technology" is promoted by placing cleaning works etc. outside the black box. To prevent the generation of pollutants is a cleaner technology than removing them in cleaning works. However, the application of this principle in practice for eco-labelling is difficult for two reasons: a) due to the integrated and complex structure of pulp mills it is difficult to find the borders of the black box; b) in most cases emissions from the mill are measured downstream of all process units, including cleaning works.

Special difficulties may arise when a mill produces several products which result in different pollutants. An example is a chemical pulp mill producing unbleached as well as bleached pulp. Some emissions, for example chlorinated organic matter, will be related to the bleached pulp only, whereas other emissions, for example dissolved organics, are related to both products. Such cases have to be considered with special care.

Conclusion: Although it may be argued that the criteria for "clean technology" should take into account the merits of different possible technical solutions, the criteria for pulp mills will be restricted to emissions to the air, to the recipient waters and to the soil.

7. The papermaking process

The environmental impact of a paper mill is far less than that of a pulp mill. The process is essentially mechanical, requiring pulp, water, limited amounts of chemicals and energy. Pulp is the main input; for the purpose of an eco-label all other inputs are comparatively small. Paper machines are designed for a rather narrow range of products, and, from an environmental point of view, similar for such a particular product group that would be considered for eco-labelling. The main differences between mills manifests itself in the discharges to the environment.

Conclusion: The emissions to the environment are the dominating criteria when judging "clean technology" of paper mills.

When applying the black box principle to paper mills one has to consider that some mills are connected to external water treatment facilities like municipal sewage-treatment plants. This has to be taken into account when comparing such mills with other mills where all treatment is within the black box.

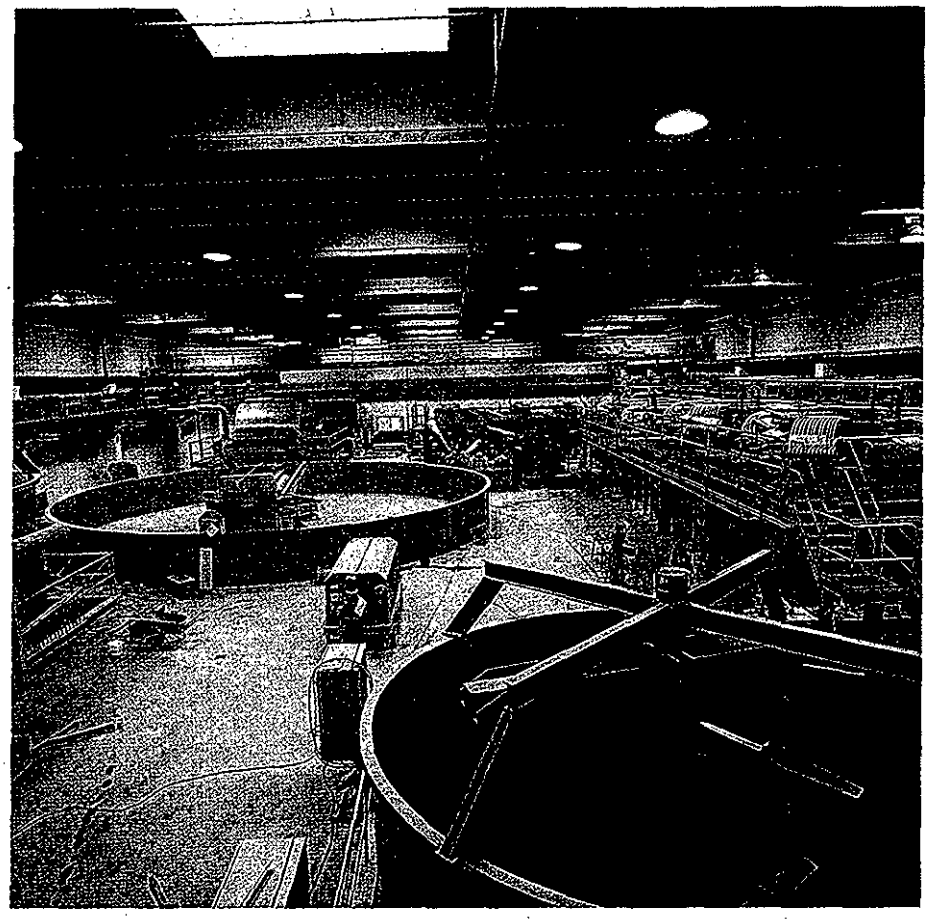


Fig. 18
"Clean technology" in paper production – the de-inking process.

8. The use of paper products

The use of paper products causes few environmental problems. Paper products have been in use for centuries and no serious negative effects of their use have been reported. Only in cases where the paper contains substances added to give the paper special properties (example: self-copying paper) there is reason to discuss risks for health or safety.

Fig. 19
Various household paper products.

Focus has been placed on pulps bleached with chlorine or chlorine-containing agents, because such pulps contain certain amounts of chlorinated organic matter. Comprehensive research on this issue, including the possible effects of so called dioxins, has lead to the conclusion that the use of bleached papers of all types is safe.

Conclusion: For the purpose of eco-labelling, there is no reason to distinguish between different types of papers because of any hazard involved with their use, provided that the paper contains no dangerous additives.

Some special qualities of paper contain added constituents. Examples are self-copying papers, dyed papers, impregnated papers etc. Before an eco-label is given to such a paper, a careful study must make sure that no harmful or otherwise environmentally unfriendly substances are present. For papers in contact with food-stuffs special regulations are applicable.

It follows from the object of eco-labelling that no paper product containing dangerous additives should obtain the label. This means that a product that contains a banned additive or amounts of an additive in excess of the permissible limit will never obtain the label. It also means that such a limit or ban, enforced by law in any of the EC member countries, will govern the eco-labelling in all the EC countries.

Conclusion: No paper product can obtain an eco-label if it contains any substance in amounts exceeding a maximum limit enforced by legislation in any of the EC countries.

8.1. Paper in comparison with other materials

In some cases a paper product competes with products of other materials, such as plastics or textiles. The question arises whether an eco-label should promote one of two or several alternatives in this aspect. Examples are diapers of paper or textiles, shopping bags of paper or plastics and packages of various materials. The analysis of this has to start with the object of the label – to advise the consumer in a situation of choise. The choice is governed not only by a label, but also by price and intended function. It is to be observed that the intended function, as judged by customer, not necessarily coincides with the intended function of the manufacturer. For example, shopping bags of plastics are sometimes preferred to similar bags of paper because they can be used for collecting wet garbage for which purpose paper bags may be less suitable. Likewise, in the choice between a disposable diaper (of paper) and a re-usable diaper (of textiles) other factors than the presence of an eco-label would, in most societies, govern the customer.

Fig. 20
Diapers can be made of textiles

Fig. 21
.... or of paper.

Conclusion: A careful functional analysis should be made to ascertain that products of different materials are comparable from the customer's point of view before one or the other is promoted by an eco-label.

8.2. **Paper in combination with other materials**

A wide range of products consists mainly of paper, but the paper is combined with other materials. They are generally thought upon as paper products. However, when paper is combined with other materials, such as in a book which contains binding materials and possibly a plastics cover or such as a paper bag with a plastics handle, the label should be used with care, taking account to the other materials. The consumer must not be mislead by a label, given because of the merits of the paper contained in a combined product, to draw the conclusion that the entire manufactured product is environmentally friendly. It must be clear to the customer that it is the paper only that has been given the label.

The packaging material, used for a product which in itself is paper only, must be considered before placing an eco-label on the package.

Fig. 22
The variation of waste paper.

9. The disposal of the used product

The disposal of used paper products is of considerable concern, mainly because of the large volumes to be handled. However, paper products are easily handled, compared to many other products.

For the purpose of eco-labelling the final disposal of paper, recycled or not, is of little concern. For each type of paper the procedures for final disposal are similar and governed by the particular circumstances in each case. The presence or absence of a label has no relevance in this respect.

Conclusion: Paper can be disposed of in several ways. The procedures for disposal are the same for all papers in a particular product group and an eco-label has no relevance in this respect. However, for products in which paper has been combined with other materials, the impact of these other materials should be observed.

Fig. 23
Treatment of collected waste paper.

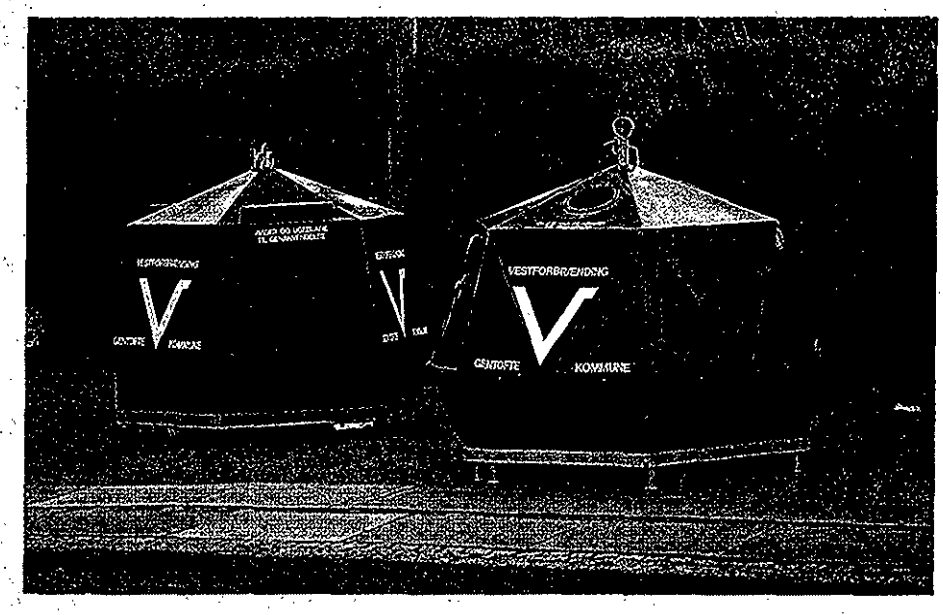
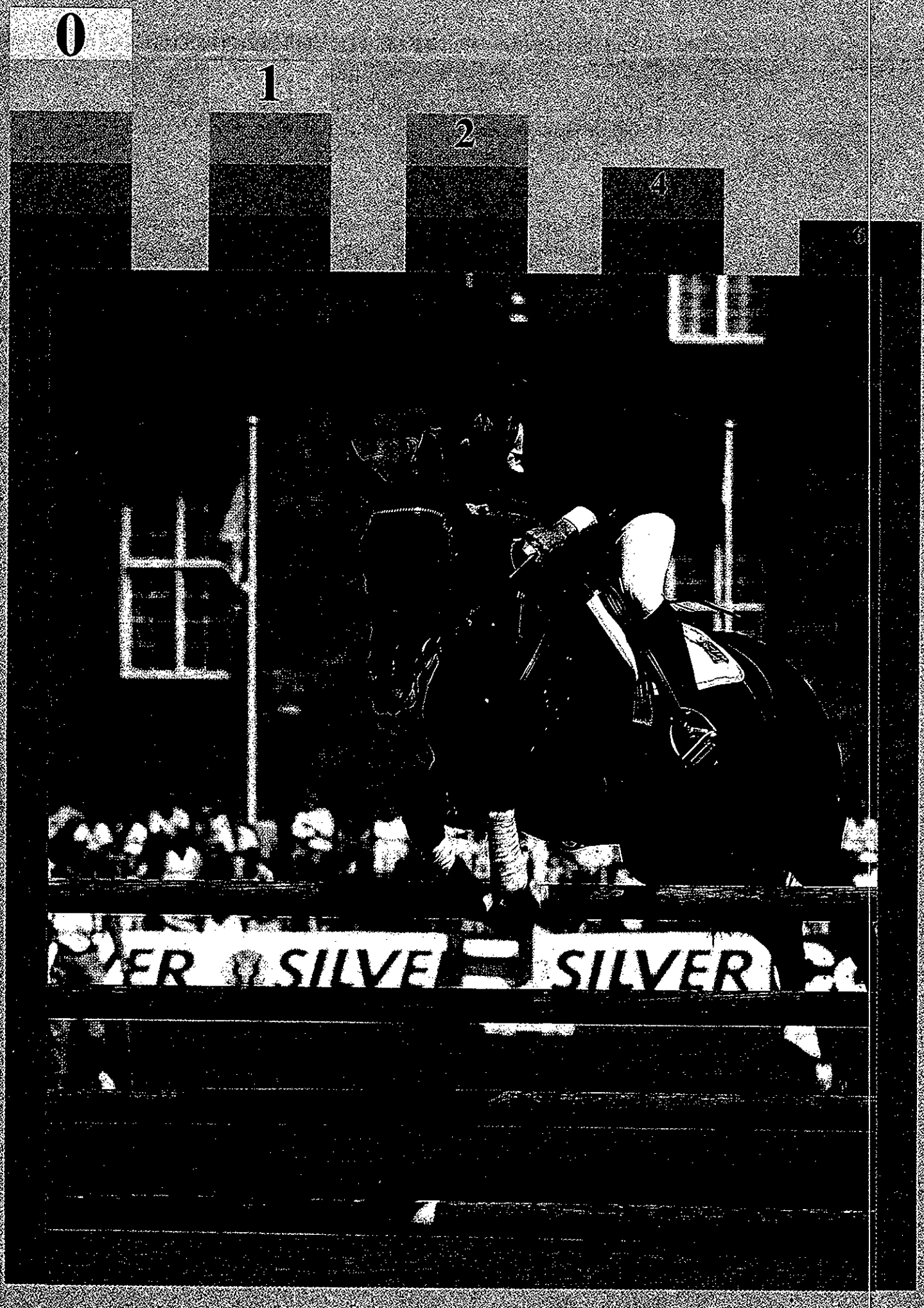


Fig. 24
Containers for collection of waste paper and bottles.


SILVER
SILVER

10. Selection of criteria and the point system

In the previous sections of this presentation a range of environmental impacts have been discussed and related to principles for evaluating the environment-friendliness of paper products. The situation is complex and several types of environmental impacts have to be balanced against each other. In order to keep the assessment procedure reasonably simple and transparent a limited range of criteria have to be selected as a basis for the assessment.

The assessment can be based on "hurdles" and on points. Hurdles are criteria which have to be met under all circumstances. In the point system the products are given points related to certain criteria. The points have a negative value and the product must not receive more points than indicated by a maximum value. The point system opens the possibility for the producer to balance various criteria against each other. For example, a relatively high emission connected with one ingredient of the pulp mix can be balanced by using a larger fraction of another pulp of low emission.

The hurdles used in the examples described in Annexes 2 and 3 are:

- The virgin pulp is made from wood obtained from regions where modern foresting principles are applied (for definition, see Section 5.1.2.). No pulp made from tropical rain forest has been used.

- All steps of the manufacture – including the production of raw materials and additives – are performed in conformance of all laws and regulations concerning environmental effects that in force where the operations take place.

- The product contains no substance in amounts exceeding a maximum limit enforced by legislation in any of the EC countries.

These hurdles could well apply to all kinds of paper products. Criteria for energy, natural resources and emissions are preferable defined by a point system. The possibilities and problems involved with a pure hurdle system also for these criteria are discussed in Annex 4.

For paper products the criteria for *energy and natural resources* are preferably combined (see Section 4). The Net Energy Requirement (NER) as defined by The International Energy Agency could in principle be used for defining the value of points in the point system. For the purpose of eco-labelling products like kitchen rolls and xerographic copying paper a short-cut is proposed, based on the assumption that the NER value for virgin fibre is about three times the NER for recycled fibre. For other product groups a more refined scale may be necessary. The use of authentical NER values in each case would require some form of accepted standard specification for estimating NER values. No such standard seems to exist.

←

Fig. 25
A point system combined with hurdles are preferred for paper products.

For *emissions to water* a range of parameters have been discussed as a basis for criteria, such as chemical oxygen carbon (COD), biochemical oxygen demand (BOD), total organic carbon (TOC), suspended solids, phosphates, nitrogen compounds, chlorinated organics (AOX), heavy metals and toxicity. The use of all these parameters is obvious complex. Some of the parameters "overlap" in the sense that the same substance is measured twice. For example, the COD value always includes all substances contributing to the BOD value, and suspended organic matter (part of suspended solids).

For the purpose of eco-labelling it seems practical to confine criteria to parameters that are generally mesured in pulp and paper mills as part of the regulatory system. Regulations vary between member countries and none of the parameters is measured in all countries. However, *the chemical oxygen demand, COD*, is widely used and measures the total emission of organic matter and can therefore be considered as the prime parameter for emission to water.

Besides total organic matter, the emission of *chlorinated organics* from bleaching of chemical pulps is of considerable public concern. The parameter AOX is generally used for this purpose. It has been critisized for not being specific for dangerous substances and it is under dispute whether low levels of AOX in effluents are an environmental impact. Although the use of a more specific parameter than AOX would be desireable, no corresponding measuring technique has been agreed upon. AOX is therefore proposed as a secondary parameter for emissions to water, in particular for effluents from operations where chlorine or chlorine-containing bleaching agents are used. Very low levels of AOX may therefore be disregarded.

For several of the parameters mentioned above the measuring methods are poorly defined or under dispute. This is the case for suspended solids and phosphates. BOD is not measured in several countries because of the labour involved and the poor reproducibility of the results.

For *emissions to air* the parameters carbon dioxide (which relates to the greenhouse effect) sulphur dioxide, nitrogen oxides (NOX) and others have been discussed. From these, *sulphur dioxide* seems to be the choice. Sulphur dioxide can, unlike NOX, be calculated from a materials balance for the mill. Carbon dioxide, which probably also can be calculated from a materials balance, addresses the greenhouse effect only. To be relevant, this parameter should also include the emissions involved in producing the raw materials. This would, in the end, require a very complex investigation in which the carbon dioxide removed from the atmosphere by photosynthesis also has to be taken into account.

For *emissions to soil* there are no parameters that are measurable and comparable. For these emissions a point system would have to rely upon qualitative criteria.

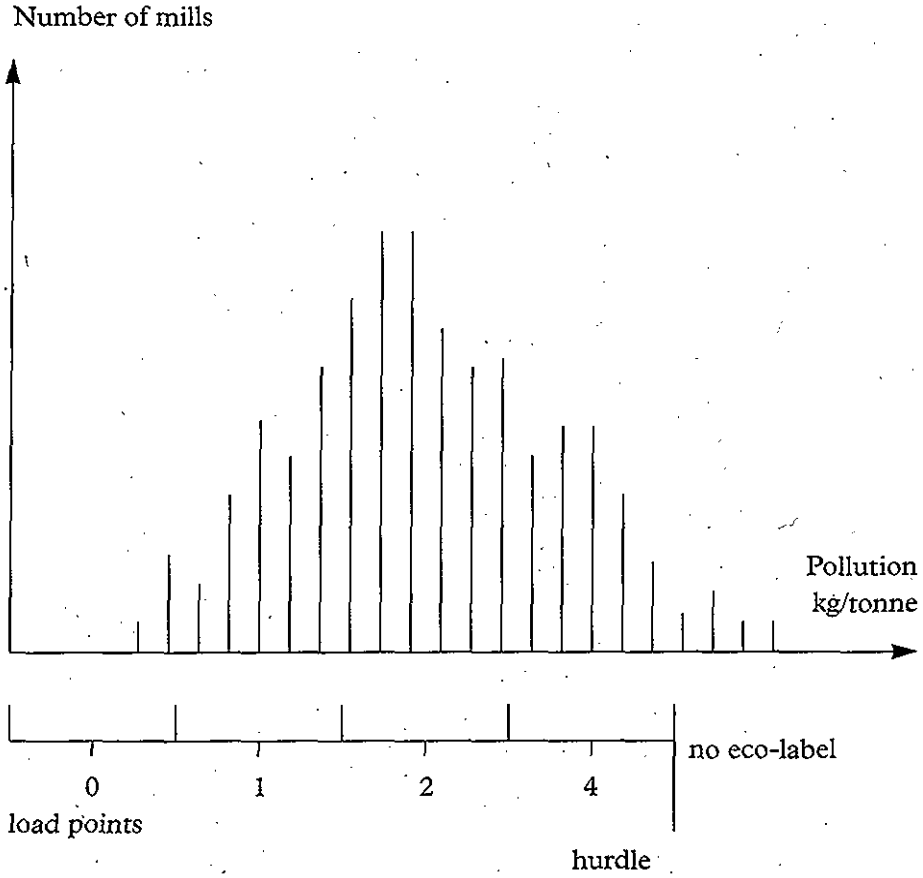
The point system can be based on a scale of the following general construction, applying to each of the selected emission parameters:

No or very low emission:	0 points
Low emission	1 point
Medium emission	2 points
High emission	4 points

The emission figures that define the four levels have to be selected on basis of a study of the actual emissions from the mills that manufacture products within particular product group under study.

To exclude that any product contains, even to a small percentage, materials from mills having very high emissions, there should be an upper limit for each of parameters. The limit functions as a hurdle.

In practice the construction of a histogram of the type shown in the figure below can prove useful. For a particular parameter the values for all mills in the study, for example given as the mean value for a year, are grouped in rather narrow groups according to pollution per tonne of product. The histogram is constructed and is then divided into five sections. The lower tail (to the left in the figure) represents very low emissions (load points = 0) and the upper tail represents the very high emissions from mills whose products will not be eco-labelled in any case. The three section in the center represent low, medium and high emissions, resulting in 1, 2 or 4 load points respectively.



The values given in Annex 2 are examples of what the result of such an exercise may be.

The final decision on what load points should be used is a matter of judgement. It should be based primarily on technical facts but also on the current evaluation of the importance of various types of environmental impacts.

The International Organization for Standardization, ISO, has adobted standard test methods for the determination of COD and AOX:

ISO 6060 –Water quality – Determination of the chemical oxygen demand (Second Ed., 1989).
ISO 9562 –Water Quality – Determination of adsorbable organic halogens (AOX). (First Ed., 1989).

For the purpose of eco-labelling mean values for a year seem appropriate. Unfiltered samples should be used in order to include organic suspended solids.

11. Summary

This report discusses the possibilities of using eco-labelling of paper products as a mean to improve the environment. All aspects of environmental impact should be considered, which leads to the "from cradle to grave" concept.

In recent publications a very wide spectrum of aspects addressing environmental impacts has been discussed. However, very little has been done to balance the various impacts against each other in order to establish objective criteria for eco-labelling.

Establishing objective criteria requires that several environmental impacts have to be quantified and balanced against each other mathematically. This in turn requires data. For a wide range of environmental aspects the information is only qualitative and in many cases the environmental effects are still under dispute. A manageable system of criteria cannot possibly take all environmental aspects into consideration nor may it be simplified to such an extent that only one single aspect is considered. A possible way to arrive at a workable system of criteria would be to consider a limited number of aspects, selected to measure verified environmental impacts of major importance.

Such a workable system of criteria for paper products could be restricted to an evaluation of the following aspects:

Energy and natural resources.
Use of recycled fibre.
Emissions from pulp mills.
Emissions from paper mills.
The product's fitness for use.

Adoption of *the black box principle* means that the technology used in the paper production is judged from the energy requirement and the environmental impact caused. Any production technology can be dirty or clean, depending on the design of the mill rather than the technical principle applied. Any attempt to discriminate a certain technology on a basis of historical data counteracts technical development. Application of the black box principle means that the environmental impact is measured on the basis of the actual performance of the particular mill that produces the product.

Application of the black box principle means that the emissions from the mill have to be measured. The technique for this is available. International standards have been adopted for a range of parameters. Presumably only a few of these need to be taken into account in order to obtain a quantitative measure of the total emission from the operation, for example, for effluents dissolved and suspended organic material (COD), organically bound chlorine (AOX) and nutrients, and in emissions to the air, sulphur dioxide.

Emissions are expressed in units that correlate to the quality of the product like kilograms per tonne. *The grammage effect* should then be taken into account to allow for quality or fitness of the product when in use. Also the presence of fillers and pigments should be considered.

In many cases it is possible to measure the quality of the product and thus to allow for the quality of material required to obtain a certain function. For example, the rate at which soft tissues absorb water (which varies greatly from one fibre type to another but also with the paper-making or converting process) can be measured so that the fitness for use can be evaluated. The results of such calculations can then be transformed into correction factors for the emission figures.

The use of *recycled fibres* is considered as positive. In the mathematical model outlined above recycled fibre would automatically receive credit because of relatively low energy requirement and low emissions from pulping of waste paper. It is a matter of judgement whether recycled fibre should be promoted more strongly than determined by these factors. In this discussion several issues have to be balanced against each other, for example:

- The saving of natural resources.
- The saving of energy.
- The reduction of the volume of garbage.
- The alternative use of waste paper as a fuel.

Eco-labelling of products of *paper in combination with other materials* should be considered with special care. Several types of such products should be recognized, like impregnated papers, coated or extruded papers, papers with incorporated components of other materials, such as plastic handles on paper bags or envelope windows. Lately it has been reported that such foreign constituents cause no problem in modern mills using waste paper.

ASSESSMENT MATRIX

	Cradle → Grave			
Environment. impacts	Raw materials	Production	Use	Disposal
Natural resources				
Energy aspects				
Water consumption				
Emissions to air				
Emissions to waters				
Emissions to soil				
Noise and Odour				

This assessment matrix is essentially the one annexed to the EC draft proposal for a council regulation for eco-labelling.

Eco-labelling of xerographic copying paper

This is an attempt to apply the principles outlined in the article "Eco-labelling of paper products – possibilities and problems" to a test case of assessment.

The product group is xerographic copying paper.

The *first step* of the assessment is to check the following points:

• The pulp is made from wood obtained from regions where modern foresting principles are applied (for definition, see Section 5.1.2.). No pulp made from tropical rain forests has been used.

• All steps of the manufacture – including the production of raw materials and additives – are performed in conformance of all laws and regulations concerning environmental effects that are in force where the operations take place.

• The product contains no substance in amounts exceeding a maximum limit enforced by legislation in any of the EC countries.

The *second step* would be to check if the product meets the requirements that follow from its intended use. In the case of xerographic copying paper this would mean that the paper meets an European Standard Specification for the quality of the product. No such standard has yet been adopted, but until then the French Standard (AFNOR Q11-013 – Papier et Carton – Papier d'impression pour photocopie) or the German Standard (DIN 19 209 – Papier für Kopierzwecke – 80 g/m²-Papier, unbesichtet) could serve as a guide.

A product that has been found to be eligible by the above requirements is then taken to the *third step*, a balanced judgement of environment-friendliness:

The proposed system for semi-quantitative evaluation of environmental-friendliness is based upon load-points, so that a high score means a high degree of environmental impact and a low score the opposite.

First the pulp mix is evaluated. The energy – natural resources aspect has to be considered. For xerographic papers the relation virgin fibre/recycled fibre of 1:3 can be used. In order to keep the balance to emission points the load points are tentatively set to 2 and 6 respectively, see the table on the next page.

Then the total emissions of sulphur dioxide, COD, and AOX are estimated. The emissions from pulp and paper production are added. If several pulps are used, the value for each pulp is multiplied with the ratio (0.01 times the percentage) in which it is present in the final paper pro-

duct. Allowance is thus made for the ratio of material other than pulp fibre, like mineral fillers.

The details can be taken from the following Table. The figures in the "basic load points" column are tentative.

Aspect	Basic load points		
Energy and Natural resources	Virgin fibre Recycled fibre*	= 6 = 2	y_1
Sulphur dioxide emission, S kg/t	less than 0.2 0.2 - 0.5 0.5 - 1.5 1.5 - 2.5	= 0 = 1 = 2 = 4	y_2
Organics to water (COD), kg/t	less than 1 1 - 10 10 - 40 40 - 60	= 0 = 1 = 2 = 4	y_3
Chlorinated organics (AOX) kg/t	less than 0.1 0.1 - 1.0 1.0 - 2.0 2.0 - 3.0	= 0 = 1 = 2 = 4	y_4
Emissions to soil	no deposits controlled uncontrolled	= 0 = 1 = 4	y_5
	Total basic load points		Σy

* Various qualities of recycled fibre may be defined.

Note – The paper-making step of the different brands of copying paper under consideration is taken as equal or neutral with respect to energy and natural resources. These aspects are therefore covered by the term y_1.

If, for any of the pulps used in the paper furnish, the emission of sulphur dioxide, COD or AOX exceeds the maximum value in the Table (2.5; 60; or 3.0 kg/t respectively) this means that the product cannot obtain the eco-label, whatever low the percentage of that pulp might be. The same holds if the totals (y_2, y_3, or y_4) exceed the said values.

The sum Σy has then to be multiplied by a grammage factor. In principle this could be the grammage or any other measure property that takes care of the correction necessary to achieve comparison at the same level of fitness for use.

In the case of xerographic paper the grammage itself can be used. However, in practice most copying papers are 80 g/m^2 or close to that value. Other properties, relating to fitness for use, such as linting or tendency for dusting, cannot by measured with sufficient accuracy to allow a comparison.

The conclusion is that there are no criteria that can be used for assessing a grammage factor to xerographic copying paper. However, its fitness for use has been ascertained by referring to an existing Standard specification. This would imply that a xerographic paper must meet the Standard specification before it can be considered for eco-labelling.

The numerical values to be associated to the basic load points should be selected so that the best mills obtain the lowest score and "dirty" mills the highest. In some cases it will not be possible to obtain numerical values because the mill produces products in several product groups and there are no means to ascribe a certain discharge values to a certain product. In such cases a value for the total discharge, combined with a description of the mill and its cleaning facilities, will make it possible to settle on a score.

The final step in the assessment will be to compare the figure for $\sum y$ with that established on the basis of a market analysis. If the value for $\sum y$ is less than the established value, the product is good for an eco-label.

Eco-labelling of kitchen rolls

This is an attempt to apply the principles outlined in the article "Eco-labelling of paper products – possibilities and problems" to a test case.

The product group is kitchen rolls. This group is less well defined than the group discussed in Annex 2 (xerographic copying paper). There is no generally accepted definition for the term "kitchen rolls", nor is there any accepted standard specification.

Before starting the process of assessment, a functional analysis is required. By this analysis various types of kitchen rolls are examined in order to establish if they do the same job and are used in the same way by the customers. It may well be that two or more types of rolls, which are on the same market, are used for different purposes. If that is the case, each sub-group has to be treated separately. For example, a functional analysis may show that kitchen rolls of single-ply heavy crêpe and of multiply soft tissus belong to different product groups

The next step is then to check the following points:

- The pulp is made from wood obtained from regions where modern foresting principles are applied (for criteria, see Section 5.1.2.). No pulp made from tropical rain forest has been used.

- All steps of the manufacture – including the production of raw materials and additives – are performed in conformance of all laws and regulations concerning environmental effects that are in force where the operations take place.

- The product contains no substance in amounts exceeding a maximum limit enforced by legislation in any of the EC countries.

Furthermore it is appropriate to check that the product meets the requirements that follow from its intended use. For kitchen rolls this would mean that the paper meets the requirements of an ordinary customer. For kitchen rolls it seems reasonable to give credit to products of high performance, as can be judged from a standard test. This is taken care of by the "grammage factor" applied later in the assessment procedure. At this stage there are no criteria by which a product can be ruled out unless it obviously is no "kitchen roll".

A product that has been found to be eligible by the above requirements is then taken to a balanced judgement of environment-friendliness:

The proposed system for semi-quantitative evaluation of environmental-friendliness is based upon load-points, so that a high score means a high degree of environmental impact and a low score the opposite.

The procedure in this step is the same as that outlined in Annex 2, however, the numerical values for the load points may have to be modified.

The figure for total load points arrived at, Σy, has then to be multiplied by a grammage factor. In principle this could be the grammage or any other measured property that takes care of the correction necessary to achieve comparison at the same level of fitness for use.

In the case of kitchen rolls the grammage itself cannot be used since the paper for kitchen rolls consists of one, two or several sheets of soft tissue. A basic requirement for kitchen rolls is that the material shall be capable of absorbing liquids rapidly. If absorption is slow, more paper will be used to absorb a certain quantity of liquid, for example water.

By testing the products under consideration for eco-labelling a quantitative measure is obtained that closely relates to the grammage effect and also to the "fitness for use" aspect. The rate of water absorption is a generally accepted measure in this respect. The table below shows that this property varies greatly depending on the pulp mix used for the product:

Absorption rates for different soft tissues

Furnish	Absorption rate Z-direction mm/s	Absorp. capacity kg/kg
1 100 % bleached	12.0	4.6
2 100 % peroxide-bleached sulphite	8.8	4.6
3 50 % peroxide-bleached sulphite 50 % unbleached sulphite	2.1	4.4
4 60 % peroxide-bleached sulphite 40 % CTMP, hardwood	5.9	4.6
5 60 % peroxide-bleached sulphite 40 % CTMP, softwood	5.4	4.6
6 50 % peroxide-bleached sulphite 50 % unbleached kraft, softwood	5.0	4.7
7 30 % unbleached kraft, softwood 70 % unbleached kraft, hardwood	2.7	5.0
8 60 % peroxide-bleached sulphite 40 % peroxide-bleached groundwood	2.0	4.0
9 100 % waste-paper pulp	1.5	4.8

The papers were made on the same experimental machine under the same conditions. The grammage was 20 g/m^2. The water absorption rate was

measured as described in SCAN-test Standard SCAN-P 62:88. Data obtained from H. Hollmark, STFI, by private communication.

The total number of load points, calculated as described above, has now to be multiplied by a *grammage factor*. This factor can be taken from a table of the following general layout:

Absorption rate:	Excellent	good	medium	poor	very poor
Grammage:	1	1.5	2	2.5	3

The figures should be chosen to reflect the relative quantities of the product that are needed to do a certain job.

Criteria by the hurdle system

At the last meeting of the working group it was proposed that the merits of the hurdle system for setting criteria should be evaluated.

A pure hurdle system avoids the use of scores (as outlined in Annexes 2 and 3) and relies entirely on a set of criteria, all of which the product has to meet.

It was argued that the hurdle system was more simple to use and more transparent to the customer than the "point system".

However, the hurdle system does not exclude the use of limiting values, for example for emissions, and measurements have to made in both systems.

It was also pointed out that a hurdle system leaves the paper-maker limited possibilities to trade pulps for each other. Some paper-makers will find that they have no possibility to obtain the label because they are confined to certain raw materials or to certain technical solutions. There will be little incentive for such paper-makers to improve their production environmentally.

The point system outlined in Annexes 2 and 3 contain a few "hurdles":

- The pulp is made from wood obtained from regions where modern foresting principles are applied (for criteria, see Section 5.1.2.). No pulp made from tropical rain forests has been used.

- All steps of the manufacture – including the production of raw materials and additives – are performed in conformance of all laws and regulations environmental effects that are in force where the operations take place.

- The product contains no substance in amounts exceeding a maximum limit enforced by legislation in any of the EC countries.

A number of further hurdles need to be introduced in order to care for the energy/natural resources aspect and the emissions.

For energy a limit on Net Energy Requierment (NER, see Section 4 in the main document) could be discussed. There could be two hurdles, one for total NER and an additional one for percentage energy from renewable energy sources. A limit in energy units requires that the applicant present a complete energy analysis for his product. A standard for making such analysis seems also necessary.

As a short-cut it has been suggested to put limits on the pulp mix. Using the argument that different types of virgin fibres have – roughly – similar NER values wheras pulps from recycled fibre have a considerably lower values, the percentage of virgin fibre in the product could be limited. For

some products, like kitchen rolls and xerographic copying paper, a hurdle saying that no virgin fibre is allowed, was mentioned.

Hurdles for emissions were briefly discussed. So for example a maximum value for COD of 5 kg/t and for AOX of 0.02 kg/t were suggested. (These values are intended to apply in combination with a low maximum value for virgin fibre, i. e. in practice the manufacture of paper from waste paper.)

The fitness-for-use requirement could be linked to a specification, such as the German or French Standards for xerographic copying paper. In other cases like that of kitchen rolls a hurdle that expresses a minimum limit for performance will be more difficult to find.

The hurdle system was suggested and discussed to some depth first at the last meeting of the group. There was little evidence for working out limiting values and no more time to discuss within the group the consequences of such a system.

It should be noted that the hurdles must be chosen with great care so that the final set still leaves the manufactures with the incentive to develop new processes and products that are more environment-friendly. There is a great risk that a set of hurdles will function as a specification which wil rather become an obstacle than an encouragement to develop new and better technology.

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An example: Guidelines by legislation for sustainable forestry in Denmark

The chairmanship have asked the Danish National Forest and Nature Agency to describe the Dansih guidelines for suitable forestry. The Agency (mr. Henrik J. Vinther and mr. Peter Munk Plum) have made the following contribution:

In 1989 a new forest act was adopted by large majority in the Danish Folketing (Parliament). Rules concerning versatile and sustainable forestry are a basic part of this law.

Article 15 is the central part of the law in this connection. According to this article, versatile and sustainable forestry involve an increase and improvement of the wood production and at the same time a protection of landscape amenity, nature conservation, cultural heritage and environmental interests, as well as recreational activities. This type of "good forestry" implies:

1) that the area shall be planted with suitable plants as soon as possible, if natural regeneration is not to be used,
2) that new stands shall be properly tended,
3) that thinning shall be carried out in order to ensure health, production and stability in the forest,
4) That final fellings may not take place before maturity,
5) That final fellings shall take into consideration the creation of a stable and varied forest,
6) that forest products for sale shall be removed as soon as possible to ensure the health of the forest, and
7) that forestry shall be managed in order to protect or improve the silvicultural basis.

Fig. 26
Wildlife and recreation is a central point in sustainable forestry.

The guidelines for sustainable forestry implies that it is necessary with a market for big and high valuable forest products as well as for smaller and less valuable products. In other words, the market for pulp and paper wood from conifer stands is very important for the management of these stands.

In other words the new forest act of Denmark aims to incorporate the contemporary basic philosophy of nature and environmental policy: to combine use and protection of the forests in a versatile and sustainable forestry.

There are no specific rules concerning use of fertilizers and pesticides in Danish forestry. But the guidelines for sustainable forestry makes it reasonable, that the use of these chemicals in Danish forestry is very low. Groundwater coming from a common Danish forest contains less than 5% of fertilizers compared with water from the common agriculture. In the hole, forestry-areas in Denmark are to be considered as a clean environment, compared with other uses of the areas, agriculture, horticulture, urbanization, etc.

The forest act contains special rules for decidouos trees which is natural in Denmark. The rules particular concern outer forest belts of decidouos trees, natural oak scrubs and minor biotopes within the forests. There are also rules under which the State may grant subsidies to private forest owners for afforestation or regeneration of decidouos forests. The current target for this subsidy scheme is, over a few decades, to bring the decidouos forest area, beech and oak in particular, up to the highest level recorded in history, in approximately 1930.

Data Sheet

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Author(s): Bethge, Per Olof

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Abstract:
In this report is discussed the possible use of eco-labelling of paper products as a means to improve the environment. All aspects of environmental impact should be considered based on the "cradle to grave" concept. Possibilities as well as problems involved with eco-labelling of paper products are highlighted. A possible methodology for setting criteria is outlined. Methodology is exemplified for 2 product groups: xerographic copying paper and kitchen rolls, but should be applicable to most paper products.

Terms: labelling; paper products; pulp and paper industry; life cycle assessment

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Resumé:
I rapporten diskuteres muligheder for at anvende et miljømærke på papirprodukter som middel til at forbedre miljøforholdene. Der skal tages højde for alle miljøaspekter, d.v.s. der anvendes en "vugge til grav"-analyse. Muligheder og problemer forbundet med at miljømærke papirprodukter beskrives. En anvendelig metode til opstilling af miljøkriterier præsenteres. Metoden eksemplificeres på 2 produktgrupper, xerografisk kopipapir og køkkenruller, men kan anvendes på de fleste papirprodukter.

Emneord: mærkning; produkter; papir; papirindustri; livscyklusvurdering

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