INDUSTRY
COMMISSION

PULP AND PAPER: BLEACHING AND THE ENVIRONMENT

REPORT NO. 1
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INDUSTRY
COMMISSION

21 May 1990

The Honourable P J Keating, M.P.
The Treasurer
Parliament House
CANBERRA ACT 2600

Dear Treasurer

In accordance with Section 7 of the Industry Commission Act 1989, we have pleasure in submitting to you the report on Pulp and Paper: Bleaching and the Environment.

Yours sincerely

M L Parker	R G Mauldon	D R Chapman
Presiding Commissioner	Commissioner	Associate Commissioner

COMMISSIONER

Benjamin Offices, Chan Street,
Belconnen ACT Australia
PO Box 80, Belconnen ACT 2616
Telephone: 06 264 1144
Facsimile: 06 253 1662

TERMS OF REFERENCE

I, PAUL JOHN KEATING, in pursuance of Section 23 of the Industries Assistance Commission Act 1973 hereby:

1. refer the following matters to the Commission for inquiry and report by 30 April 1990:

   (a) the market prospects for, and technical feasibility of, unbleached and non-chlorine bleached paper products

   (b) community attitudes to the use of unbleached paper products

   (c) global trends in the substitution of unbleached pulp for bleached pulp

   (d) the prospects for using non-wood feedstocks in the manufacture of unbleached pulp

   (e) available evidence on the environmental impact of alternative bleaching technologies.

2. specify that a draft report on the matters under reference need not be prepared and that the Commission may take evidence and make recommendations on any matters relevant to its inquiry under this reference.

P J Keating

28 December 1989

Notes:

This reference was forwarded to the Industries Assistance Commission. However, a new body -- the Industry Commission -- came into existence on 9 March 1990, absorbing functions previously performed by the Industries Assistance Commission, the Inter-State Commission and the Business Regulation Review Unit. Throughout this report, ‘Commission’ refers to the Industry Commission. At the Commission’s request, the reporting date was extended to 21 May 1990.

CONTENTS

ABBREVIATIONS

ANM -- Australian Newsprint Mills Ltd

AOX -- adsorbable organic halides (see Glossary)

APM -- Australian Paper Manufacturers

APPM -- Australian Pulp and Paper Mills

BEK -- bleached eucalypt kraft (see Glossary)

BOD -- biological oxygen demand (see Glossary)

Bowater -- Bowater Tissue Ltd

BRR -- Bureau of Rural Resources

CCSERC -- Conservation Council of the South-East Region and Canberra (Inc.)

CHAST -- Centre for Human Aspects of Science and Technology

CMP -- chemi-mechanical pulp (see Glossary)

CTMP -- chemi-thermo-mechanical pulp (see Glossary)

DAS -- Department of Administrative Services

DASETT -- Department of the Arts, Sport, the Environment, Tourism and Territories

FAFPIC -- Forestry and Forest Products Industry Council

KCA -- Kimberly-Clark Australia Pty Ltd

LWC -- lightweight coated (paper)

PADS -- People Against Dioxins in Sanitary Products

PATEFA -- Printing and Allied Trades Employers Federation of Australia

PPMFA -- Pulp and Paper Manufacturers Federation of Australia

TMP -- thermo-mechanical pulp (see Glossary)

OVERVIEW AND FINDINGS

The Commission's reference requires it to provide information about:

- environmental impacts of alternative bleaching technologies;
- factors affecting demand and supply for unbleached and non-chlorine bleached paper products; and
- the potential for using non-wood feedstocks in the manufacture of unbleached pulp.

Environmental concerns about chlorine bleaching underlie the inquiry. In recent years Australians have become increasingly concerned about the discharge of man-made organochlorines into the environment. This was very evident in the debate about the bleached eucalypt kraft pulp mill proposed for Wesley Vale in Tasmania. The mill would have used a chlorine bleaching process and discharged organochlorines into the sea.

Community groups are also concerned about the use of Australia's forest resources, particularly mature native hardwood forests, for pulp and paper making.

Although this report is primarily an information document, the Commission also discusses some issues related to government regulation of pollution.

Some of the issues are also relevant to the Commission's concurrent inquiry into recycling. A separate report dealing with the recycling of paper has been prepared.

Environmental impacts of alternative bleaching technologies

Chapter 2 provides information about bleaching technologies and their environmental impacts. It also explains how producers can reduce those impacts and describes existing environmental regulation.

Why pulp is bleached

Much pulp is used in its unbleached form, particularly for packaging and industrial papers, for some tissues and for newsprint. Bleaching is often undertaken, primarily for two purposes: first, to increase brightness; second, to remove residual lignin. Lignin can be thought of as the 'glue' holding the cellulose fibres of wood together; it accounts for up to 50 per cent of the weight of pulpwood, the basic feedstock for pulp manufacture.

Mechanical pulping processes retain the lignin to obtain a higher yield. To the extent that these pulps are bleached, hydrogen peroxide or some other non-chlorine process is generally used. The lignin content causes the paper to yellow relatively quickly when exposed to light, and so papers from mechanical pulps are generally used in products such as tissues and newsprint, which have short lives.

Chemical pulping with chlorine bleaching is used when a durable, high-brightness product with a more permanent application, such as printing and writing, is required. This process removes virtually all the lignin.

Impacts of chlorine bleaching

Lignin is an organic material. The lignin that remains after chemical pulping is oxidised in the chlorine bleaching process. The effluent from the process contains a range of organochlorines. Some organochlorines break down quickly; and some, including dioxins and furans, have long lives. Organochlorines may be largely removed by treatment of effluent at the pulp mill, but it is not currently feasible to avoid discharging some into the environment with the effluent. Some organochlorines can also remain embedded in the pulp and, ultimately, in the paper products.

The effects of organochlorine discharges on people and on natural ecological systems are not fully understood or quantified. Indeed, the effects of the effluents from bleached eucalypt kraft mills are largely unknown. It is especially difficult to quantify the levels of discharge of particular types of organochlorines from pulp mills. In order to provide better information, the Commonwealth Government is contributing $7.7 million over five years on a dollar-for-dollar basis with State Governments and industry for research into chlorine bleaching and its effects.

Impacts of alternatives to chlorine bleaching

With current technology, the main alternative to chlorine bleaching involves a mechanical pulping process followed by bleaching with non-chlorine compounds such as hydrogen peroxide. Although this process avoids the formation of organochlorines, these processes have other environmental impacts. For instance, their effluents are toxic unless treated. Further, mechanical pulping requires high levels of external energy. Generating energy can have environmental impacts through emission of fossil fuel pollutants and in other ways.

Industry's response

The pulp and paper industry worldwide has responded to concerns about organochlorines. Chemical pulping and bleaching processes have been modified, and alternatives have been developed.

Process modifications that minimise the presence of organochlorines in pulp mill effluents include extended delignification, more efficient washing of pulp before bleaching, and the substitution of chlorine compounds for elemental chlorine. Many of these procedures have been applied successfully in Australia.

The chemi-thermo-mechanical pulp process has been developed overseas to improve the quality and durability of mechanical pulp while avoiding chlorine bleaching. This process is not yet used in Australia. If it were undertaken it would probably require a mix of plantation softwood and plantation eucalypt. The process requires high external energy input and, although chlorine bleaching is not used, it produces toxic effluents.

Governments' responses

The Commonwealth Government has produced environmental standards for new bleached eucalypt kraft mills. These are intended to be minimum standards and are to be reviewed each five years. The Commonwealth and the States are negotiating the implementation and monitoring of these standards.

State Governments apply environmental protection standards to mills in their respective jurisdictions, and assess proposed projects for their possible environmental impacts.

Should chlorine bleaching be banned?

The community is justifiably concerned about discharges of organochlorines from pulp mills. But it is difficult to measure the levels of such discharges and their long term effects are largely unknown.

So it is not easy to conclude that discharge of organochlorines should be banned altogether, particularly in view of the costs this would impose and the environmental impacts of alternatives. Producers and governments are responding to community concern and consumer demand for unbleached and non-chlorine bleached products is strengthening.

Prospects for unbleached and non-chlorine bleached papers

The Commission's reference requires it to report on the following matters: the market prospects for, and technical feasibility of, unbleached and non-chlorine bleached paper products; community attitudes to the use of unbleached paper products; and global trends in the substitution of unbleached pulp for bleached pulp. These matters are addressed in detail in Chapter 3.

Technical feasibility

The technology for producing unbleached and non-chlorine bleached pulps and papers is well established. There is no doubt that it is feasible to use such pulps and papers more widely. But they would not necessarily be the most appropriate papers for the uses intended. For example, although non-chlorine bleaching can raise brightness to reasonable levels, non-chlorine bleached papers may not be sufficiently permanent to store information for extended periods, and may not have sufficient strength to run on some modern high-speed printing and converting machines.

The chemi-thermo-mechanical pulping process -- a relatively new process which is not yet used in Australia -- generally uses a peroxide bleach rather than chlorine. Papers made from this pulp are technically suitable to displace chlorine bleached chemical pulp in some of its traditional uses.

Market prospects

Unbleached and non-chlorine bleached papers are already widely used in Australia. Most newsprint, some tissues, and the vast majority of packaging and industrial papers are unbleached or non-chlorine bleached. After 1990, when Australia's major tissues producer moves away from chlorine bleaching, at least two-thirds of the pulp content of tissue paper will also fall into that category. Unbleached and non-chlorine bleached papers will then account for about three-fifths of papers supplied to the Australian market.

Paper is not a homogeneous commodity, though, and its markets are differentiated according to hundreds of purposes. Papers differ in brightness, texture, strength, absorbency, porosity, coating, colour, density and so on. Some characteristics in current demand can be obtained only with chlorine bleaching.

It is likely that there will continue to be strong demand for chlorine bleached printing and writing papers, and for some chlorine bleached packaging and industrial papers. Advertisers require high-brightness paper to impart a colourful message; printers require chlorine bleached papers for products intended to last for extended periods.

There are some signs, though, that Australians are becoming more willing to use unbleached or non-chlorine bleached papers for printing and writing. There is evidence of rapidly growing niches in high-yield mechanical pulps such as chemi-thermo. All papers of this type currently used in Australia are imported.

Market prospects for unbleached and non-chlorine bleached papers are influenced by the prices of those papers compared with their chlorine bleached competitors. To the extent that the full environmental impacts of pulp and paper production are not reflected in prices, the market prospects for unbleached and non-chlorine bleached papers will be disadvantaged. This issue is taken up in Chapter 5.

Community attitudes

Community concerns about environmental impacts of pulp and paper making are bringing shifts in the markets for paper products. Consumers have long accepted unbleached and non-chlorine bleached papers for newsprint and the vast majority of packaging and industrial papers. There is now a movement from chlorine bleached tissue products and sanitary products.

For printing and writing papers and possibly for some high-grade newsprint, however, a change in community attitudes is not so evident. Industry participants contended that high brightness or durability is required in Australia for printing and writing. They said that all the current alternatives to chlorine bleaching have technical deficiencies for achieving high brightness and removing lignin. There are some developing niche markets for non-chlorine bleached printing and writing papers but they remain small.

Some participants claimed that producers are not supplying adequate quantities of unbleached and non-chlorine bleached papers. Office papers, tissues and sanitary papers were cited. There were also claims that manufacturers are not adequately promoting the availability of 'environmentally friendly' products.

One explanation for these perceptions might be the time scales under which the various parties operate. Consumers can respond quickly to changes in their perceptions of environmental issues, but producers are often locked into fixed technology until new investments can come to fruition.

In the past each area of the Australian market for paper tended to be dominated by one large producer, but the market's structure has become more open in recent years. Although tariffs of up to 15 per cent currently apply to paper -- pulp and newsprint imports are free of duty -- domestic producers compete with imports in most areas of the market. The structure of the Australian market should not prevent consumer preferences being transmitted to producers, or prevent producers responding to them, albeit after some delay.

Global trends

In commenting on global developments in the pulping industry, the OECD (1989) has said:

> Operating at the juncture of constraints resulting from environment protection, changing consumer preferences, cost pressures and evolving technology, the industry has seen marked developments in its principal input materials: in the pulping field, mechanical pulping, after losing ground in favour of chemical pulping has seen new inventions with higher returns and optimal cost situations; within chemical pulping, sulphate pulp has increased at the expense of sulphite pulp; hardwood as natural raw material has been on the increase compared to softwood; and most importantly, there has been in all countries a rapid surge in the use of waste paper.

It also remarked that the use of mineral fillers is increasing rapidly. These substitute for some pulp in paper making.

Nevertheless, although mechanical pulping may be gaining ground, chemical pulping and chlorine bleaching predominate. Of the 9.4 million tonnes of additional world pulp capacity planned for 1990-93, about 7.1 million tonnes will be bleached kraft pulp. Mechanical processes account for most of the remainder.

Prospects for non-wood feedstocks

The bulk of paper manufactured in Australia comes from plantation thinnings (particularly pine), logging residues and sawmill wastes. Only a small proportion of wood fibre for domestic production of paper comes from eucalypt pulpwood. Recycled wastepaper is a major element in some products, notably packaging and industrial papers. Cotton linters (fibres that adhere to cottonseed after ginning) are the only non-wood fibre used to produce paper in Australia.

Inquiry participants gave details of proposed non-wood developments using bagasse (the residual fibre from the milling of sugarcane), kenaf (a plant of the hibiscus family), and wheat straw. These were all oriented towards export sales of pulp. There was also some discussion of other possible non-wood feedstocks, such as hemp and fractionated sugarcane fibre. Participants' comments are summarised in Chapter 4.

Increased use of non-wood feedstocks could reduce the demand for pulpwood. Some participants regarded such a situation favourably, particularly if it reduced the demand for pulpwood from native forests. But non-wood feedstocks can have environmental impacts of their own. And if they were to replace imports or supply export markets, their use in paper manufacture would have negligible effects on the level of tree harvesting in Australia.

Cotton linters are currently chlorine bleached and it appears that at least some of the proposed bagasse pulp might also be. The kenaf and wheat straw proposals are for unbleached or non-chlorine bleached pulps, but as these proposals are directed at export markets they would not replace chlorine bleached wood pulp currently produced in Australia.

Whether or not the pulping of non-wood feedstocks is environmentally superior to wood pulping can only be determined on a case-by-case basis. There is no doubt that the effluents from non-wood feedstocks could cause environmental damage unless adequately treated. In addition, the process of growing and harvesting non-wood feedstocks on some sensitive soil types can cause environmental damage. This consideration would be most relevant in the case of kenaf grown in northern Australia.

Prospects on the Australian domestic market for pulp produced from non-wood feedstocks appear slight. None of the larger pulp and paper companies sees any advantage in pulping non-wood feedstocks __ some of these companies have their own extensive forestry interests, and there appears to be a surplus of pulpwood available from State forestry commissions. Any investment in the production of non-wood feedstocks would therefore have to be undertaken by new entrants in green field projects. They would face difficulty competing in the Australian market with the established companies.

Most of the pulps produced from non-wood feedstocks would have to be exported. Indeed, the current proposals are aimed at just that. Even in export markets, this would present problems because the pulps from non-wood feedstocks are generally perceived to be inferior to the pulps most commonly traded between countries — bleached softwood and hardwood kraft pulp. Non-wood pulps are likely to sell into niche markets, possibly at discounted prices.

With the possible exception of pulpwood pricing, none of the evidence available to the Commission suggests that there are any specific government policies or regulations that would adversely affect proposals for non-wood feedstocks. Nor are there any grounds to provide government assistance to promote pulping of non-wood feedstocks in Australia, as was requested by some participants. Of course, the promoters of non-wood feedstocks could be eligible for general government assistance, such as for research and export market development.

The issue of appropriate pulpwood pricing is under consideration by the Resource Assessment Commission. To the extent that pulpwood competes with wastepaper as a feedstock in the manufacture of paper, the question of pulpwood pricing is also considered in the Commission's interim report on paper recycling.

Governments and pollution control

The uncertainty surrounding the effects of chlorine bleaching is reflected in divergent views about its control. Some inquiry participants considered that it should be prohibited, some considered that pollution taxes should apply, some considered that safe environmental standards can be established, and others said that an adequate assessment of the impacts of chlorine bleaching and its alternatives is hampered by the failure of prices to reflect environmental costs.

In Chapter 5 some important issues concerned with pollution from chlorine bleaching are discussed, including: the extent to which producers of chlorine bleached pulp and paper should bear the costs of the pollution they create; whether environmental standards should be set on a mill-by-mill, a regional, or a whole-country basis; standards for existing mills; what form government controls could take; and coordination and predictability of government policy.

Setting and implementing standards

Some difficult problems arise in setting standards and applying a 'polluter pays' principle to chlorine bleaching. The main one is that the environmental costs of the process are not adequately established. If standards are too lax, excessive environmental damage will occur. If standards are too stringent, producers will bear excessive costs and Australia will be disadvantaged relative to overseas competitors.

Setting environmental standards for chlorine bleaching involves judgment in balancing the environmental and economic costs and benefits of the process, and of its alternatives. At present, the lack of knowledge about effects of organochlorines and other discharges adds to the degree of uncertainty in making these judgments. However, as research into the effects of chlorine bleaching progresses, as bleaching technology evolves, and as technology for monitoring organochlorine discharges improves, the uncertainty in judgments about environmental standards will diminish.

Organochlorine discharges from pulp mills, both new and old, cause environmental damage and some organochlorines are toxic and cumulative. Nevertheless, although discharges from pulp mills can be significant in particular locations they make up only a very small proportion of total organochlorines in the environment. Some organochlorines occur naturally, and some are formed by other industrial and domestic processes.

If the goal is to minimise total organochlorine levels in the environment, or to reduce them to acceptable levels, standards should be set for all forms of organochlorine polluting activity, not just for new pulp mills. Indeed, the technology of new mills is much less polluting than that of older mills which chlorine bleach and of many other industrial and domestic activities. There is no reason why consistent environmental standards should not be applied to all activity, including older pulp mills. Some of those mills may already meet adequate standards, and reasonable time would have to be allowed for others to adapt to new standards.

Environmental standards for organochlorine discharge should not necessarily be uniform between all mills, all activities or all regions. What can be allowed depends importantly on the geographic features of a particular site or region.

There are various approaches to implementing whatever environmental standards governments decide should apply to chlorine bleaching. While each can achieve the same environmental objectives, they have different impacts on the efficiency of economic activity. Chapter 5 briefly canvasses some of the merits and drawbacks of tradeable pollution rights, pollution taxes, and direct controls and regulations. No conclusions on their relative merits are reached. But each of the approaches would necessitate regulators developing clear environmental objectives and standards. Monitoring of standards would also be required under any approach. Where a particular process is thought to cause environmental damage through pollution, it is reasonable to expect that the industry responsible should bear at least some of the costs involved in monitoring its level, and in researching the nature and extent of any damage.

Coordination and predictability of policy

Appropriate standards might differ between sites or regions depending on their geographic characteristics. Even so, the existing fragmentation of responsibility for environmental matters between the Commonwealth and the States could be a problem. Unless standards are reasonably consistent and policy is coordinated, there is a danger that less than adequate regard will be accorded the environmental impacts of pulping and bleaching.

Standards evolve and are progressively refined as additional information comes to hand about the environmental impacts of pollution, and as new technology for minimising those impacts becomes available. Thus it may not be possible to accord the certainty of standards which industries seek when assessing investment proposals. Nevertheless, it is important that government actions in the environmental area not be subject to arbitrary change.

Summary of findings

Market prospects for, and technical feasibility of, unbleached and non-chlorine bleached paper products

The technology for producing unbleached and non-chlorine bleached papers is well established. There is no doubt that it is feasible to use such pulps and papers more widely. But they would not necessarily be the most appropriate papers for the uses intended.

Unbleached and non-chlorine bleached papers are already widely used in Australia. Most newsprint, a growing proportion of tissues, and the vast majority of packaging and industrial papers are unbleached or non-chlorine bleached. But there is likely to be continuing strong demand for chlorine bleached printing and writing papers, and some chlorine bleached packaging and industrial papers. The demand for high-grade newsprint, which includes a proportion of chlorine bleached pulp, is also likely to grow. There is some evidence of developing niche markets for unbleached and non-chlorine bleached papers for printing and writing.

Community attitudes to the use of unbleached paper products

In some areas of the paper market, recent changes in community attitudes have led to consumers placing more emphasis on the environmental impacts of pulp and paper making and less on the technical and aesthetic qualities of paper products. This applies particularly to products such as tissues and sanitary papers. Such a change in community attitudes is not evident to the same extent for printing and writing papers. For these, change in community attitudes largely favours recycled rather than unbleached or non-chlorine bleached papers.

Global trends in the substitution of unbleached pulp for bleached pulp

Although mechanical pulping and non-chlorine bleaching is gaining ground worldwide, chemical pulping and chlorine bleaching still predominate. Of the 9.4

million additional tonnes of world pulp capacity planned for 1990-93, about 7.1 million tonnes will be bleached kraft pulp.

Prospects for using non-wood feedstocks in the manufacture of unbleached pulp

On the Australian domestic market, prospects for pulps and papers made from non-wood feedstocks appear limited. If pulps and papers were to be produced in Australia from non-wood feedstocks, it is likely that they would have to be exported. Current proposals aim to do just that. Even so, pulps from non-wood feedstocks are perceived to be inferior to the pulps most commonly traded between countries -- bleached softwood and hardwood kraft pulp. Non-wood pulps are thus likely to have to sell into niche markets, possibly at discounted prices.

In Australia, there are firm proposals for pulp production using bagasse, kenaf and wheat straw. Several have reached an advanced stage of technical and market appraisal.

Available evidence on the environmental impact of bleaching technologies

With current technology, chlorine bleaching involves the discharge of effluents containing organochlorines into the environment. Some organochlorines also remain embedded in the pulp and, ultimately, in the paper products. The acute and chronic effects of organochlorine discharge are not fully understood or quantified. Indeed, the effects of the effluents of bleached eucalypt kraft pulp mills are largely unknown. It is difficult to quantify the levels of discharge of organochlorines from pulp mills. Funds for research into these matters are being made available.

The main alternatives to chlorine bleaching involve mechanical pulping followed by bleaching with non-chlorine compounds such as hydrogen peroxide. Although this eliminates the formation of organochlorines, these processes have other environmental impacts.

1 THE INQUIRY

This inquiry has mainly arisen out of concerns for the impacts of chlorine bleaching on the environment. These impacts arise in two ways: through discharges from the bleaching process, and through the by-products of chlorine bleaching contained in the paper products themselves. Community groups are also concerned about the environmental impact of using mature native hardwood forests for pulp and paper making.

The terms of reference for this inquiry are set out at the front of the report. The three main issues concern:

- evidence on the environmental effects of alternative bleaching technologies;
- factors affecting demand and supply for unbleached and non-chlorine bleached paper products; and
- factors affecting use of non-wood feedstocks in the manufacture of unbleached pulp.

These are discussed in Chapters 2, 3 and 4.

This is primarily an information report, but in Chapter 5 the Commission discusses some issues related to government regulation of pollution.

Some of the issues are also relevant to the Commission's inquiry into recycling. A separate report has been prepared entitled *Interim Report on Paper Recycling* (Industry Commission 1990).

This report, and the report on paper recycling, are part of the Pulp Mill and Paper Industry Package announced by the Commonwealth Government on 12 December 1989 (Joint Press Release 1989). The Package is intended to `promote the future environmental and economic sustainability of Australia's pulp and paper industry'. Other elements of the package include: `a comprehensive set of environmental guidelines that enforce the world's most stringent limits of pollution levels for new bleached eucalypt kraft pulp mills', a Commonwealth contribution of $7.7 million to a research program essentially aimed at alleviating the environmental impacts of bleached kraft mills, continuing Bureau of Industry Economics monitoring of changes in market demand for unbleached and chlorine-free products, and negotiations with the States for implementing and monitoring the environmental guidelines.

Some other recent Government actions also are relevant. Customs duties on unbleached sanitary goods, and sanitary goods bleached other than by a chlorine process, are currently being reviewed, as is the sales tax on non-chlorine bleached paper. The Government is to participate in raising community awareness of the benefits of non-chlorine bleached paper. DASETT is undertaking a study to identify sources of dioxin emissions in Australia and their relative significance. A public information paper on organochlorines and the marine environment is being prepared under the auspices of the Australian and New Zealand Environment Council. This paper is expected to be completed by mid-1990.

1.1 Inquiry procedures

Following receipt of the reference, the Commission called for submissions. A brief questionnaire was prepared and forwarded to persons with an interest in the inquiry.

Industry consultations were undertaken in all States in January and February 1990, and public hearings held in all States in February and March. The consultations and public hearings were held in conjunction with those for the Commission's separate inquiry into recycling.

The names of individuals, companies and organisations consulted by the Commission about issues relevant to this report are included in Appendix A. Submissions which focused on matters considered relevant to this inquiry were received from the 42 individuals, companies and organisations listed in Appendix B.

1.2 Summary of participants' views

Participants presented a range of views at the public hearings and in their submissions. Their views are summarised below.

Environmental impacts of alternative bleaching technologies

Participants' comments centred on chlorine bleaching. Concern was widely expressed about the possible environmental effects of the release of bleaching effluent containing organochlorines. It was generally acknowledged that these environmental effects were potentially adverse, but were largely unknown at this stage.

Some participants considered that governments should ban chlorine bleaching. Major pulp producers countered that they had modified, or were modifying, their bleaching so as to reduce organochlorine release.

Demand for and supply of unbleached and non-chlorine bleached papers

Unbleached and non-chlorine bleached papers already account for a substantial proportion of the Australian market, and tissue producers are moving towards greater use of them.

Most chlorine bleached paper in Australia is for printing and writing, with some for packaging and industrial uses. Most producers of these papers, together with some major users, outlined the advantages of chlorine bleached papers. While acknowledging that there were some niche markets for unbleached and non-chlorine bleached papers, they considered there were limited prospects for them.

Other participants considered that the demand for unbleached and non-chlorine bleached papers is strong but that the paper companies restrict supply.

Some participants queried whether the prices of chlorine bleached papers properly reflect their environmental costs.

Non-wood feedstocks

Some participants, including conservation and environmental groups, supported greater use of non-wood feedstocks in Australia, claiming that their environmental effects were less severe than those associated with wood pulping and chlorine bleaching. Other participants considered that this had not been fully established.

The non-wood feedstocks drawn to attention by participants to this inquiry were bagasse, fractionated sugarcane fibre, cotton linters, hemp, kenaf and wheat straw.

Details were provided about specific proposals to establish pulping of non-wood feedstocks in Australia. These proposals concentrate on export markets. The difficulty of selling such pulp into the Australian market was widely acknowledged. Existing producers of wood pulps indicated that non-wood feedstocks held no advantages for them.

2 BLEACHING TECHNOLOGIES AND THEIR ENVIRONMENTAL IMPACTS

This chapter discusses evidence relating to the environmental impacts of alternative bleaching technologies. It relates mainly to wood pulps. The bleaching of non-wood pulps is considered in Chapter 4.

2.1 What is chlorine bleaching?

The process of making paper commences with the production of pulp. Unless it is bleached, wood pulp is coloured to some degree. This is due to the presence of lignin which remains after pulping. Bleaching whitens pulp in either of two ways: it degrades and removes the residual lignin; or it brightens it.

Chlorine bleaching of chemical pulps is common. APM and ANM defined chlorine bleaching as bleaching with elemental chlorine (ie gaseous chlorine) only. Their definition did not include bleaching with chlorine-based compounds such as chlorine dioxide or hypochlorite.

However, a major concern in this inquiry is the formation and discharge of organochlorines. These organic compounds containing chemically bound chlorine are formed whenever elemental chlorine or chlorine-based compounds are used to bleach pulp (see CSIRO 1989, glossary). Bleaching pulps with chlorine dioxide or hypochlorite, therefore, is regarded by the Commission as chlorine bleaching as it produces organochlorines, albeit at reduced levels compared with bleaching with elemental chlorine.

This chapter describes alternative pulping and bleaching technologies, summarises evidence about the environmental impacts of bleaching, outlines how pulp producers attempt to reduce these impacts, and describes government environmental regulation. A glossary of technical terms is given at the end of this report.

2.2 Bleaching technologies

Bleaching is a sequence of chemical treatments and washes of the pulp. The particular sequence used mainly depends on the nature of the fibre (for example, softwood, hardwood, or non-wood), the type of pulping process applied, and the end use of the fibre. Table 1 indicates the variety of bleaching sequences used by pulp mills in Australia. Appendix C discusses specific pulping processes. While the main purpose of bleaching is to improve the optical characteristics of the pulp, characteristics such as absorbency, strength, durability, and cleanliness can also be improved.

Bleaching chemical pulps

Chemical pulping breaks down the wood by dissolving most of the lignin. In this process, the woodchips are mixed with strong acids or alkalis, with or without pressure and heat. Various chemicals and processes can be used to produce different types of chemical pulp, for example, sulphite, kraft (sulphate) and soda anthraquinone pulp.

Bleaching of chemical wood pulps involves the removal of residual lignin. Bleaching sequences involving the application of elemental chlorine and/or chlorine-based compounds are commonly used. However, APPM said that elemental chlorine now supplies a small part of the oxidising power for bleaching. The PPMFA said that there may be up to seven stages in the bleaching sequence depending on the type of sequence used and the degree of brightness required.

The chlorine bleaching sequences usually commence with the treatment of the unbleached pulp with a lignin degrading chemical, such as elemental chlorine. Chlorine dioxide may be partially substituted for elemental chlorine in this stage. An alkali treatment stage follows, in which the pulp is treated with chemicals that extract the degraded lignin. After extraction, the pulp is brightened with chemicals such as sodium or calcium hypochlorite, or chlorine dioxide. Further stages include repeated alkali extraction and brightening. Between stages the pulp is usually washed.

Bleaching mechanical pulps

Mechanical pulping involves separating the fibres by abrasive mechanical action, usually by passing woodchips between rotating metal discs (refiner groundwood). Modifications to these processes include:

- thermo-mechanical pulping where the lignin in the woodchips is softened by heat prior to mechanical processing;
- chemi-mechanical pulping where the lignin is softened by chemicals; and
- chemi-thermo-mechanical pulping where the lignin is softened by both chemicals and heat. Chemi-thermo-mechanical pulping is not currently used in Australia.

Mechanical pulps are not bleached with lignin degrading chemicals such as elemental chlorine, since this would cause a substantial loss of yield. Instead the bleaching is undertaken with lignin preserving chemicals, such as peroxide and hypochlorite. Sodium dithionite can be used in some cases.

Bleaching semi-chemical pulps

Semi-chemical pulping combines both chemical and mechanical methods of pulping. It consists of chemically treating the wood prior to mechanical processing. Chemicals such as caustic soda or alkaline sulphite liquor act to partially delignify and break down the lignin bonding in the wood chips. Semi-chemical pulping processes include neutral sulphite semi-chemical and cold soda pulping.

Semi-chemical pulps are usually bleached with lignin preserving chemicals such as hypochlorite. Bleaching semi-chemical pulps with similar sequences used for the bleaching of chemical pulps is possible, but substantial amounts of elemental chlorine and caustic are needed to degrade and extract the residual lignin and this would substantially reduce yields.

Table 1: **Bleaching processes used by major Australian pulp manufacturers**

Firm	*Mill location*	*Pulp or paper type*[a]	*Fibre feedstock*	*Bleaching process*
ANM	Boyer[b] (Tas)	Purchased unbleached kraft pulp		Bleached with calcium hypochlorite to 58 ISO[c].
		CCS[d] pulp	Eucalypt	Bleached with calcium hypochlorite to 59 ISO .
		Thermo-mechanical pulp	Pine	Some is bleached with sodium hydrosulphite to 65 ISO.
		Ground-wood pulp	Eucalypt	Bleached with hydrogen peroxide to 65 ISO.
	Albury (NSW)[e]	Thermo-mechanical pulp	Pine	Not bleached. Proposes to bleach with hydrogen peroxide.
APM	Maryvalue (Vic)	Kraft pulp	Eucalypt	Some is not bleached. Some is bleached with the following sequence to 88 ISO: a mixture of elemental chlorine, chlorine dioxide and hypochlorite, followed by extraction with oxygen, and treatment with chlorite dioxide and hypochlorite. Intends in 1990 to use the following bleaching sequence: a mixture of 50 per cent elemental chlorine dioxide, followed by extraction with oxygen and peroxide, and chlorine dioxide.

continued

Table 1: **continued**

Firm	*Mill location*	*Pulp or paper type*[a]	*Fibre feedstock*	*Bleaching process*
APM	Maryvalue (Vic)	NSSC pulp	Eucalypt	Not bleached
		Kraft pulp	Pine	Not bleached
	Fairfield (Vic)	Recycled paper	Waste-paper	Not bleached
	Broadford (Vic)	Recycled paper	Waste-paper	Not bleached
	Botany (NSW)	Recycled paper	Waste-paper	Not bleached
	Petrie (Qld)	Chem-mechanical pulp	Pine	Not bleached
	Port Huon (Tas)	NSSC pulp	Eucalypt	Not bleached
	Spearwood (WA)	Recycled paper	Waste-paper	Not bleached
	Millicent (SA)	Mechanical pulp	Pine	Not bleached
APPM	Burnie (Tas)	Soda anthra-quinone pulp	Eucalypt/ pine blend	Bleached to 86 ISO with the following sequence: elemental chlorine, dioxide, and hypochlorite. Experimenting with other sequences such as elemental chlorine, extraction with peroxide, chlorine dioxide, and hypochlorite.

continued

Table 1: **continued**

Company	*Mill location*	*Pulp or paper type*[a]	*Fibre feedstock*	*Bleaching process*
APPM	Burnie (Tas)	Semi-chemical pulp	Eucalypt	Single treatment with hypochlorite to 70 ISO.
	Wesley Vale (Tas)	Groundwood pulp	Pine	Bleached with single stage peroxide to 70 ISO.
		Cold soda pulp	Eucalypt	Bleached to 70 or 80 ISO with hypochlorite, followed by hydrogen peroxide. Currently examining the feasibility of bleaching with hydrogen peroxide only.
	Shoalhaven (NSW)	Recycled paper	Waste-paper	De-inked and bleached to 80-85 ISO with hypochlorite. Investigating alternatives, eg, FAS[f] and peroxide bleaching.
		Soda pulp[g]	Cotton linters	Bleaching with the following sequence to 84-85 ISO: elemental chlorite, followed by alkaline extraction, and hypo-chlorite. Improve bleaching processes for cotton linters are under 'intensive review'.
Bowater[h]	Myrtleford (Vic)	Refiner mechanical pulp	Pine	Bleaching with hydrogen peroxide.
KCA	Millicent (SA)	Bisulphite pulp	Pine	Bleached with elemental chlorite, caustic soda and hypo-chlorite to 85-88 ISO. Intends to bleach only with hydrogen peroxide to 82-85 ISO, in 1990.

continued

Table 1: **continued**

Company	*Mill location*	*Pulp or paper type*[a]	*Fibre feedstock*	*Bleaching process*
KCA	Millicent (SA)	Thermo-mechanical pulp	Pine	Bleached with hydrogen peroxide.
The Pratt Group[i]	Reservoir (Vic)	Recycled paper	Waste-paper	Not bleached.
	Warwick Farm (NSW)	Recycled paper	Waste-paper	Not bleached.
	Smithfield (NSW)	Recycled paper	Waste-paper	Not bleached.
	Coolaroo (Vic)	Recycled paper	Waste-paper	Not bleached.

a Unless otherwise stated, the pulp or paper is produced at the mill site. Some of these mills use pulps purchased from other mills or imported. **b** ANM is investigating the installation of a recycling facility at Boyer that processes 65 000 tpa of wastepaper. **c** ISO is the international standard measure of brightness of pulp. Brightness is measured by taking reflectance in the blue region of the visual spectrum on a scale of 0 to 100 per cent (100 per cent being the whitest). **d** CCS pulp is a cold soda pulp. **e** ANM is proposing to install a de-inking facility at Albury that will use 90 000 tpa of waste newsprint and 40 000 tpa of waste magazines. Some of the recycled fibre will then be combined with the TMP in the manufacture of newsprint. Hydrogen peroxide treatment is an integral part of the de-inking process. **f** FAS bleaching involves the use of formamidine sulphamic acid as a reductive bleaching agent. **g** APPM is reviewing cotton linters pulping at Shoalhaven. **h** Bowater is intending to produce chemi-thermo-mechanical type pulp at Myrtleford from a blend of pine and eucalypt. **i** The Pratt Group is proposing to make unbleached recycled newsprint in Victoria or New South Wales. This would require the construction of a de-inking plant. It is also proposing to make 'white' unbleached board from recycled paper.

Source: Submissions.

2.3 Environmental impacts of bleaching technologies

Environmental impacts from the bleaching wastes

The bleaching of pulp generates wastes. A substantial part of the waste is in liquid form. This effluent arises from the washing of pulp between some bleaching stages. It contains spent bleaching chemicals, degraded lignin, and other substances.

The environmental impacts of the effluent from bleaching vary and can depend on the fibre feedstock, the pulping process, the bleaching sequence, and whether the effluent is treated or untreated.

Regardless of the method of bleaching, the effluent may have certain characteristics which can damage the environment, such as suspended solids and the capacity to deplete oxygen from the receiving waters. However, a feature of chlorine bleached effluent is the presence of organochlorines.

Chlorine bleaching

The CSIRO has recently documented studies undertaken overseas, primarily in Scandinavia and North America, which examine the toxic (ie poisonous) effects of chlorine bleached kraft mill effluents on aquatic life (CSIRO 1989, pp. 14-22). However, CSIRO said that even though large quantities of mature Australian eucalypt are pulped in Japan, no research publications on effluent composition or toxicity could be located. Because of limited information available from overseas, the CSIRO said that it was difficult to ascertain the effects of effluent from the bleaching of eucalypt kraft pulp.

The CSIRO concluded that chlorine bleached kraft mill effluents seldom display acute toxicity (where deleterious effects on organisms occur within 3 or 4 days) to fish, except during a mill's commissioning period or because of poor operating procedures as in the case of spills. It noted that in the past decade much of the acute toxicity of such effluents was associated with resin and fatty acids and to a lesser extent, chlorophenolic compounds. It indicated that resin and fatty acids are biodegradable and, their concentrations diminish rapidly during biological treatment (a method of treating waste). These compounds are not very persistent in the environment with half-lives of one to several weeks.

The CSIRO said, however, that the chronic toxicity (where effects take months or years to appear) of bleached kraft mill effluents remains a concern 'although it is almost certainly lower' for modern kraft mills than for conventional older mills. The organochlorines are the principal source of chronic effects in chlorine bleached kraft mill effluents. Organochlorines are present not only in chlorine bleached kraft mill effluent but in any pulp mill effluent resulting from chlorine or chlorine-based bleaching processes.

The identification and measurement of organochlorine compounds are difficult. The CSIRO stated that several hundred organochlorine compounds have been identified overseas in chlorine bleached kraft mill effluent. These include chlorinated dioxins and furans and chlorophenolic compounds (such as chlorophenols, chloroguaiacols and chlorocatechols). However, those identified represented a small portion of the total quantity of organochlorines in the effluent.

The CCSERC referred to a study which noted that the environmental impact of 97 per cent of the total amount of the organochlorines discharged from kraft bleach plants is not known, as the chemicals have not been identified as specific substances (Keys 1989, p. 17). Furthermore, the concentration of some organochlorines, for example dioxins below one to two parts per quadrillion, is difficult to measure (CHAST 1989b, p. 4).

The CSIRO noted that organochlorines are 'considered to be the potentially most hazardous group of substances for the aquatic environment' (CSIRO 1989, p. 15, quoting the National Swedish Environmental Protection Board).

According to the CSIRO, the organochlorines of most concern are those which are soluble in fat (thus tending to bioaccumulate in animal fat), polychlorinated, with a small molecular mass, and not readily broken down (thus tending to accumulate in the environment over time) (CSIRO 1989, pp. 15-16). Once released, little can be done to eliminate them or to prevent them from entering food chains and reaching concentrations in aquatic organisms many times higher than concentrations in receiving waters or sediments. These organochlorines include the chlorinated dioxins, the chlorinated furans and the chlorophenolic compounds which have been identified in chlorine bleached kraft mill effluent. Significant amounts of the chlorinated dioxin, 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) and of the chlorinated furan, 2,3,7,8 tetrachlorodibenzo-furan (TCDF) have been found in bleached kraft mill effluent.

The CSIRO reported that the weight of evidence suggests that chlorinated dioxins and furans are not mutagenic (ie capable of causing an alteration to inherited genetic material) and do not initiate cancer although they might promote cancers arising from other causes (CSIRO 1989, p. 17). It said that 2,3,7,8 TCDD and 2,3,7,8 TCDF were the most toxic of the chlorinated dioxins and furans group. It indicated that 2,3,7,8 TCDD has caused decreased growth and eventual death in rainbow trout at concentrations between 38 parts and 115 parts per quadrillion.

In respect of chlorophenolic compounds, the CSIRO reported that a wide range of toxic effects on aquatic animals are documented (CSIRO 1989, pp. 17-18). These compounds have been found to concentrate in the tissues of aquatic animals at levels many times their concentrations in water. Some of these compounds are apparently excreted fairly rapidly if the animals are exposed to clean water. The CSIRO reported that a variety of chlorophenolic compounds can be 'converted microbiologically' to other chlorinated compounds of equal or greater toxicity.

Some participants provided information about the quantity of organochlorines in chlorine bleached pulp mill effluents. CHAST estimated that at least 44 tonnes of organochlorines would enter the environment annually from a chlorine bleached kraft mill with a capacity of 440 000 tonnes per year (CHAST 1989a, p. 4).

Friends of the Earth (Sydney) referred to the poor quality of effluent released from some pulp mills into the receiving waters. It said that APPM at Burnie releases 11.5 tonnes per day of organochlorines into the ocean and that KCA releases 11 tonnes per day of organochlorines from the mill site at Millicent into Lake Bonney (Robert Cartmel, Greenpeace, personal communication to Friends of the Earth, 26 February 1990).

In response, APPM said that the mass of organochlorines is largely irrelevant because they are biodegradable. The concern should be with the small proportion of organochlorines that can bioaccumulate. Also in response, KCA said that the total quantity of organochlorine compounds in the effluent in terms of AOX from the Millicent mill is about 1.0 tonne per day. KCA said that no correlation exists between the environmental significance of organochlorines and their mass. It said that of ‘genuine biological concern’ is the small fraction of organochlorines which are capable of accumulating in fatty tissues and that ‘the branding of all chlorinated organic compounds as toxic is scientifically indefensible and extremely misleading’.

ANM said that at Boyer, measurements of the effluent from bleaching CCS (ie cold soda) pulp and purchased kraft pulp with calcium hypochlorite show no detectable dioxins. The company said that the AOX level is approximately 1kg per tonne of fibre bleached.

According to APM treated effluent from its Maryvale mill appears to have an AOX level of 0.7 to 0.8 kg per tonne of air dried BEK pulp (APM 1990).

APPM said that concentrations of dioxins in the effluent from its mills, in general, are less than background concentrations of 0.2 parts per quadrillion. It said that the United States Environment Protection Authority could not detect one of the main dioxins, TCDD, in either the liquid effluent or the sludge from the Burnie mill. The Commission notes that the Tasmanian State Institute of Technology (funded by APPM) is to carry out research on the toxic effects of eucalypt pulp mill effluent on marine life.

A number of participants commented on the environmental effects, particularly the chronic effects, of organochlorines in chlorine bleached pulp mill effluent.

Information provided by Ankal Pty Ltd indicated that published Australian research on dioxins is limited by comparison to that available in countries such as Norway, Sweden and Finland (McPherson 1990).

DASETT indicated that the Australian and New Zealand Environment Council is preparing an information paper, which is to be made public, on organochlorines and the marine environment. The paper is to be completed by mid-1990.

The CCSERC said that gauging the accumulative and polychemical effects of long term low level emissions of organochlorines is not possible because the time frames involved are too long to enable results to be available ‘before it is too late’. The Council said that the risk of accidental spillage is also a major concern.

APM noted a Swedish study which identified the adverse impacts of bleached kraft mill effluent on fish and ‘bottom fauna’. The study considered the impacts were due to high levels of AOX in the effluent.

CHAST indicated that polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) have been shown to have detrimental effects in animals, including wasting syndrome, skin disorders, effects on the immune system, impaired liver function, altered haematological functions, impaired reproduction, and increased incidence of tumours. CHAST said that there is a great variability of the toxicity in the dioxin 2,3,7,8 TCDD for different species (CHAST 1989a, pp. 14-15).

The PPMFA said that there is little doubt that some organic chlorine-based compounds, along with some unchlorinated compounds, can cause significant damage to aquatic life if present in sufficiently high concentrations. However, the Federation said that a study by a group of experts from North America and Finland concluded that ‘treated bleached kraft effluents from well managed and operated North American mills show little or no adverse impacts on receiving waters’ (Scientific Panel on Pulping Effluents in the Aquatic Environment 1989).

APPM provided information about a United States study where rainbow trout in tanks were treated with various concentrations of dioxins, and compared with a control. Even though no dioxins were added to the control, there was a background concentration of 0.2 parts per quadrillion. The study found that the fish in the control tank were not affected, but at higher concentrations some of the fish died or at least there were ‘detectable’ effects.

Friends of the Earth (Fitzroy) said that BEK pulp mills create toxic emissions of an unstudied nature and may cause damage, particularly to fragile marine environments, of a long term or irreversible nature.

Some participants focused on the hazards posed by organochlorines, particularly dioxins, to human health. Information supplied by Ankal Pty Ltd suggests that the main toxic effect of dioxins on humans is the development of the skin disorder chloracne (McPherson 1990).

The PPMFA said that the hazards to human health associated with dioxins, particularly cancer, have been evaluated by experts in various countries (eg Universities Associated for Research and Education in Pathology Inc. 1988; Interdepartmental Working Group on PCDDs and PCDFs 1989; and Ahlborg et al. 1988). It said:

> While not excluding the possibility that the ingestion of very high doses of dioxin in some industrial accidents may have contributed to cancer formation, virtually all these investigations have concluded that there is no convincing evidence that dioxin has caused cancer in humans. In fact, the only illness that has shown a definite relation to dioxin intake is chloracne and that only at high dose levels.

CHAST regarded the emissions of large quantities of organochlorines, such as PCDFs (including 2,3,7,8 TCDD) and PCDDs, and trichlorphenols, as a serious health risk. It indicated that acute toxic effects, such as chloracne from PCDDs and PCDFs were rare and usually due to industrial accidents. It said in the case of chronic toxicity that it was difficult to establish a causal relationship between exposure to a chemical and the appearance of symptoms, when a continuous or repeated exposure to small quantities of a hazardous chemical has occurred over a prolonged period of time. However, CHAST referred to correlations between chronic exposures to organochlorines and a number of symptoms and diseases. For example, it referred to a study which linked malignant lymphomas (a tumour of the lymphatic tissues) including non-Hodgkin's lymphoma to occupational exposure to chlorophenols and 2,3,7,8 TCDD (CHAST 1989a, pp. 16-18).

APM said that 2,3,7,8 TCDD, while exhibiting toxic responses and cancers when administered in substantial dosage to laboratory animals, has not shown a similar response in humans. It noted that individual humans exposed to 2,3,7,8 TCDD as a result of industrial accidents or the agent orange defoliant spray program in Vietnam exhibited chloracne. The company said, however, that following extensive medical assessments of the patients, 'the vast majority of medical opinion considers 2,3,7,8 TCDD not to be genotoxic and therefore there is a safe level of exposure'.

Some participants noted that the pulp and paper industry is not the only source of dioxins. Information supplied by Ankal Pty Ltd indicates that dioxins are present and formed from many causes. These include industrial processes other than pulp and paper manufacture and natural causes such as volcanoes and earthquakes (McPherson 1990).

The PPMFA claimed that the pulp and paper industry was not the only source of dioxins. It said that dioxins were distributed widely throughout the environment and came from many sources.

APPM said that dioxins were ‘ubiquitous’, the main sources of man-made dioxins being incinerators, motor vehicles, and other methods of combustion.

APM said that the pulp and paper industry was not the only source of TCDD emissions. It pointed to a Swedish study (by Rappe) which showed that waste incineration and the metals industry are sources of ‘greater significance’.

A number of government initiated studies into dioxins have been undertaken or are intended. The National Health and Medical Research Council has recently investigated the effects of dioxins in paper products. The Western Australian Government, as part of its investigation into the effects of dioxins in paper products, will review the sources of dioxins, the level of exposure in the general population and occupationally exposed individuals, and the significance of exposure to human health and the environment. The adequacy of relevant standards and options for the control of dioxins will also be assessed. A report is to be released within six months (see Premier of Western Australia 1990). In addition, DASETT stated that it is undertaking a study to identify the possible sources of dioxin emissions in Australia and their relative significance.

Bleaching without chlorine and chlorine-based compounds

Some alternatives to the chlorine bleaching of chemical pulps include:

- bleaching chemical pulps with oxygen or hydrogen peroxide rather than with elemental chlorine and chlorine-based compounds;
- not producing chemical pulps, but instead producing and bleaching mechanical pulps with hydrogen peroxide.

While these and other alternatives to chlorine bleaching do not produce organochlorines, they do have potentially damaging effects. For example, the high electrical energy requirement of mechanical pulping has environmental impacts in emissions of greenhouse gases from the burning of fossil fuels or destruction of native forests in the construction of hydro-electric dams.

Bleaching mechanical pulps with hydrogen peroxide produces additional salts in the effluent. If the effluent is discharged into inland rivers and lakes, salinity levels can be raised. High salt levels can make the water unsuitable for a variety of human and animal uses.

A number of participants commented on the environmental impacts of alternative bleaching methods. APM stated that it was incorrect to say that only chlorine bleached pulps have potentially adverse environmental impacts. Other pulp and paper operations and other industry processes will have adverse environmental impacts if inefficiently or ineffectively managed and controlled.

ANM proposes to add a hydrogen peroxide bleaching plant for its TMP newsprint mill at Albury. The company has prepared an environmental impact assessment which is on public display. Total dissolved solids (including salts) in the treated effluent are expected to increase from 254 mg/litre to an average of 484 mg/litre. The salinity load in the treated waste water is expected to increase from 745 tonnes to 1775 tonnes per annum. Salinity at Morgan (in South Australia) is likely to increase by 0.16 electrical conductivity (EC) units (where EC is measured by Micros Siemens per centimetre at 25oC). ANM said that there is no known technology that will remove low level inorganics (approximately 500 mg/litre) and total dissolved solids from effluent in an economical manner. ANM considered the effect on the aquatic environment and downstream beneficial water use (domestic supply, recreation and irrigation) to be insignificant and the cost of on-site treatment ‘excessive’. It said that the salt discharges into the Murray river would be small compared with other point source discharges, for example, from municipal sewage treatment plants and irrigation runoff.

ANM is also proposing a de-inking plant for its mill at Albury. The environmental impact of de-inking is considered in the Commission’s interim report on paper recycling.

The CCSERC claimed that pollution from bleaching with hydrogen peroxide is inevitable; however it is less toxic compared with elemental chlorine and chlorine dioxide.

KCA said that bleaching its bisulphite and thermo-mechanical tissue pulps with hydrogen peroxide does not generate any chlorinated organic compounds. It said that only positive environmental impacts result from hydrogen peroxide bleaching compared with the chlorine bleaching sequence used at the Millicent mill. By-products of hydrogen peroxide bleaching are oxygen and water.

APPM said that the bleaching of wood pulp with oxygen and hydrogen peroxide is not known to have any adverse effects on marine life or on the food chain.

CHAST said that the effluent from bleaching mechanical pulps with sodium or zinc hydrosulphite contains no organochlorines but has high levels of biological oxygen demand (CHAST 1989a, p. 16). It said that the environmental impacts of 'alternative' or non-chlorine bleaching technologies have not yet been worked out for eucalypt pulp.

Environmental impacts of the use and disposal of bleached products

The use and disposal of bleached pulp and paper products may also affect the environment and human health. As noted above, in at least one State, investigations are about to be undertaken into the effects of dioxins in paper products such as disposable nappies, milk cartons, and sanitary products. This issue has recently been considered by the National Health and Medical Research Council. The Council stated (National Health and Medical Research Council 1989):

> On the basis of the limited data presently available from overseas and Australia, Council does not see any current evidence of a public health hazard from use of food in paper containers and from paper sanitary/personal products.

The Council, however, considered that it would be 'prudent public health policy to reduce exposure'. It recommended that 'appropriate measures be taken to reduce the level of dioxin contamination wherever possible and that this matter be reviewed as further information becomes available'.

Some participants commented on dioxins in chlorine bleached products. PADS, for example, expressed concern about the use and disposal of 'dioxin contaminated' sanitary products. Community groups have also expressed concerns about dioxins in bleached cardboard beverage containers, such as milk cartons. However, APM said that the perception held by some sections of the community that paper products, in particular bleached papers, have an adverse impact on the environment, 'is not supportable from the overall perspectives of environmental safety and sustainable development'.

A number of participants commented on the levels of dioxins in bleached products. The PPMFA said that a Swedish study in 1988 (Keenan, Sauer & Lawrence 1988) showed that in most cases the amounts of dioxins likely to be ingested through normal use of paper products is 'some orders of magnitude' below recommended 'safe levels'. PADS, however, said in relation to the use of chlorine bleached sanitary products that although dioxin levels are low, 'a risk exists'. It considered a product bleached with alternative bleaching chemicals, such as hydrogen peroxide, was safer. KCA said that its sanitary and nappy products will be free of dioxin after bleaching with elemental chlorine is replaced with hydrogen peroxide bleaching in 1990. KCA said it would continue to import pulps bleached with oxygen, peroxide and chlorine dioxide. It is 'hopeful that overseas practice' will enable it to import pulp bleached only with oxygen. KCA said that no dioxins can be detected in that pulp.

The PPMFA said that the use of pulp types other than chlorine bleached kraft gives no guarantee of avoiding dioxins in paper products. The PPMFA quoted a recent Swedish survey which showed total dioxin levels to be lower in bleached kraft pulp samples than in samples of unbleached sulphite, bleached TMP and de-inked recycled paper (National Swedish Environment Protection Board 1989). APPM said that Swedish tests showed that APPM's bleached pulps contain less dioxin than the non-chlorine bleached samples.

The disposal of bleached paper products may also have environmental impacts, as any organochlorines in the products may contribute to dioxin emissions from incinerators or landfills (Keys 1989, p. 27). PADS was concerned that there is no indication on the packaging of chlorine bleached sanitary and nappy products as to safe disposal and that dioxins in these products may enter the sewage system. KCA said that its products were biodegradable, although the polybacking on diaper products was a concern.

2.4 Reducing the environmental impacts of bleaching

Pulp mills can take measures to reduce the formation of organochlorines, organic materials, heavy metals, suspended solids, and other potential pollutants in their bleaching wastes.

Measures that reduce the formation of organochlorines involve modifications to pulping and bleaching processes to reduce the use of elemental chlorine or involve treatment of pulp mill wastes. Appendix D discusses these measures and presents participants' comments.

Process modifications that reduce the use of elemental chlorine include:

- extended delignification or cooking of the pulp prior to bleaching with elemental chlorine;
- bleaching with oxygen prior to bleaching with elemental chlorine (ie oxygen delignification);
- improved washing during the pulping process;
- partially replacing elemental chlorine with chlorine dioxide;
- using oxygen and hydrogen peroxide during the extraction stages of the chlorine bleaching sequence; and
- replacing chlorine bleaching with hydrogen peroxide bleaching.

APM and KCA already use some of these process modifications or intend to introduce them. However, oxygen delignification is not presently used in Australia.

Treatment of the wastes from chlorine bleaching can minimise the discharge of organochlorines into the environment. Waste treatment can be undertaken by methods which are either an integral part of the pulping and bleaching process or external to it.

Integral treatment includes recovery or recycling of energy, water, fibres and chemicals. However, recycling of chlorine bleached effluent does not appear to be possible. Some modifications to chlorine bleaching processes, such as oxygen bleaching, can promote recycling of spent bleaching chemicals.

External treatment of waste after it is discharged from the mill includes the use of precipitators and cyclones for treating stack gases and aeration ponds for the treatment of effluent. External treatment of effluent can be at three levels:

- primary treatment which mechanically removes much of the coarse suspended solids;
- secondary or biological treatment; and
- tertiary treatment (for example, activated carbon absorption, lime treatment and foam separation).

External effluent treatment facilities vary between mills using chlorine bleaching. For example, the effluent from ANM's Boyer mill is subjected to primary treatment. ANM said that if its proposal for a LWC papers facility at Boyer proceeds, a biological treatment plant will be installed. The effluent from APM's Maryvale mill receives primary treatment on-site. The bulk of the effluent is then subjected to secondary treatment by the Latrobe Water and Sewerage authority. The remainder receives secondary treatment on-site before discharge. The effluent from all APPM's mills receives various kinds of primary treatment. KCA said that liquid discharge `is in its raw state from the site [at Millicent] to a drain 11 kms from the mill'.

The modification of pulping and chlorine bleaching processes and the treatment of waste, while assisting in the abatement of pollutants such as organochlorines, impose costs on the pulp mill. Up-to-date information about the costs of abating pollution, caused by chlorine bleaching was not sought during the inquiry. However, ANM said that its effluent treatment plant at Albury (which does not bleach its pulp) cost $13 million in 1980 and the costs of operation in 1988-89 were about $3 million.

There are no direct charges imposed on mills when discharging effluent unless sewage facilities are used.

2.5 Environmental regulation

The Commonwealth and State Governments intervene extensively to control damage to the environment arising from industrial activity. The main types of environmental regulation affecting the bleaching activities of pulp mills relate to environmental impact assessment (which applies to new projects) and pollution control. These regulations are predominantly imposed at State level. The Commonwealth Government can impose similar environmental controls where it has the Constitutional power to do so, for example, where export licences are required or where foreign investment approval is sought. The scope for the Commonwealth to intervene in environmental matters has widened after a series of High Court judgments over the last twenty years.

States

State Governments have substantial power to impose environmental controls over the siting, construction and operation of bleached pulp mills. The main controls are in the area of environmental impact assessment and pollution control.

The precise form of environmental impact assessment procedures varies from State to State. Some have legislative backing. These procedures generally require the proponent of a project to prepare a report which includes a technical assessment of the development, an indication of the control measures, the associated environmental consequences and safeguards envisaged, and the economic justification for the project. Public comment on the report is usually invited and the report is reviewed by the Government. The Government then decides whether the project should proceed, and if so, under what conditions.

A number of features of environmental impact assessment procedures have been the subject of criticism (for example, see Burns & Associates 1989). The discretion of administrators to determine whether environmental impact statements are required for a particular project is the main concern. Criticism has also been levelled at the requirement that the proponent of a project prepares the statement and the length of time these procedures take.

There are State pollution controls on the discharge of wastes including gases, liquid effluents, and solid wastes. The controls are broadly similar across States but emission standards, for example, can differ between old and new mills. Standards can also vary according to the nature of the receiving environment. For example, controls over discharges into inland waterways appear to be more stringent than over discharges into a marine environment. APPM indicated that different standards often apply to similar types of potential pollutants. For example, standards applying to organochlorines produced from the chlorination of water are less rigorous when compared with standards applying to the chlorination of pulp.

The Commission notes that the Australian and New Zealand Environment Council is presently examining State pollution controls.

Commonwealth

The Commonwealth Government's pulp mill and paper industry package includes environmental guidelines for new BEK pulp mills, negotiations with the States regarding the operations of pulp mills approved under the guidelines, and a research program involving the Commonwealth, the States and industry.

Commonwealth environmental guidelines relating to new BEK pulp mills

The Commonwealth guidelines for new BEK pulp mills are based on a report prepared by CSIRO in July 1989 (CSIRO 1989). The guidelines clarify the 'minimum environmental requirements which the Commonwealth Government will seek for any new BEK pulp mill proposal requiring approval by its Ministers' (Joint Press Release 1989, Attachment A, p. 8). For example, the guidelines will apply to proposals requiring an export licence or foreign investment approval.

State Governments will continue to exercise substantial power in respect to the environmental impacts of future BEK pulp mills. A State could issue guidelines for BEK pulp mills that are stricter than those imposed by the Commonwealth.

The Commonwealth guidelines establish limits on the emission of specified pollutants into the atmosphere and receiving marine waters. These limits are presented in Appendix E. The guidelines also outline procedures for the disposal of sludge from primary and secondary treatment. The Commonwealth Government considers that these two features will permit pulp mills to install the ‘best available technology economically achievable’.

The guidelines also require that:

- meteorological, hydrodynamic and biological studies be undertaken of the proposed pulp mill site;
- air emission stacks and ocean outfall pipes conform to ambient air and water quality criteria;
- a marine environment survey and baseline studies (during mill construction) of marine plants, animals and sediments be undertaken near the proposed outfall;
- waters be monitored near the proposed outfall and for the life of the mill; and
- the environmental performance of the pulp mill be made public.

The guidelines are to be reviewed every five years. However, if there are significant advances in the `best available technology economically achievable' or if unforeseen environmental impacts are observed they will be reviewed more often. Any revisions are to apply to new, rather than existing, mills.

The Commonwealth is negotiating with the States on environmental assessment arrangements for future BEK pulp mill proposals, including monitoring arrangements. This is intended to allow for greater coordination between the two levels of Government.

In a position statement issued after the release of the guidelines, FAFPIC argued that the Commonwealth must establish an agreed process with the States for the environmental assessment and approval of pulp mill proposals and must undertake to support the outcomes of that process. It also recommended that such a process allow for public participation and be of limited duration (FAFPIC 1989).

A recent report prepared for FAFPIC commented on the relationship of the Commonwealth and States over environmental matters (Simons 1990). It stated (at p. 5-59) that:

> The key issue in our view, is not the nature or level of environmental constraints, but uncertainty and delays in approval procedures.

A number of participants expressed views regarding the Commonwealth guidelines. The NSW Department of State Development referred to inadequacies in the guidelines and to the State Government's commitment to reach agreement with the Commonwealth Government on environmental standards for new BEK pulp mills.

The PPMFA said that the guidelines ensure that any mill built in Australia will be 'environmentally safe'. Similarly, APPM said that the guidelines ensure that any new mill in Australia will be 'completely safe'. It claimed that the guidelines are more rigorous than those in other countries and are presented in a precise language that leaves no room for misinterpretation.

However, Kempsey Shire Council, in its submission in response to the NSW Pulp and Paper Industry Task Force Report, noted that the fishing industry in the Macleay River rejected the guidelines. It said that the industry believes there should be no pollutants whatever emitted into the marine environment and that the guidelines do not adequately protect the industry.

CHAST, in its submission to the NSW Department of State Development on the Task Force Report, stated that monitoring of the effluent composition and environmental impacts under the guidelines should be undertaken by an independent authority.

APPM said that agreement between the Commonwealth Government and State Governments over the regulation of pulp mills is important. The company referred to its proposal to build a BEK pulp mill at Wesley Vale and how the 'rules of the game' had changed when the Commonwealth intervened. APPM claimed that in contrast to the Commonwealth, the States appear to prefer an approach which allows for the development of site-specific and project-specific guidelines.

Research grant

The Commonwealth Government is to contribute $7.7 million over five years to fund a pulp and paper research program on a dollar-for-dollar basis with industry and State Governments. The program is to be administered by a board with representatives from the CSIRO, Commonwealth Departments, State Governments, industry and conservation groups. The objectives of the research program are to:

- monitor the environmental impacts of kraft mills;
- monitor international developments in kraft technologies and alternative technologies;
- reduce pollutants that may have adverse effects; and
- achieve reductions in organochlorines (produced in existing mills) by a further 90 per cent and, in the longer term, develop organochlorine-free bleaching methods for eucalypt pulp.

3 MARKET AND PROSPECTS FOR UNBLEACHED AND NON-CHLORINE BLEACHED PAPERS

The reference requires the Commission to report on:

- market prospects for and the technical feasibility of producing unbleached and non-chlorine bleached papers;
- community attitudes to the use of unbleached paper products; and
- global trends in the substitution of unbleached pulp for bleached pulp.

These issues are covered in this chapter.

Paper is not a homogeneous commodity. There are four main market segments -- newsprint, tissues, printing and writing papers, and packaging and industrial papers -- but the market for paper is differentiated into many hundreds of end uses. Papers vary according to brightness, texture, strength, absorbency, porosity, coating, colour, density, and other characteristics.

Unbleached papers are used in many market segments. For other uses, bleached papers are preferred -- either chlorine or non-chlorine bleached.

Appendix Table C1 sets out pulping and bleaching details for the main Australian producers.

3.1 Domestic markets

Most concerns raised by participants relate to tissues, and to printing and writing papers. This section also briefly covers newsprint and packaging and industrial papers.

Newsprint

A significant proportion of newsprint used in Australia is imported (mainly from New Zealand). Newsprint is produced here by only one company, ANM. In 1988-89, according to ANM, about 650 000 tonnes of newsprint were used in Australia of which about 42 per cent was imported.

ANM, which is jointly owned by News Ltd and by Fletcher Challenge of New Zealand, produces newsprint at Boyer in Tasmania and at Albury in New South Wales. The Albury plant produces newsprint exclusively. The Boyer mill produces newsprint and some other grades (telephone directory paper and high-brightness machine-finished printing paper).

Chemical pulping is not undertaken by ANM. Its Boyer plant produces several types of TMP and CMP pulps (see Appendix Table C1) and also uses some imported kraft pulp. Some of this imported pulp is purchased bleached with elemental chlorine and/or chlorine dioxide, and some purchased unbleached is subsequently bleached at Boyer with calcium hypochlorite.

At Albury, ANM produces newsprint from unbleached TMP pulp. No Albury paper contains chlorine bleached pulp. The company has plans to hydrogen peroxide bleach some of its existing pulp at Albury. An environmental impact assessment of this proposal is available for public comment.

ANM intends to recycle wastepaper into pulp. The proposed plant would make use of about 90 000 tonnes of old newsprint and about 40 000 tonnes of old magazines each year. De-inking of the waste would be a prerequisite. The company has chosen Albury as the preferred site for this $100 million plant and has committed $4 million to an environmental impact study.

ANM has also announced that it will investigate another recycling facility to process 65 000 tonnes per annum of wastepaper at the Boyer mill. This waste would include a substantial quantity of old telephone directories.

To utilise these new pulps, ANM proposes to upgrade its existing machine to produce more newsprint at Albury, use some of the existing Boyer pulp stream to produce LWC at Boyer and to use the new pulp on the existing machines at Boyer.

LWC is a new area of production for ANM. The company indicated that Telecom is ‘keen’ to purchase directory paper containing recycled fibre, particularly old telephone directories.

The Pratt Group is considering establishing a plant in Sydney or Melbourne to produce about 150 000 tonnes of newsprint per annum from wastepaper. This would involve de-inking of old newsprint. Subsequent to ANM’s announced decision to establish a de-inking plant at Albury, the Pratt Group advised that ‘discussions with ANM about joint venture possibilities are continuing’.

Evidence was given by ANM and News Ltd of a shift in demand for newsprint towards a stronger brighter product. Such papers were said to be more suitable for use in high-speed four-colour offset presses of the type shortly to be introduced by News Ltd into many of its Australian operations. The John Fairfax Group already uses colour in some of its publications and is to extend that use. Colour advertising printed on such papers is said to project a better image than black and white advertising on standard newsprint, thus making newspaper advertising more competitive with television advertising.

ANM indicated that some of the whiter grades of newsprint are only achievable through the use of at least some chlorine bleached kraft pulp. At present this amounts to 8 per cent of Boyer newsprint, and none for Albury. In addition, CCS pulp (made by ANM) and purchased unbleached kraft pulp are bleached with calcium hypochlorite and also incorporated in some Boyer newsprint. It is unclear how the proportions of these types of bleached pulps will change as ANM’s papers are adapted to meet the demand by publishers for higher brightness.

Tissues

The Australian market for tissues, according to KCA, is about 156 000 tonnes per annum of which about 95 per cent is produced in Australia. The industry is dominated by KCA and Bowater. KCA’s final product capacity is about double that of Bowater’s.

KCA produces both mechanical (TMP) and chemical pulps at Millicent in South Australia. The pulps are supplemented by imported bleached chemical pulp. A significant proportion of KCA’s pulp output is unbleached.

These pulps are combined in various ratios at Millicent to produce tissue papers, which are converted to consumer products either at Millicent (about 80 per cent of the total paper capacity) or at Sydney. KCA supplies just under one-half of its toilet tissue in unbleached form.

Bowater produces CMP pulp at Myrtleford in Victoria, as part of an integrated process producing pulp as well as plywood and sawn and treated timber. At Box Hill, Victoria, this pulp is used, together with imported softwood kraft pulp, and pulp from APM at Maryvale in Victoria, to produce tissue paper. These are converted into consumer products either at Box Hill or at another plant in Melbourne. In some of its products, Bowater currently includes a small proportion of recycled paper. This is high-grade white paper such as printers' waste.

Cosco Holdings Pty Ltd, a smaller company based in Ipswich, Queensland, produces consumer packs of toilet tissues from imported pulp. Its capacity is about 20 000 tonnes per year. The Paper Converting Company and Austissue Pty Ltd (see below) also produce small quantities of tissue products.

KCA stated that the use of chlorine and hypochlorite for bleaching of its pulps at Millicent will be eliminated during 1990. It said that 'by mid-1990, the Apcel mill will be using the most environmentally acceptable bleaching processes in use anywhere in tissue manufacturing' -- this refers to bleaching with hydrogen peroxide. In respect of imported pulp, KCA stated that it is now changing to more environmentally acceptable pulps bleached with oxygen, peroxide and chlorine dioxide and is 'hopeful that overseas practice will soon allow us to purchase oxygen only bleached pulps (about mid-1990)'. KCA stated that 'no dioxins can be detected in the [imported] pulp and no elemental or free chlorine is used in the manufacturing process'.

KCA commented that in tonnage terms the Australian market for tissues is showing little growth -- in value terms the growth is in supplying 'increasingly value added products to an increasingly sophisticated market'. KCA said that:

> ... the quality characteristics of tissue products, particularly toilet tissue, has undergone a developing consumer preference for products with softness, strength and with more appealing presentation. As a result, there has been a movement away from the duller unbleached one-ply 'generic' products towards softer two-ply 'up-market' products. Such products are generally more highly priced, however the consumer has exercised this preference and has led a significant movement in favour of product improvement. Both unbleached and bleached products have been on the Australian market for many years, and the more recent environmental issues have not resulted in any discernible trend back to unbleached products.

KCA claimed that there will always be a consumer preference for the softer, cleaner bleached tissue for personal use, whether supplied white or in pastel colours. Products at the lower end of the market, which are sold on price alone, or for commercial use, will always be available in unbleached form, KCA said, and consumer preference will dictate the extent to which they are accepted.

Bowater considered that competition in the tissue industry in recent years has been focused on improved product quality. Nevertheless, Bowater stated that over the past two years there has been an increase in the use of unbleached, peroxide bleached and chlorine dioxide bleached pulp rather than pulp bleached with elemental chlorine.

According to market research information supplied by Bowater, the tissues market divides into three segments: premium buyers (who seek the highest quality and are prepared to pay for it), value buyers (who will trade off quality for price) and price buyers (who seek the lowest price). These groups respectively make up about 46, 10 and 44 per cent of the market. Further, Bowater said that about 75 per cent of consumers were aware of environmental issues, and 28 per cent had trialled products labelled as 'environmentally friendly'. About 8 per cent were current users of such products. 'Disappointment with product quality was the normal reason given for consumers not repeating purchases of environmentally friendly products.' Bowater said that 42 per cent of consumers are not interested in 'environmentally friendly' products at all, and 15 per cent would make 'strenuous efforts not to use the products because of an acute reaction to anything to do with "greenies"'.

The market research reported by Bowater indicates relatively low market penetration of products labelled as 'environmentally friendly'. Yet large volumes of unbleached and non-chlorine bleached tissues are sold by KCA and Bowater. The research also seems at odds with the decision of KCA to move further away from chlorine bleaching. However, it indicates that about equal proportions of consumers buy on the basis of quality and on the basis of price. The research may indicate that if products labelled as ‘environmentally friendly’ are to win a higher market penetration, then relative price reductions or relative quality improvements will be necessary.

PADS expressed concern about the use of chlorine bleached materials in feminine sanitary products (not all components of these products are of wood fibre pulp). It said that:

> European and British manufacturers have been forced to market products which are not chlorine bleached. In Australia, the same manufacturers have chosen to dispute the evidence which has convinced their overseas companies to discard chlorine bleaching.

PADS requested Commonwealth Government intervention to remove from the market sanitary products containing dioxins as a by-product of chlorine bleaching. PADS indicated that Sancella (a company associated with Bowater) has commenced supplying pads with 100 per cent non-chlorine bleached material.

KCA said that it will cease using chlorine bleached pulps in these products during 1990. Johnson & Johnson, another large Australia manufacturer of sanitary products (the company does not itself make wood-based tissue pulp), has announced that it will cease to use tissues bleached with elemental chlorine. Johnson & Johnson has also announced that it will cease production of disposable nappies, another product of particular concern to PADS.

It is apparent that in the tissues area there is a move away from chlorine bleaching. Further, there has been a start towards the use of recycled papers to produce tissues in Australia. Austissue Pty Ltd in Western Australia has recently commenced production of jumbo rolls of tissue from high-quality wastepaper. At present, that company is operating at about half its capacity of 6000 tonnes of waste per annum. Austissue’s product is sold to converters, both in Australia (about 45 per cent of output) and overseas. The Paper Converting Company, which takes some of Austissue’s output, produces about 9000 tonnes per year of toilet tissue and paper towels. Sales tax is not payable on product converted from tissue, such as that produced by Austissue, made from 100 per cent recycled paper. Bowater is considering installing paper processing capacity of around 10 000 tonnes using high-quality wastepaper to replace purchased chemical pulp. The Commission is aware that other studies are being undertaken into the possibilities of producing tissue from recycled papers.

Printing and writing papers

This category includes lightweight magazine papers, offset printing papers, envelope papers and paper for continuous stationery, but excludes newsprint. The largest growth area is in the business and computer paper segment.

According to APPM, the Australian market for printing and writing papers totalled about 740 000 tonnes in 1988-89, of which imports accounted for almost 50 per cent.

Australian production has been dominated by APPM, but in recent years there has been growing competition from APM and ANM in certain categories of papers. APPM is still by far the largest Australian producer of these papers. It supplies about 290 000 tonnes, ie about three-quarters of total Australian production.

APPM produces at Burnie and Wesley Vale in Tasmania and at Shoalhaven in New South Wales. Each of these mills produces pulp and paper.

At Burnie, pulp is converted into uncoated printing and writing papers. About 10 per cent imported pulp is used at Burnie. Wesley Vale is about 70 per cent self-sufficient in pulp. The main paper output of the mill is of lightweight coated and uncoated papers for use in printing. Wesley Vale also coats papers from Burnie. The mill at Shoalhaven produces pulp from high-quality wastepaper and cotton linters. This is combined with imported bleached chemical pulps to make printing and writing papers. Shoalhaven is more than 50 per cent self-sufficient in pulp.

White printing and writing papers are produced by APM at Maryvale and Fairfield in Victoria. Total capacity is about 115 000 tonnes. At Fairfield recycled waste is also used.

ANM produces telephone directory paper and uncoated mechanical machine-finished printing paper at Boyer in Tasmania. (For details refer to the newsprint section.)

Excluding papers from recycled waste very little, if any, printing and writing papers are currently produced in Australia from non-bleached pulps. Most bleaching for those papers includes elemental chlorine and chlorine compounds, although some peroxide bleached pulps may be used.

APPM said that ‘papers made from unbleached pulps, whether they be hardwood or softwood, are unable to be marketed as fine papers for printing and writing’. Further, it stated that ‘we detect no demand for unbleached or less bleached paper products in the printing and converting markets which in any way has been driven by concern for bleaching products’.

APM commented that these papers require whiteness, brightness and opacity, strength, flatness, even thickness, freedom from curl, a smooth even surface that accepts ink, copier toner and typewriter ribbon, and must have a high fibre bonding quality to resist dusting and be of a high level of uniformity. ‘Unbleached papers are unsuitable alternatives except in specific promotional applications.’ ‘Non-chlorine bleached products for business and communications papers are not acceptable to printers or publishers or other areas for the majority of applications.’

APM also said that ‘it has only been in the past year or so that consumers worldwide and in Australia have been prepared to accept a proportion of less white, less bright products for a limited range of applications’. But a submission from Leighton Holdings Ltd indicates that sales in West Germany of Steinbeis recycled office paper -- a paper of relatively low brightness -- increased over the years from 1981 to 1989 by over 300 per cent to account for about 13 per cent of the West German market for copy paper and computer stationery. The National Paper Marketing Council of Australia commented that Australians prefer whiter papers than Europeans: ‘Australia is what we call a blue-white, high-white market’.

PATEFA commented upon the possible use of unbleached or recycled paper in various end uses. It said that unbleached and non-chlorine bleached printing and writing papers are unsuited to the following market areas: security printing; the book, magazine and catalogue sector; and promotional printing. It said that ‘the use of unbleached pulp results in low quality and limited use printing and writing papers and does not meet quality standards. The substantial removal of lignin is necessary to achieve the required qualities and currently chlorine bleaching is the only effective way to remove it'. However, it saw some openings in some areas for the use of the lower quality papers, depending upon market acceptance. PATEFA considered that papers made from unbleached pulps were unsuitable for web offset printing.

There are some signs that Australian users/consumers are becoming more prepared to substitute unbleached or non-chlorine bleached papers in some end uses. APPM commented that there are fast growing small niches in high-yield mechanical pulps -- ie CTMP, bleached CMP and TMP. It said that as they do not achieve the brightness requirements of main-volume papers, their introduction is predominantly as a supplement to existing pulps and where energy costs are favourable. CTMP papers are not made in Australia, and there are some limited but growing imports of them. According to the recent Simons report (1990), CTMP production is growing rapidly worldwide, but only small volumes are available as market pulp. It is high yielding, the report indicated, yet produces a quality pulp which can displace chemical pulp in some end uses. Oxygen bleached, rather than chlorine bleached, papers are available in Australia from some importers. The Commission's separate interim report on paper recycling outlines growing consumer acceptance of printing and writing papers made from recycled papers (not further bleached).

The Tasmanian Government has asked consultants to undertake a study into unbleached and non-chlorine bleached papers. The results of this study were not available when the Commission's report was finalised.

Packaging and industrial papers

In this product area, extensive use is already made of recycled and of unbleached papers. Many products are brown -- for example, cement sacks, corrugated containers and the inner layers of multi-layer cartons. Some products, however, use bleached papers. Examples include liquid packaging cartons, some packaging and industrial papers and the outer layers of multi-layer cartons.

Board for liquid packaging cartons is imported, and imports also satisfy many other speciality needs. In 1987-88, imports accounted for about 27 per cent of the 1 284 000 tonne Australian market for packaging and industrial papers (excluding prepackaged imports).

With Smorgon's recent closure of its papers business, only APM and the Pratt Group produce in this area of the market in Australia. APM holds about 80 per cent of the domestic market for packaging and industrial paper, 60 per cent of the corrugated container materials market, and about 72 per cent of the cartonboards (including fluid packaging) market.

APM has several plants around Australia producing these products, with a total paper-making capacity of about 910 000 tonnes. Some, but not all, of APM's plants produce pulp. Considerable quantities of wastepapers and some imported pulps are also used.

In 1988-89, only about 17 per cent of APM's fibre use was of bleached pulp. Of this, the majority was used for printing and writing papers. Of the fibre used in the packaging and industrial sector, less than 10 per cent was bleached. APM intends to reduce the proportion of elemental chlorine used in bleaching eucalypt kraft pulps at Maryvale during 1990.

The Pratt Group through Southern Paper Converters produces paper only from wastepaper. It has plants in Sydney and Melbourne utilising about 300 000 tonnes of wastepaper. The papers it produces are not bleached. They are used primarily (90 per cent) by other divisions of the Pratt Group in the production of corrugated boxes (the Visy Board division) and lithographic laminated cartons (Visypack division). Export markets are being developed.

A machine currently being commissioned by the Pratt Group has the capacity to produce white-topped board, laminating boards and fillerboards in a variety of grammages. The objective is to produce these grades from recycled fibre and clay coating.

Gable top cartons used in packaging of liquids in most States are made from imported chlorine bleached papers. However, Tetra Pak gable top cartons in some States, and the paperboard component of Tetra Brik aseptic cartons, are 80 per cent unbleached. Elemental chlorine is not used in production of the bleached component. Apart from improving the visual impact of unbleached board, bleaching eliminates odours and tastes that could otherwise migrate through the plastic coating, and helps to sterilise edges that may be in contact with the product.

PATEFA commented that solid bleached sulphate (ie bleached kraft) boards have several desirable properties: high odour resistance, structural strength, excellent cutting, folding and creasing properties, and an extremely smooth print surface. It said, however, that certain CTMP non-chlorine bleached boards could be used as a cheaper substitute when specifications are less critical.

Assessment

Unbleached and non-chlorine bleached papers are already widely used in Australia. Most newsprint, some tissues, and the vast majority of packaging and industrial papers are unbleached or non-chlorine bleached.

DASETT commented that:

> The recent debate concerning pulp mills has focused attention on the uncertain implications for human health and the clearly adverse effects on the environment of the chlorine bleaching of paper pulp. This has led to a change in community attitudes, with the emphasis being placed on these issues rather than on the aesthetic qualities of paper products.

This certainly appears to be true for tissue products. As noted above, KCA is to move away from chlorine bleaching during 1990. Once this is done, at least two-thirds of the pulp content of Australian-made tissue paper will be unbleached or non-chlorine bleached. If KCA moves away from chlorine dioxide bleached imported pulp to oxygen bleached pulp, as it is endeavouring to do, an even higher proportion of Australian tissue will be unbleached and non-chlorine bleached.

Table 2 shows the likely situation in the Australian market after KCA changes its Australian bleaching processes. The main area of use of chlorine bleached papers will then be printing and writing. Some packaging and industrial papers used will be chlorine bleached -- in liquid packaging, and in areas where good printing characteristics are required. When the Pratt Group’s new machine to produce white unbleached board from recycled paper comes on stream the proportion of packaging and industrial papers which are chlorine bleached will be reduced.

Table 2: **The estimated Australian market for paper 1990** [a]

('000 tonnes)

Product Group	*Unbleached and non-chlorine bleached*	*Chlorine bleached* [b]	*Total*
Newsprint	580 [c]	70	650
Tissues	107	48	155
Printing and writing	10	730	740
Packaging and industrial	1065	225 [d]	1290
Total	1762	1073	2835

a Classified by pulp content. Excludes imports of papers incorporated into final goods. **b** Includes bleaching with chlorine compounds. **c** Assumes imported newsprint is not chlorine bleached. **d** Assumes 5 per cent and 50 per cent of local production and imports, respectively, are chlorine bleached.

Source: Estimated from data supplied by participants.

DASETT's comments on community attitudes do not appear to hold to the same degree for printing and writing papers. Participants contended that users of printing and writing papers require high brightness and durability. They said that current alternatives to chlorine all have technical deficiencies for achieving high brightness and removing lignin. The PPMFA stated that 'there is at present no technology available which is capable of producing pulps at today's required quality levels without the use of chlorine compounds'.

APPM stated:

> The quality specifications required for various paper grades have been established from long experience in different applications. Efficiency in paper manufacturing, as well as in the subsequent printing and converting processes, requires specific properties of the fibre raw material. The end uses of the final products dictate other properties. The prevailing standard levels for brightness, strength, opacity and other printing properties of paper represent an optimum balance between end-use requirement and production costs for the paper.

However, there are fast growing niches in high-yield non-chlorine bleached mechanical pulps. CTMP is a high-yielding pulp which has potential to displace chemical pulps in some applications. This pulp is not currently made in Australia.

As discussed in the Commission's interim report on paper recycling, there has been growing consumer demand for recycled papers.

Thus, with the exceptions of printing and writing papers, some packaging and industrial papers and possibly some high-grade newsprint, consumers have long accepted unbleached and non-chlorine bleached papers in many uses.

Some participants claimed that manufacturers are not producing the products consumers have demonstrated they want. Some claimed that manufacturers and others are not adequately promoting the availability of environmentally friendly products. For example, the Australian Consumers Association commented as follows:

> Allegations by manufacturers and advertisers, that demand for unbleached and recycled paper is due to 'a vocal minority' are not substantiated by the growing evidence of changes in consumer buying behaviour. For example, retailers who stock unbleached toilet paper have found that they are unable to keep up with demand. This is at a time when such unbleached paper is commanding a price premium in the marketplace.

In response, producers disputed this claim. For instance, KCA commented that 'there is no attempt to restrict supply of unbleached tissue'.

One explanation for these differences in perceptions might be the time scales under which the various parties to market transactions operate. Consumers can respond quickly to changes in their perception of environmental issues. Producers are often locked into fixed technology in the short term. What ANM said in regard to newsprint is also true of other pulp and paper mills:

> The pulping systems [that] are applicable in modern high-scale newsprint mills are very inflexible. A pulping plant is very expensive ... A slow change in technology, however, can be accommodated.

Differing attitudes to risk are also relevant. Advertisers, for example, may not be willing to risk lowering the 'quality' of their product by using recycled or non-chlorine bleached papers while their competitors continue to print on bright white papers.

As noted in Chapter 4, there are at least two Australian producers in each main segment of the Australian market, except for newsprint. Further, although duties of up to 15 per cent may apply (imports of pulp and of newsprint are free of duty), imports compete in most areas of the Australian market. These factors should ensure that consumer preferences are transmitted to producers, and that producers should respond to them, albeit after some delay.

DASETT commented that one of the most important issues for consideration in this inquiry is whether or not prices properly reflect environmental costs. This issue is taken up in Chapter 5.

3.2 Export markets

World trade in paper pulp is principally of bleached kraft pulp of high brightness levels. World markets for unbleached kraft pulp, and for mechanical pulps (bleached or otherwise), are comparatively small. Figures provided by APPM suggest that bleached kraft pulp in 1988 made up about 82 per cent of pulp traded on world markets. Unbleached softwood kraft accounted for about 5 per cent and there was no unbleached hardwood pulp traded. Production of CTMP pulp is growing rapidly worldwide but only small quantities are available as market pulp (Simons 1990).

Information submitted by the PPMFA suggests that about 73 per cent of projected pulp-making capacity increases between 1990 and 1993 worldwide will be accounted for by kraft pulp, of which only about 2 per cent will be unbleached (PPI 1990). Most of the rest will be CMP/CTMP. According to a recent study (CSIRO 1989), Tasman Pulp and Paper in New Zealand is increasing bleaching capacity because it cannot export all its unbleached output.

In the near term, Australian export opportunities seem to lie in BEK pulp, and possibly in LWC paper. The latter product would incorporate non-chlorine bleached CTMP pulp from a mixture of pine and plantation eucalypt (this type of pulp is not presently made here). The Simons report (1990) indicates that although state of the art technology is not currently commercially available for bleached CTMP pulp and LWC paper it will probably be available in the next few years.

Some participants were critical of attempts to establish world-scale BEK pulp mills in Australia to produce for export markets. They considered that future developments should be aimed at import replacement, and produce unbleached and non-chlorine bleached pulps, possibly from non-wood feedstocks. However, small mills directed at import replacement are unlikely to be economic. There are two reasons for this.

First, they would not produce those types of papers that Australian users currently require. Australians appear to be somewhat less demanding of high-brightness high-whiteness papers than some of Australia's potential export customers (such as Japan) -- this is evidenced by the acceptance by Australians of the less bright, yet chlorine bleached, soda anthraquinone pulps. However, Australia is still considered to be a market that demands high-whiteness printing and writing papers. Demand for unbleached and non-chlorine bleached papers is fairly static in those market areas where chlorine bleached papers have been traditionally used. The evidence summarised in Chapter 4 suggests there is only a limited market in Australia for non-wood pulps. Some niche markets may be developing for unbleached and non-chlorine bleached papers, but the vast majority of demand for writing and printing papers remains for high-brightness durable papers.

Second, economies of scale in this industry are very significant, particularly for wood-based pulps. The Simons report indicates that Australia's domestic market is not large enough, except in the case of newsprint, to take all the output from new world-scale pulp and paper mills. The report concludes that 'it would not be reasonable to expect companies establishing wood-based pulp mills to forgo the benefits of economies of scale'.

Many of the papers Australia imports would, if displaced by Australian pulp and paper production solely for the domestic market, be produced on a relatively small scale and at high cost.

4 NON-WOOD FEEDSTOCKS

The Commission is required to report on the prospects for using non-wood feedstocks in the manufacture of unbleached pulp. While the reference refers specifically to unbleached paper, this chapter of the report also examines the prospects for using non-wood feedstocks for bleached pulp.

4.1 Sources of non-wood fibre

There are many sources of virgin fibre for paper other than wood (see Table 3). In Australia, some of these would be agricultural residues (wheat straw, sugarcane bagasse and cotton linters) and some would have to be grown specifically for their fibre (eg hemp and kenaf).

Table 3: **Classification of plant fibres**

Group	*Species*
1. Bast fibres	flax, hemp, jute, kenaf, ramie, rosella
2. Grain hairs	cotton, kapok
3. Grasses and other monocotyledons	bamboo, corn stalks, esparto, papyrus, reeds, straw, sugarcane bagasse
4. Leaf fibres	abaca, aloe, sisal
5. Wood fibre	hardwoods, softwoods

Source: Virta 1986.

World production of non-wood pulp was over 10 million tonnes in 1989. This represented about 7 per cent of the world's pulp production (Maddern & French 1989, p. 433). The average size of pulp mills using non-wood feedstocks is small -- according to Virta (1986, p. 130) their average production capacity in 1984 was 17 700 tonnes.

Most of the mills using non-wood feedstocks are in developing countries. The major reasons for this include a shortage of wood relative to the growing demand for paper (presumably due to rapid population growth and a rising standard of living), the availability of large quantities of fibrous agricultural residues and diminishing forest resources. Lower labour costs make the collection of these residues more economic than in more developed countries.

Non-wood pulps (with the exception of speciality pulps such as flax and cotton linters) have in the past been considered inferior to most hardwood and softwood pulps for paper-making purposes. This appears to be as much the result of the rudimentary pulping processes used as from particular non-wood fibre characteristics. However, advances and refinements in the processes and technology of handling, pulping and paper making have led to an increasing number of pulp and integrated mills based on non-wood fibres in the developed world.

Cotton linters are the only non-wood feedstock currently used for paper making in Australia. These are the fibres which adhere to the cottonseed after ginning. The linters are removed mechanically from the oilseed and are purified by alkaline cooking to remove residual cottonseed oil and agricultural contaminates (Maddern & French 1989, p. 436). Linters have a high cellulose content and a low lignin content -- characteristics that produce a smooth-texture, low-stiffness paper with minimal bleaching. Cotton linters are suited to writing, archival and other durable papers. Practically all Australian supplies of cotton linters are used in the production of writing and printing papers at APPM's Shoalhaven mill. The mill uses a soda pulping process, bleaching the pulp with chlorine and hypochlorite. According to Dr Gartside (CSIRO Division of Forestry and Forest Products) the recovery of chemicals from the spent pulping liquors is not economic due to the small operating scale. Effluent from the pulping and bleaching process is currently discharged into the Shoalhaven River.

Other non-wood feedstocks canvassed by participants include hemp, fractionated sugarcane fibre, bagasse, kenaf and wheat straw.

Dr Katelaris drew the Commission's attention to the long history of hemp in the production of paper. It is still used in France to produce some cigarette papers. Dr Katelaris claimed that the cropping of hemp has several advantages over other non-wood feedstocks and wood. Like linters, hemp fibres are much longer than wood fibres, requiring cutting as a prepulping process. It is common to produce paper by recycling other hemp products -- for example cloth, rope or cordage. Hemp has a high cellulose and low lignin content, producing a strong durable paper suitable for archival purposes, wrapping paper, dense tissues (such as tea-bag), and speciality papers (such as bible, cigarette and carbon papers). The growing of hemp for pulp is not under active consideration in Australia at present.

Fractionated Cane Technology Ltd is studying the use of sugarcane fibre to produce animal feed and cane flour for human consumption. According to the company the fibrous by-product of the process (cane rind and internal fibre) is highly suited to pulping as it is free from pith and undamaged (unlike bagasse fibre produced by conventional sugar mills). It claimed that the tear strength of the pulp made from the fibre is nearly 50 per cent higher than from bagasse. The company has completed about half of a seven-year development program. A fractionated cane mill would compete for cane supplies from established growers.

4.2 Current Australian proposals for non-wood feedstocks

Whereas hemp and fractionated sugarcane were discussed as possible non-wood fibre sources, specific proposals were discussed for bagasse, kenaf and wheat straw.

Bagasse

Bagasse is the residual fibre from the milling of sugarcane. Bagasse is pulped in many countries including South Africa, South America, Cuba, India, Indonesia, China and Taiwan. In 1987, an estimated 93 bagasse pulp mills were operating at output capacities of 30 tonnes per day or more (Atchison 1989).

Bagasse fibres are short and comparable to those of hardwood. According to Maddern & French (1989, p. 435), about 40 per cent of the raw bagasse comprises pith which produces a low strength paper with inferior paper properties. They state that bagasse pulp must be properly depithed to minimise the use of pulping chemicals. Maddern & French claim that properly depithed bagasse pulp is suitable for tissue papers and other papers requiring dense, low porosity sheets. CSR Ltd said that bagasse is currently used overseas to produce paper of various grades, liner and corrugated board.

According to CSR Ltd, the sugar industry produces about 3.5 million tonnes of dry bagasse fibre annually, most of which is burnt to provide the energy required in the sugar mills. Bagasse surplus to the needs of the sugar mill is generally incinerated in the mills, as it is otherwise difficult and costly to dispose of. If a use could be found for the surplus fibre then about 15 per cent (or 525 000 tonnes annually) of bagasse could be available from current mills without substituting other fuel sources.

While the large quantity of bagasse at sugar mills minimises collection and transport costs, the intensive crushing of the cane during sugar extraction in conventional sugar mills damages the fibres. This damage significantly reduces the strength of bagasse paper.

Queensland Bagasse claimed that Australia is essentially the last of the major sugar producing countries which does not exploit its bagasse. The company has proposed a 50 000 tonne pulp mill, costing $150 million, to be sited in northern Queensland. It would produce using a soda pulping process both bleached and unbleached pulp for the export market. Bleaching would involve either chlorine dioxide or a non-chlorine bleaching agent. Though the pulp produced would not have the strength or brightness of equivalent wood pulps, it could be blended with wood pulp in proportions up to 60 per cent, as already done in other parts of the world.

Mackay Sugar Co-operative Association Ltd indicated that for years mills have been trying to find alternative uses for surplus bagasse, ranging from stockfeed to particle board. To date no financially viable project has been developed. It said, however, that it is giving serious consideration to a proposal to enter into a joint venture with an Australian company to manufacture pulp from bagasse. Both the Mackay Co-operative and Queensland Bagasse indicated that government assistance would help the establishment of bagasse pulping.

A 1988-89 proposal by CSR Ltd for a bagasse pulp mill in the Burdekin irrigation area is currently on hold. The proposal is similar to that of Queensland Bagasse. The mill would have a production capacity of 50 000 tonnes of chlorine bleached and unbleached pulp. To provide enough raw material for a pulp mill producing 50 000 air dry tonnes per annum, the bagasse from three or four sugar mills would be required -- such a mill would need to be centrally located near a cluster of existing sugar mills.

CSR Ltd said that, although it was technically viable, the project was on hold because of the absence of domestic markets, international market uncertainty and the environmental problems of chlorine bleaching. It said:

> In the absence of a satisfactory domestic market, [CSR] will continue to monitor the situation, particularly the reaction of pulp prices to new pulp manufacturing capacity expected to come on-stream in 1991-92.

Kenaf

Kenaf is a plant of the hibiscus family that can be grown under irrigated or dryland conditions. The highest yields are obtained in regions of high temperature with ample moisture.

Much work has been done on the prospects of growing kenaf in Australia for the production of pulp. While prospects exist for year-round cropping in suitable areas, this is limited by the sensitivity of kenaf to frosts and seeding (which contaminates the raw feedstock, complicating pulping). Unless year-round cropping ensured reliable feedstock supplies, special storage sheds would be needed to store large quantities of prepared kenaf.

The BRR noted that there are several alternative harvesting and postharvesting treatment processes, with the major point of issue being dry versus green harvesting. The choice of dry or green harvesting depends on the kenaf variety chosen and the local climate.

The bark and core fibres have distinctly different pulping characteristics. According to Maddern & French (1989, p. 436) the long bark fibres (representing 40 per cent of the kenaf stem) produce a pulp that compares favourably to bleached long-fibre wood pulp. Kenaf bark produces a paper that can be used for tea-bag and cigarette tissue. Ankal Pty Ltd claimed that, as a specialty pulp, the bark pulp would sell at a substantial premium to softwood pulp.

Core fibres are short and wide, resulting in a slow draining pulp that produces paper with low tear strength. But the BRR noted that the core pulp provides bulk and smoothness when blended with other pulps.

According to Dr Kirschbaum of the BRR, whole stem kenaf may be pulped with the CTMP process to produce newsprint as the natural proportions of the core and bark fractions are about optimal for newsprint. Whole stem kenaf pulp has been produced commercially in Thailand for newsprint since 1984. It is also pulped in India and the Philippines, while a newsprint mill using whole kenaf is being built in Texas in the United States. No known mill is now operating commercially using the separated bark and core kenaf fibres.

Ankal Pty Ltd has proposed a $200 million, 100 000 tonne per annum kenaf mill in the Murrumbidgee Irrigation Area of NSW. The mill would use continuous soda anthraquinone pulping and non-chlorine bleaching. It would use a patented process to separate the bark and core fibres, which would be pulped separately. Effluent from the pulping process would be treated (the minimum economic pulp mill size for such treatment was indicated to be 100 000 tonnes), and the treated effluent either used to irrigate kenaf or returned to the river system.

Ankal Pty Ltd said that in the Murrumbidgee Irrigation Area it would be managing its own kenaf and that there would be no problems in obtaining water rights for irrigating the kenaf crop. The company has developed and trialled intensive agricultural methods which allow the mechanised harvesting and baling of the air dried kenaf stems. The baled kenaf would be hauled 15-20 kilometres to the mill site.

Ankal Pty Ltd has spent $4 million on its kenaf projects, with production opportunities in the United States and China also being pursued. Ankal's Australian kenaf pulp mill proposal is based on projected export markets. The company claims to have markets for the core pulp in the Asian region. It considered that government support should be provided.

In commenting upon a recent conference held to discuss the possibilities for kenaf in Australia, the CSIRO Division of Tropical Crops and Pastures said that the greatest potential for kenaf is as a low input dryland crop grown in the semi-arid tropics and subtropics. It said that the areas suitable for growing kenaf in northern Australia are presently underutilised.

Since 1987 the Northern Territory Government has been investigating the potential of kenaf as a fibre feedstock for a pulp and paper industry. The immediate objective is to provide an information source to encourage commercial participation in the development of a full-scale feasibility study. Over $1.6 million has been committed to the program to date.

The Government commented that while many of the studies undertaken have potential application elsewhere in Australia, the extensive further research required to support a non-wood fibre pulp/paper industry cannot be regarded as a task for the Northern Territory Government alone. Further, it believed the program qualified for research assistance under the Commonwealth Government's Pulp Mill and Paper Industry Package. It sought Commonwealth funding to support the continuation of its Fibre Crops Program for the further two to three years required.

The Western Australian Department of Agriculture (1988) assessed kenaf as having potential in the Ord River Irrigation Area. However, there are no current proposals for kenaf mills there.

Dr Kirschbaum, in commenting upon the prospects for kenaf in Australia, said:

> There is no doubt that establishment of a kenaf industry is agronomically, technically and economically feasible. Profitability, however, is difficult to assess and becomes a fine decision between the price that must be paid to make it the preferred crop to be grown by farmers versus the need to keep fibre costs below costs of traditional fibre sources. Costs are increased by the need to ensure a reliable supply of kenaf despite unreliable weather regimes and dangers of insect or nematode build-up. Soil deterioration must also be avoided ... The success of any venture in raising the necessary capital will depend on the ability of promoters to convince potential investors that kenaf can be produced at a cost comparable or superior to the costs of producing wood-based pulp.

Wheat straw

Straw is a by-product of the cereal grain industry, with large quantities available annually in Australia. While the yield of straw per hectare is low (averaging around 0.5 tonnes) the straw can be collected at the same time as harvesting. Straw was used as a feedstock at APM's Broadford (Victoria) mill until the early 1980s. APM said that the cost and availability of straw at the mill gate, long processing times and an inability to automate the process made the pulping of straw uneconomic.

Because of the bulk of the raw material, any new mill would need to be located near the fibre source to minimise transport costs. This makes the choice of mill site crucial to a project's viability.

According to the River House Group, wheat straw can be used to produce high-quality chlorine bleached pulps of 84-86 ISO brightness within Commonwealth guidelines for organochlorine emissions. However, these pulps would not meet the 90-92 brightness level required for the Japanese pulp market and the River House Group is not aware of any commercial bleaching process for straw that would meet this brightness requirement. The other major commercial use for wheat straw is for unbleached corrugating medium for cardboard boxes, due to the high strength of wheat fibre.

Two proposals for producing pulp from wheat straw in Australia are current.

The River House Group proposes a mill at Moora in Western Australia to produce 95 000 tonnes per annum of unbleached pulp suitable for corrugating medium. The mill is expected to cost about $50 million. The proposal is subject to an environmental impact assessment currently being undertaken and is at the final feasibility and 'bankable' document stage. River House aims to export the pulp to East Asia and is currently seeking markets. Production could commence in two to three years, with straw collection and stockpiling commencing in the 1990 harvest.

The River House Group intends to use straw which has little or no current value to farmers. Straw can be used as an animal feedstock or as a fertiliser (by being burnt and/or ploughed back). The need to plough back straw depends largely on soil quality, with the ability to do so limited by the slow rate of decomposition (up to four years) and the resulting removal of nitrogen from the soil.

The Group said that it needs 135 000 tonnes of straw per annum within a 100 kilometre radius of the mill and that there are several regions in Australia capable of supplying this quantity, even if there were only a low response from farmers.

A company in which the River House Group has an interest, Arisa Pty Ltd, advanced a similar proposal to produce unbleached straw pulp in the Balaklava region of South Australia. Arisa is working with the River House Group in negotiating sales contracts.

Both mills would be based on technology purchased from SAICA, a Spanish company which produces about 150 000 tonnes per annum of straw pulp at a mill in Spain using a soda anthraquinone pulping process. Arisa claimed that the SAICA pulping process uses lower temperatures and pressures than wood-fibre pulping. This greatly reduces the capital cost of plant as well as energy and water requirements. SAICA's output is used with wastepaper to produce corrugating medium. Other European companies produce straw pulp for writing, printing and banknote papers. The country producing the most straw pulp is China.

Arisa Pty Ltd stated that confidential economic analysis supported the view that the production of unbleached pulp from straw would be competitive with wood-based product.

4.3 Environmental impacts

DASETT considered that alternative feedstocks have considerable potential for environmental protection and more efficient resource use. However, several environmental questions arise with the use of non-wood feedstocks:

- do non-wood pulps require bleaching?
- can bleaching, where required, be non-chlorine?
- does the pulping of non-wood feedstocks have particular environmental consequences?
- what effect would the large-scale, intensive cultivation of non-wood feedstocks have on the environment?
- to what extent can non-wood feedstocks substitute for wood, reducing the demand for pulpwood, particularly native hardwoods?

As noted above, cotton linters (about 25 per cent of the pulp furnish at APPM's Shoalhaven mill) are chlorine bleached. With the possible exception of the bagasse proposals, chlorine bleaching is not being considered with regard to current non-wood feedstock proposals. There are plans to produce unbleached pulp from straw, peroxide bleached pulp from kenaf and bleached pulp from bagasse. At this stage no decision has been taken as to whether bagasse pulp will be chlorine or non-chlorine bleached, but Queensland Bagasse said it has ruled out elemental chlorine as a bleach.

Views about whether the use of non-wood feedstocks is environmentally superior to wood feedstocks conflict. Dr Gartside said that:

> ... in general you have to use the same sort of processes as for wood, so that all the issues of the chemical processes you might use, bleaching, mechanical as against chemical pulping, peroxide bleaching as against bleaching with chlorine and its derivatives ... are the same for non-wood ... To my knowledge there are no advantages for ... non-wood (feedstocks) that will give ... an environmental advantage in the process area.

This view was supported by evidence from the PPMFA, APPM and APM. For example, the PPMFA commented that since the pulping and bleaching processes used for non-wood feedstocks are essentially the same as for wood, their environmental impacts are likely to be similar. Locating non-wood feedstocks pulp mills in inland areas could add to effluent treatment costs compared to mills discharging directly to the ocean.

Some other participants claimed that non-wood feedstocks were easier to pulp than wood feedstocks because of lower lignin contents. Further, they claimed that the soda process, which would be used, is environmentally superior. The River House Group claimed that 'it is chemically and thermally easier to pulp non-wood feedstocks than wood ... the less costly and less polluting soda processes are usually used to produce high-quality non-wood pulps'.

Dr Gartside said that the advantage of the soda anthraquinone process compared with the kraft process is reduced odour (sulphur dioxide is not produced) but at the expense of difficult chemical recovery and inferior pulp yield and pulp quality.

Additional problems arise from the pulping of non-wood feedstocks. For example, APM noted that most non-wood fibres (with the exception of cotton linters and depithed bagasse) have relatively high silica (ash) contents which reduce the efficiency of the chemical recovery from the cooking liquors. According to Atchison (1989, pp. 98-100) improvements in the bagasse pulping process have raised the recovery rate from the 70-80 per cent recovery levels of the 1960s to the 89 per cent level now achieved in modern bagasse mills. These improvements could be applied to the pulping of other non-wood fibres, notably straw and kenaf. Even so, chemical recovery rates with wood pulping are potentially higher -- for instance APPM claims that up to 99 per cent of unused chemicals could be recovered from the spent pulping liquors in wood-based mills.

Installation of effluent treatment facilities as well as improvements in pulping technology have resolved many of the environmental problems previously associated with production from non-wood feedstocks.

With regard to kenaf, the CSIRO Division of Tropical Crops and Pastures commented that only limited information is available to assess the likely environmental impact of a pulp mill. It stated: ‘it is reported that chemical usage is likely to be higher than for a wood pulp mill, but energy requirements are likely to be some 20-30 per cent lower’.

Although use of a waste product, such as wheat straw, cotton linters or bagasse, may be environmentally benign (and in the case of bagasse provide a solution to a disposal problem), any large-scale cultivation of non-wood feedstocks could possibly damage the environment. The CCSERC said that some non-wood feedstocks are ‘a major ecological worry’. DASETT claimed that kenaf holds possibilities for the cropping of ‘degraded’ land currently unavailable for the production of other crops, but Dr Kirschbaum said that Northern Territory soils -- in which kenaf might be grown -- are fragile. Ankal Pty Ltd claimed that kenaf was salt tolerant with deep tap roots that could lower the water table, thereby reducing the problem of soil salinity.

Intensive cultivation usually requires fertilisers, insecticides and pesticides, all of which can cause environmental damage. However from the information available to the Commission it is not clear whether the environmental consequences of the intensive cultivation of non-wood feedstocks would be any more severe than other cropping.

Fractionated Cane Technology Ltd claimed that sugarcane is an environmentally superior source of fibre because it belongs to a class of tropical grasses that are extremely efficient in removing carbon dioxide from the atmosphere. If products made from it are stored for long periods, it can make a very quick contribution to solving greenhouse problems.

Any assessment of environmental effects must ask whether production of pulp from non-wood feedstocks would save trees, save pulp and paper imports, or save wastepaper. Some assessment must also be made of the community’s valuation of wilderness and its perceptions about the environmental value of forests and trees. Only a small proportion of fibre used in Australian paper manufacture comes from eucalpyt pulpwood.

4.4 Prospects for non-wood feedstocks pulp

Worldwide the use of non-wood feedstocks could grow relative to wood (though a proportion of that demand will be for bleached pulp). Reasons include the decline of wood resources, the availability of agricultural residues and the increasing demand for paper.

However, while many non-wood fibres show potential for replacing wood as a source of fibre, the critical factor preventing projects from going ahead in Australia has been the difficulty in establishing domestic and international markets. This section examines some possible reasons for this -- including the relative quality and price of non-wood pulps, pulpwood royalties and the difficulty that non-wood pulps have in breaking into established markets.

Comparing the quality of pulp from non-wood feedstocks with that of wood is difficult due to the lack of any complete standard of comparison. Where non-wood and wood feedstocks are compared it is typically on the basis of the fibre length, with long-fibre non-wood feedstocks roughly equivalent to softwoods and short-fibre non-wood feedstocks roughly equivalent to hardwoods. But paper furnish is usually a blend of long and short fibres as well as inorganic additives chosen along with the pulping process to optimise cost, paper machine performance and particular product characteristics.

Participants' views on the quality of non-wood feedstocks for pulp and paper making varied. The River House Group claimed that European producers of non-wood pulps or papers have market acceptance of their product. Ankal Pty Ltd said that specialty kenaf bark pulp should sell at a substantial premium to softwood pulps, with core pulp selling at a small discount. CSR Ltd considered that bagasse pulp would sell at a 7 per cent discount to hardwood pulp, as there is a market perception that bagasse is an inferior pulp. Queensland Bagasse said that the quality of bagasse pulp is definitely lower than comparable hardwood pulps.

The PPMFA stated that (with the exception of kenaf bark) the paper-making qualities of non-wood pulps are inferior to those of wood. Established Australian pulp and paper companies also hold the view that non-wood pulps are inferior. For instance, APM said that processing and quality limitations made locally available non-wood feedstocks unattractive as raw material for pulp and paper manufacture.

News Ltd, a large user of paper, commented that:

> As of now ... kenaf remains in the potential market as an alternative source. It is a long way from demonstrating capabilities as a commercial product. In fact, one would have to question seriously whether its prospects have not been seriously diminished by the growing emphasis on recycling material obtained from wood virgin sources ... Obviously, we are not talking agricultural issues but the fact that these products must be able to climb the hurdles of quality and cost.

Dr Gartside considered that:

> Non-wood pulps are generally inferior to wood pulps in that they contain contaminating materials such as non fibrous cellular material and high amounts of ash. Both these can give problems in operation [of] the pulp and paper plants, lead to higher production costs and can result in inferior paper quality.

Because the non-wood feedstocks currently being considered have few perceived quality advantages over wood, such pulps could have difficulty breaking into the domestic market. Even a price discount relative to wood pulps may not be sufficient to establish a market.

Each of the main Australian pulp and paper producers currently obtains a significant proportion of its pulping timber from State-owned forests, either native hardwood or Pinus radiata softwood. Several participants alleged that the prices being charged by the various States for pulpwood are low. If this were the case, the attractiveness of non-wood feedstocks for pulp making would be artificially reduced. However, other participants considered that the apparent low price of pulpwood reflected its nature as a waste product.

According to the Australian Bureau of Agricultural and Rural Economics (ABARE 1990), the supply of pulp logs in Australia is likely to continue to be surplus to domestic requirements. The Forestry Commission of NSW said that there is a surplus of pulpwood material and that ‘there is an immediate need to sell all of this material, wherever possible, even if this involves export until domestic industry is established’. Any such ‘surplus’ is likely to have a depressing effect on pulpwood prices, at least in the short term.

Whether pulpwood prices are too low, or too high, is difficult to determine as the issue of the pricing of forest resources is far from simple, particularly as there are relatively few sellers and buyers of pulpwood. Some relevant questions are:

- whether a forest is logged primarily for sawlogs, veneers or pulpwood;
- whether forestry infrastructure such as road and fire prevention services is provided by the State or by wood purchasers;
- whether pulpwood is regarded as a joint product with sawlogs, or a waste product;
- whether sawlogs and pulpwood should be distinguished on economic or physical criteria; and
- how recreation and wilderness attributes should be valued.

Pulpwood prices have been generally set on the basis of negotiations between States and individual companies. Often they have been one-buyer one-seller transactions. Sometimes prices have been fixed in advance for long periods with no provision for review. Recently prices tend to have been set by States on a cost-plus basis. Prices can also vary depending upon pulpwood availability.

The issue of pulpwood pricing is discussed in the Commission's interim report on paper recycling, where it is concluded that there is some evidence of underpricing.

The pulp and paper industry in Australia is dominated by several large vertically-integrated companies. In the past, each company has tended to have its own market area. Many, but not all, have extensive interests in their own forests and in other wood products such as sawn timber, plywood and particle board. For instance APM, the largest Australian paper manufacturer, is also Australia's largest private forest owner. Most companies also extend their operations downstream. Both APPM and APM have interests in companies which wholesale writing and printing papers; Amcor Ltd, which owns APM, and the Pratt Group produce containers and cartons; Bowater and KCA convert jumbo rolls of tissues into consumer products.

Some participants considered that the market concentration and vertical integration in the Australian pulp and paper industry would disadvantage potential entrants seeking to sell pulp or paper made from non-wood feedstocks. Further, the existing structure of the industry was said to give established companies the incentive to continue to pulp wood and ignore the potential of non-wood feedstocks.

However, the structure of the Australian industry has become more open in recent years and scope for monopoly behaviour is less than it once was. Except for newsprint, there are at least two Australian competitors in each area of the market. Bowater and KCA compete in the tissues market (together with some smaller companies); APPM, APM and ANM make various types of printing and writing papers; and APM and the Pratt Group compete in a range of wrapping and packaging papers. Although tariffs of up to 15 per cent currently apply to paper -- pulp and newsprint imports are free of duty -- domestic producers compete with imports in most areas of the Australian market.

For newsprint, there is only one Australian producer. Several factors limit the scope for other companies to produce newsprint in Australia, either from wood or non-wood feedstocks: ANM is 50 per cent owned by Australia's largest newspaper publishers, News Ltd; the other main Australian publisher also has long term supply contracts with ANM; and a high proportion of imports are from the New Zealand newsprint-producing subsidiary of the other part owner of ANM, Fletcher Challenge of New Zealand.

As well as meeting the capital costs of establishing pulp and paper mills, new entrants would face the extra cost of establishing their own distribution and sales networks. Further, there appears little prospect that existing pulp and paper producers would wish to use non-wood feedstocks. Reasons include:

- to the extent that industry and State forestry commissions regard pulpwood as a by-product of sawlog production, pulpwood will continue to be cheaply available;
- some of the established pulp and paper companies are also owners of forests;
- established mills are generally located in regions remote from sources of non-wood fibres, with high transport costs the result; and
- existing plant is designed for wood as a feedstock. As APM said: `heavy investment in plant and equipment has been optimised for the handling and processing of wood and hence there would be a considerable economic penalty associated with the use of non-wood materials which process differently'.

The River House Group said: `the Australian market for [our] pulp is highly concentrated ... which makes it strategically difficult to negotiate a reasonable sales contract, particularly prior to beginning production'. Queensland Bagasse said that because markets are not readily available in Australia its bagasse project is based entirely on export markets.

In commenting upon the outcome of a recent conference into the possible use of kenaf in Australia, Dr Kirschbaum stated that:

> ... as a new product kenaf faces ... a number of quite severe cost penalties and in fact it would have to be substantially more economical than using wood fibre before the industry were to take it up... it was made quite clear by industry representatives ... that the significant vertical integration of the pulp and paper industry in Australia means that it is exceedingly difficult for a new product to break [in] ... kenaf would have to offer substantial advantages, either in product quality which it cannot really do, or price.

Breaking into the Australian market would be difficult. The established pulp and paper companies have little incentive to produce or purchase non-wood pulp. Further, the international market for non-wood feedstocks pulp is small and subject to large price fluctuations. This adds to project risk. Market prospects are also constrained by the new wood pulp manufacturing capacity to come on-stream and the increase in the use of wastepaper as a feedstock.

These issues, in turn, raise the question of whether pulp from non-wood feedstocks can be economically produced at the prices necessary to win markets in Australia or overseas. DASETT noted that transition costs would be involved in moving to non-wood feedstocks, but concluded that ‘consumers may be prepared to accept modest cost increases’.

Several components of the costs of pulping non-wood feedstocks may be higher than those for wood. For example, annual crops incur the cost of storage, while transport costs (to the mill) are higher due to the low density of non-wood materials. The high silica (ash) contents of some non-wood feedstocks can clog mill evaporators and boilers, making the recovery of pulping chemicals more difficult.

New projects also face the high infrastructure costs commonly associated with green field proposals, particularly if the mill site is geographically isolated from the existing pulp and paper industry (for example, kenaf in the Northern Territory and bagasse in Northern Queensland).

With the possible exception of pulpwood pricing, none of the evidence available to the Commission suggests that there are any specific government policies or regulations which adversely affect proposals for non-wood feedstocks. Nor are there grounds to provide government assistance specifically to promote pulping of non-wood feedstocks in Australia, as was requested by some participants. Of course, the promoters of non-wood feedstocks could be eligible for generally available government assistance for research and export market development.

The issue of appropriate pulpwood pricing is under consideration by the Resource Assessment Commission. The question of whether product pricing properly reflects environmental costs is considered in Chapter 5.

5 GOVERNMENTS AND POLLUTION CONTROL

Like many activities, pulp and paper mills generate pollution. In particular, with the technology presently used in Australia, chlorine bleaching releases organochlorines into the environment. The costs of this pollution are borne by the community through risks to health, reductions in social amenity, and the like.

Pressure from conservation groups, and growing environmental awareness in recent years, has alerted governments and the community generally to these wider social costs. Furthermore, it has led to calls for the costs of pollution to be taken into account when weighing up the costs and benefits of particular activities. For example, DASETT stated that:

> As Australia moves to environmentally sustainable development, the environmental impacts of an industry from 'cradle to grave' must become an integral part of the assessment of costs and benefits of industry and of the risks associated with it. It is equally essential that it is the full costs of current practices, environmental and economic, that are used when comparing the feasibility of alternative practices and resource uses.

Individual companies have responded to these community concerns, recognising the possible marketing advantages of improved effluent treatment, and many improvements have been made. Nevertheless, in the absence of government intervention, mills would be likely to discharge more pollution than society is prepared to accept, as the commercial incentives for them to minimise pollution are not sufficiently strong.

State Governments aim to limit organochlorine discharges through pollution control measures. They also have formal assessment procedures for proposed developments with potential environmental impacts. The Commonwealth Government has formulated minimum standards for new BEK mills.

Participants expressed divergent views regarding these environmental safeguards and the ways in which governments should intervene to protect the environment.

Some considered that chlorine bleaching should be prohibited, some considered that pollution should be taxed, while some considered that safe environmental standards can be established.

Particular aspects of government control of pollution from chlorine bleaching are discussed below. They are:

- the extent to which producers of chlorine bleached pulp and paper should pay for the costs of the pollution they create;
- whether standards should be set on a mill-by-mill, a regional or a whole-country basis;
- standards for existing mills;
- what form government controls should take; and
- coordination and predictability of government policy.

These issues are considered in terms of how they can contribute to the protection of the environment, while at the same time enhancing economic outcomes.

5.1 Setting and implementing environmental standards

Environmental standards need to be set, whatever the method of implementing environmental policy. But there are special difficulties in applying environmental standards, or a `polluter pays' principle, to chlorine bleaching. The main one is that the environmental costs of the process are not adequately established.

Evidence points to adverse environmental effects, and some of the discharges from pulp mills are known to be toxic and cumulative. However, the acute and chronic effects of organochlorine discharges are not fully understood or quantified. Indeed, the effects of the effluents of BEK mills are largely unknown. Further, it is difficult to quantify the levels of discharge of particular types of organochlorines from pulp mills, and the best method of measurement is in scientific dispute.

As toxic chemicals are involved, government action to control chlorine bleaching pollution is certainly justified. But establishing appropriate environmental standards is difficult. If standards are too lax, excessive environmental damage will occur. If standards are too stringent, excessive costs will be borne by producers and Australia will be disadvantaged relative to overseas competitors.

Banning chlorine bleaching altogether, if only in new mills, is not likely to be the answer. Apart from the lost opportunities this would impose on producers and consumers, alternatives to chemical pulping/chlorine bleaching of wood can themselves cause environmental damage. Examples include: the largely unknown environmental costs of producing and pulping non-wood feedstocks; hydrogen peroxide bleaching which can add inorganic salts to inland rivers; mechanical pulping processes for which sophisticated effluent treatment is uneconomic; and the generation of electricity for mechanical pulping which can add to greenhouse gases.

Thus, the setting of environmental standards for chlorine bleaching must involve an element of judgment, having regard to current knowledge about the environmental and economic costs and benefits of both chlorine bleaching and its alternatives. At present, the lack of knowledge about the effects of organochlorines and other discharges adds to the degree of uncertainty in making these judgments. However, as research into the effects of chlorine bleaching progresses, and as technology for monitoring organochlorine discharges improves, the uncertainty in coming to judgments about environmental standards will diminish.

There is some danger that environmental regulation will concentrate upon the discharge of organochlorines from new pulp mills to the exclusion of the wider environmental picture. Organochlorine discharge from pulp mills, both new and old, can cause environmental damage. However, although their discharge can be significant in particular locations, pulp mills account for a very small proportion of total organochlorines in the environment. Some organochlorines occur naturally, and some are formed by other industrial and domestic processes.

If the goal is to minimise total organochlorine levels in the environment or reduce them to an acceptable level, standards need to be set for all forms of organochlorine polluting activity, not just for new pulp mills. Indeed, the technology of new mills is much less polluting than that of older mills which chlorine bleach and of many other industrial and domestic activities.

Standards should not necessarily be uniform between all mills, all activities or all regions. What can be responsibly allowed depends importantly upon the geographic features of a particular site or region. For example, discharging organochlorines into an inland river or lake can be much more damaging than discharging into a fast-flowing ocean current. If damage from pollution differs between sites or regions, a case can be made for varying the required standards. Nevertheless, because of the toxicity of some organochlorines it is likely that standards would be required for all sites and regions.

There is no reason why consistent standards should not be applied to all activity, including older pulp mills. Some of those mills may already meet adequate standards, whereas reasonable time would have to be given for other mills to adapt to the new standards.

5.2 Policy approaches to environmental objectives

Various approaches can be taken to achieve whatever environmental standards governments decide should apply to chlorine bleaching. While each can achieve the same environmental objectives, they may have different impacts on the efficiency of economic activities. The approaches include the establishment of tradeable pollution 'rights' (an approach to environmental control under much discussion in the literature, and which is sometimes applied in West Germany and the United States), pollution taxes and direct controls. They could operate singly or in conjunction.

Another approach, not discussed in this report, involves governments favouring unbleached and non-chlorine bleached pulps and papers through measures such as government procurement, or customs and sales tax concessions. Some of the relevant issues are discussed in the Commission's interim report on paper recycling.

Each of the approaches discussed below would involve regulators developing clear environmental objectives and standards. Monitoring of performance would be required under each approach. Where a particular process is thought likely to cause long term environmental damage through pollution, it is reasonable to expect that the industry responsible should bear at least some of the costs involved in monitoring its level, and in researching the nature and extent of any damage.

Tradeable rights

With tradeable pollution rights, the government would allocate rights among producers to contribute to pollution. They could be assigned in various ways, for instance in accordance with existing pollution levels, or through auction. The rights could be traded between existing producers, to new producers or, indeed, to community and environmental groups. Tradeable rights may be most appropriate where several producers in a region create similar types of pollution.

The advantage of such rights is the flexibility, and consequent cost reductions, they allow producers in ensuring that government standards are met, and the opportunities they create for reducing pollution levels. For example, a producer with older more polluting technology may clean up its processes and sell its surplus rights to pollute to a producer seeking to enter the industry with more modern less polluting technology. Purchase by a non-producer, eg a community group, provides a means of tightening environmental standards. Prices would be determined solely between buyers and sellers.

Pollution taxes

Pollution taxes also allow greater flexibility to industry than direct controls, and provide a tax-based incentive to reduce pollution. The rates could be structured to penalise pollution where it counts most. Like tradeable rights, pollution taxes applied to the pulp and paper industry would possibly need to be site or region specific. The tax structure could even be made progressive to impose heavier penalty rates as pollution increases. The process is akin to waste treatment authorities varying their fees according to the degree of contamination of the effluents which they take in for treatment.

Direct controls

Direct controls and regulations are at present the most widespread form of government intervention for pollution control. Typically, they establish allowable levels of pollution, or regulate the use of production processes that create pollution. The ultimate direct control is outright banning of the polluting process. Even if direct controls vary between regions according to the potential seriousness of pollution, they typically allow little flexibility to suit the particular circumstances of individual producers, and give no incentive to producers to meet more than the minimum standard. Self-regulation by industry of the environmental standards might not be fully effective, and it is likely that direct controls would require policing by the authorities to ensure that standards are met.

However, where pollutants are toxic and cumulative in the environment, the apparent certainty achieved by direct controls may increase their attractiveness relative to tradeable rights or pollution taxes.

5.3 Coordination and predictability of policy

As noted above, appropriate standards might differ between sites or regions depending upon their geographic characteristics. Even so, the existing fragmentation of responsibility for environmental matters between the Commonwealth Government and State Governments could be a problem in applying any of the approaches discussed above. Unless standards are reasonably consistent and policy is coordinated, there is a danger that less than adequate regard will be accorded the environmental impacts of pulping and bleaching.

Standards evolve and are progressively refined as additional information comes to hand about the environmental impacts of pollution, and as new technology for minimising those impacts becomes available. Thus it may not be possible to accord the certainty of standards which industry seeks when assessing investment proposals. Nevertheless, it is important that government actions in the environmental area are not subject to arbitrary change.

A ORGANISATIONS COMPANIES AND INDIVIDUALS CONSULTED

Name	*Date*	*Venue*
Associated Pulp and Paper Mills	6 February	Melbourne
Australian Conservation Foundation and other conservation groups	9 February	Perth
Australian Newsprint Mills Ltd	23 January	Hobart
Australian Paper Manufacturers	7 February	Melbourne
Bowater Tissue Ltd	24 January	Melbourne
Dr Bob Brown, MHA Tasmania	23 January	Hobart
Bunnings Ltd	9 February	Perth
Commonwealth Department of Administrative Services	17 January	Canberra
CSIRO	24 January	Melbourne
Ecopaper Pty Ltd	14 February	Sydney
Forestry Commission of New South Wales	22 January	Sydney
Forestry Commission of Tasmania	23 January	Hobart
Fractionated Cane Technology Ltd	5 February	Brisbane
J. Gadsden Pty Ltd	6 February	Melbourne
Golden Australia Paper Manufacturers Pty Ltd	9 February	Perth
Kimberly-Clark Australia Pty Ltd	22 January	Sydney
Leighton Holdings Ltd	3 May	Canberra

Name	*Date*	*Venue*
Moore Business Systems Australia Ltd	6 February	Melbourne
News Ltd	22 January	Sydney
New South Wales Department of State Development	14 February	Sydney
Philip Morris Ltd	6 February	Melbourne
Queensland Cane Growers Council	5 February	Brisbane
Queensland Department of Environment and Conservation	5 February	Brisbane
Queensland Department of Manufturing and Commerce	5 February	Brisbane
River House Group	9 February	Perth
Spicers Paper Ltd	7 February	Melbourne
Western Australian Department of Resources Development	30 January	Canberra
Western Australian Environmental Protection Agency	9 February	Perth
Western Australian Office of the Cabinet	8 February	Perth
Wilderness Society	7 February	Melbourne
Woolworths Ltd	14 February	Sydney

B SUBMISSIONS

This appendix lists only those submissions which focused on matters considered relevant to this inquiry. Submissions which focused on recycling are listed in the interim report on paper recycling.

Organisation	*Submission number*	*Hearing venue*
Ankal Pty Ltd	168, 223	Sydney
Arisa Ltd	23	Adelaide
Associated Liquidpaperboard Converters	97	Melbourne
Associated Pulp and Paper Mills	158, 221	Sydney
Australian Conservation Foundation (Brisbane)	88	Brisbane
Australian Consumers Association	145	Sydney
Australian Newsprint Mills Ltd	90, 218, 224	Hobart Melbourne Sydney
Australian Paper Manufacturers	157, 222	Sydney
Bathurst Conservation Group	136	-
Bowater Tissue Ltd	93	Melbourne
Bureau of Rural Resources	147	Sydney
Centre for Human Aspects of Science and Technology	121	Sydney
Conservation Council of the South-East Region and Canberra (Inc.)	58	Canberra

Organisation	*Submission number*	*Hearing venue*
CSIRO Division of Forestry and Forest Products	83, 107	Melbourne Sydney
CSIRO Division of Tropical Crops and Pastures	182	-
CSR Ltd - Mills Group	14	Brisbane
Department of Administrative Services	61	Canberra
Department of the Arts, Sport, the Environment, Tourism and Territories	242	-
Ecopaper Pty Ltd	106	Sydney
Forestry Commission of New South Wales	155	Sydney
Fractionated Cane Technology Ltd	124	Brisbane
Friends of the Earth (Fitzroy)	73	Melbourne
Friends of the Earth (Melbourne)	101	Melbourne
Friends of the Earth (Sydney)	103	Sydney
Friends of the Earth (Sydney) and the Nature Conservation Council of NSW	191	Sydney
Dr Andrew Katelaris	114	Sydney
Kempsey Shire Council	13	-
Kimberly-Clark Australia Pty Ltd	170, 220	Sydney
Leighton Holdings Ltd	226	-
Mackay Sugar Co-operative Association Ltd	133	-
National Association of Forest Industries	237	-
National Paper Marketing Council of Australia	132	Sydney

Organisation	*Submission number*	*Hearing venue*
News Ltd	32, 171	Perth Adelaide Hobart Melbourne Brisbane Sydney
New South Wales Department of State Development	244	-
Northern Territory Government	166	Sydney
People Against Dioxins in Sanitary Products	156	Sydney
Printing and Allied Trades Employers Federation of Australia	165	Sydney
Pulp and Paper Manufacturers Federation of Australia	95, 219	Melbourne
Queensland Bagasse	45	Perth
River House Group	20	Perth
Stationery Manufacturers of Australia	138	Sydney
Western Australian Government	228	-

C PULPING PROCESSES

The production of pulp involves the breaking down of vegetable material by either mechanical or chemical means, or by a combination of both. Table C1 shows that a variety of pulping processes are used in Australia. The table also presents information about the location and capacities of pulp and paper mills, fibre feedstocks used and the type of bleaching undertaken.

C1 Chemical pulping

Chemical pulping breaks down the fibre source by dissolving most of the lignin. In this process, the woodchips are mixed with strong acids or alkalis, with or without pressure and heat. Various chemicals and processes can be used to produce different types of chemical pulp, for example, kraft, soda anthraquinone, and sulphite pulp.

Kraft pulping

Kraft pulp, sometimes referred to as sulphate pulp, is made by cooking woodchips under pressure with a hot alkaline chemical solution. Under these conditions the woodchips break down into cellulose fibres in a 'black liquor' consisting of dissolved wood substances and cooking chemicals. Much of the lignin is dissolved. The fibres are separated from the 'black liquor' by washing. The 'black liquor' is then concentrated and burnt in a furnace. This allows the cooking chemicals to be recovered for recycling and produces energy to drive the pulp mill.

The kraft process can be modified at various stages. For example, extended delignification or modified continuous cooking removes a greater proportion of lignin than conventional pulping, with consequent reductions in the amount of chlorine required if bleaching subsequently takes place. This and other modifications are considered in Appendix D.

Soda anthraquinone pulping

The soda anthraquinone pulping process is similar to the kraft process. However, sulphur chemicals are not used. Instead the pulping chemicals are caustic soda and soda anthraquinone.

Sulphite pulping

There are various kinds of sulphite processes. These are generally acidic and mainly use bisulphites of sodium, calcium or magnesium.

For most sulphite processes, recovery of cooking chemicals from spent liquors is more difficult than for the kraft and soda processes.

C2 Mechanical pulping

Mechanical pulping separates the fibres by abrasive action, usually by passing woodchips between rotating metal discs (refiner groundwood). Other mechanical processes include stone groundwood and pressurised groundwood. Thermo-mechanical pulping involves the softening of lignin by heating prior to mechanical processing. Chemi-mechanical pulping involves a chemical pre-treatment to soften the woodchips (for example, with sodium sulphite) before mechanically pulping. The chemi-thermo-mechanical pulping process is similar to the chemi-mechanical process except that the chemically treated woodchips are mechanically pulped at high temperatures.

Because lignin is retained in mechanical pulps, these processes result in a higher pulp yield from pulpwood than do chemical processes. However, mechanical pulping requires a greater input of external energy per tonne of pulp produced.

C3 Semi-chemical pulping

Semi-chemical pulping combines both chemical and mechanical methods. Compared with chemi-mechanical pulping, semi-chemical pulping makes greater use of chemical processes. It consists of chemically treating the wood prior to mechanical processing. Chemicals such as caustic soda or alkaline sulphite liquor act to partially delignify and break down the lignin bonding in the woodchips.

Semi-chemical pulping processes include neutral sulphite semi-chemical and cold soda pulping.

In neutral sulphite semi-chemical pulping, woodchips are briefly cooked with sodium sulphite and bicarbonate or carbonate until about half of the lignin is dissolved. Then the fibres are further separated by mechanical refining.

Cold soda pulps are made by pre-treating woodchips with sodium hydroxide at ambient temperatures before mechanical processing.

Table C1: **Pulp and paper mills in Australia**

Firm	*Mill Location*	*Facility (tonnes per annum)*	*Pulp type* [a]	*Fibre feedstock*	*Bleaching process*	*Major products*
ANM	Boyer (Tas)	Integrated mill. Ground-wood, CCS, thermo-mechanical pulping. Pulping capacity is about 290 000 tpa. Two paper machines. Paper-making capacity is 224 000 tpa.[d]	Purchased kraft	-	Chlorine bleaching. [b]	Newsprint, directory, offset.
			CCS [c]	Eucalypt	Chlorine bleaching.	
			Thermo-mechanical	Pine	Non-chlorine bleaching.	
			Ground wood	Eucalypt	Non-chlorine bleaching.	
	Albury (NSW)	Integrated mill.Thermo-mechanical pulping. Pulping capacity is about 185 000 tpa. One paper Machine. Paper-making Capacity is 200 000 tpa. [f]	Thermo-mechanical	Pine	Not bleached.[e]	Newsprint.

continued

Table C1: **Continued**

Firm	*Mill location*	*Facility (tonnes per annum)*	*Pulp type* [a]	*Fibre feedstock*	*Bleaching process*	*Major products*
APM	Maryvlae (Vic)	Integrated mill. 250 000 tap kraft pulp mill and 100 000 tpa NSSC pulp mill. Four paper Machines. Paper-making Capacity is 260 000 tpa.	Kraft	Eucalypt	Some is chlorine bleached. Some is not bleached.	Wrapping and packaging papers.
			NSSC	Eucalypt	Not bleached.	
			Kraft	Pine	Not bleached.	
	Fairfield (Vic)	Paper mill. Three Machines. Paper-making Capacity is 150 000 tpa.	-	Waste-paper	Not bleached.	Wrapping and packaging papers
	Botany (NSW)	Paper mill. One of two Machines operating. Capacity is 170 000 tpa.	-	Waste-paper	Not bleached.	Wrapping and packaging papers
	Petrie (Qld)	Integrated mill. 29 000 tpa chemi-mechanical pulp mill. One paper Machine. Paper-making capacity is 100 000 tpa.	Chemi-mechanical	Pine	Not bleached.	Wrapping and packaging papers

continued

Table C1: **Continued**

Firm	*Mill location*	*Facility (tonnes per annum)*	*Pulp type* [a]	*Fibre feedstock*	*Bleaching process*	*Major products*
APM	Port huon (Tas)	NSSC pulping capacity is 94 000 tpa.	NSSC	Eucalypt	Not bleached.	NSSC pulp.
	Spearwood (WA)	Paper mill, 40 000 tpa.	-	Waste-paper	Not bleached.	Wrapping and packaging papers.
	Broadford (Vic)	Paper mill, 40 000 tpa.	-	Waste-paper	Not bleached.	Wrapping and packaging papers.
	Millicent (SA)	21 000tpa mechanical pulp mill. Paper machine closed.	Mechanical	Pine	Not bleached.	Mechanical pulp.
APPM	Burnie (Tas)	Integrated mill. 85 000 tpa soda anthraquinone pulp mill and 10 000 tpa semi-chemical pulp mill. Four paper machines. Paper-making capacity is 160 000 tpa.	Soda anthra-quinone Semi-chemcial	Eucalypt/ pine blend Eucalypt	Chlorine bleaching. Chlorine bleaching.	Uncoasted wood-free papers, base papers, coated wood-free base papers and boards.

continued

Table C1: **Continued**

Firm	*Mill location*	*Facility (tonnes per annum)*	*Pulp type* [a]	*Fibre feedstock*	*Bleaching process*	*Major products*
APPM	Wesley Vale (Tas)	Integrated mill. 36 000 tpa cold soda pulp mill, 7 000 tpa groundwood pulp mill. One Paper machine. Paper-making capacity is 70 000 tpa. Coating capacity 42 000 tpa.	Groundwood	Pine	Non-chlorine bleaching.	Uncoated mechanical papers, telephone directory, coated mechanical and wood-free papers.
			Cold soda	Eucalypt	Chlorine bleaching. [g]	
	Shoalhaven (NSW)	Paper mill with three paper machines. Paper-making capacity is 70 000 tpa. [i]		Waste-paper	Chlorine bleaching. [h]	Uncoated wood-free papers and borads.
			Soda	Cotton linters	Chlorine bleaching.	
Austissue	Canning Vale (WA)	Paper-making capacity 6 000 tpa.		Waste-paper		Tissue paper.
Bowater	Myrtleford (Vic)	40 000 tpa mechanical pulp mill [j] .	Refinder mechanical	Pine	Non-chlorine bleaching	Mechanical pulp.

continued

Table C1: **Continued**

Firm	*Mill location*	*Facility (tonnes per annum)*	*Pulp type* [a]	*Fibre feedstock*	*Bleaching process*	*Major products*
The Patt Group	Warwick Farm (NSW)	One plant adjoining corrugating facilities.	-	Waste-paper	Not bleached.	Packaging papers.
	Smithfield (NSW)	Two plants adjoining corrugating facilities.	-	Waste-paper	Not bleached.	Packaging papers.
	Coolaroo (Vic)	Two plants adjoining corrugating facilities.	-	Waste-paper	Not bleached.	Packaging papers.

[a] Unless otherwise stated, the pulp is produced at the mill site. Some of these mills use pulps purchased from other mills or imported. [b] Chlorine bleaching is defined as bleaching with elemental chlorine and/or chlorine based compounds. See Chapter 2. [c] CCS is a cold soda pulp. [d] ANM is investigating the installation of a recycling facility at Boyer that processes 65 000 tpa of wastepaper. [e] in addition tot he de-inking facility, ANM is considering installing a hydrogen peroxide bleaching plant. [f] ANM is proposing to install a de-inking facility at Albury that will use 90 000 tpa of waste newsprint and 40 000 tpa of waste magazines. Some of the recycled fibre will then be combined with the TMP in the manufacture of newsprint. Hydrogen peroxide treatment is an integral part of the de-inking process. [g] APPM at Wesley Vale is currently examining the technical and ecoomic feasibility of bleaching its cold soda pulp with hydrogen peroxide only. [h] APPM is considering alternative non-chlorine bleachingm ehtods. [i] APPM is reviewing cotton linterspulping and bleaching at Choalhaven. [j] Bowater is intending altervative non-chlorine bleaching methods. APPM is a blend of pine and eucalypt. This will be bleached with hydrogen peroxide. [k] Bowater is increasing paper-making capacity at Box Hill to 105 000 tpa from late 1990. [l] KCA intends to bleach its bisulphite stock at Millicent with hydrogen peroxide in 1990. [m] The Pratt Group is proosing to make unbleached recycled newsprint in Victoria or New South Wales. This would require the construction of a de-inking plant. It is also proposing to make ‘white; unbleached board from recycled paper.

Sources: Submission and information supplied by participants.

D REDUCING THE ENVIRONMENTAL IMPACTS OF CHLORINE BLEACHING

Pulp mills undertake measures that reduce the formation of organochlorines, organic material, heavy metals, suspended solids, and other potential pollutants in their bleaching wastes.

This appendix focuses on measures which mitigate the formation of organochlorines, including dioxins, which are associated with chlorine bleaching. These measures involve modifications to pulping and chlorine bleaching processes or involve treatment of pulp mill wastes. APM, for example, said that ‘the amount of organically bound chlorine wastes emanating specifically from chlorine bleaching processes can be reduced to environmentally safe levels by strict process controls and waste water treatments’. However, the PPMFA said total elimination of these compounds is ‘not yet in sight’ as there is no technology presently available which is capable of producing pulps ‘at today’s required quality levels’ without the use of chlorine compounds.

D1 Abating organochlorine pollution through process modification

Modifications to pulping and chlorine bleaching processes that reduce the formation of organochlorines in pulp mill wastes generally involve a reduction in the use of elemental chlorine. APM said that high amounts of elemental chlorine have been associated with unacceptable levels of organochlorine by-products, particularly dioxins. It said that processes that do not use elemental chlorine but use bleaching chemicals such as chlorine-based compounds, oxygen, and peroxide, yield environmentally insignificant amounts of organochlorines and reduce dioxins to background levels. However, ‘processes using low levels of elemental chlorine have similar environmentally acceptable results’.

Reductions in elemental chlorine usage can be achieved by minimising the lignin content of the pulp prior to bleaching with elemental chlorine. The less residual lignin there is after the pulping process, the less elemental chlorine is needed to degrade and remove it. The lignin content of unbleached pulp can be reduced by extended delignification, by oxygen bleaching, and by improved washing. Reductions in elemental chlorine can also be achieved by partial replacement with chlorine dioxide, by using oxygen and peroxide during the extraction stage, or by bleaching entirely with hydrogen peroxide. These methods are discussed below.

Extended delignification

Extending delignification or cooking during the pulping of woodchips can reduce the amount of elemental chlorine used in subsequent bleaching without seriously reducing yield. The CSIRO referred to research in Sweden and Canada on this technology, but there is no information available about the use of extended delignification technology with mature eucalypt wood (CSIRO 1989, p. 9).

Efficient washing of pulp

Thorough washing during the pulping process can reduce the lignin content of the pulp before bleaching with elemental chlorine. The CSIRO said that if the pulp entering the chlorine bleaching stage contains dissolved lignin in the water associated with it because of inefficient washing, then this dissolved lignin will be chlorinated and will contribute to the chlorinated organic material in the effluent (CSIRO 1989, p. 10).

Oxygen bleaching

Oxygen bleaching prior to bleaching with elemental chlorine can reduce the amount of residual lignin in the pulp and so less elemental chlorine is required. The CSIRO said that oxygen bleaching removes about half of the residual lignin in the pulp without seriously damaging the fibres. It said that the effluent from the oxygen bleaching stage does not contain chlorine and can, therefore, be added to the chemical recovery system without adding to the effluent from the pulp mill (CSIRO 1989, p. 10).

There is research into methods of removing greater amounts of the residual lignin in the pulp during the oxygen bleaching stage. These methods, which include the prenox process and acidic pretreatment, aim to make the lignin in the pulp more reactive to oxygen.

The prenox process involves the treatment of pulp with nitrogen oxides prior to oxygen bleaching. The effluent from the pretreatment stage contains sodium nitrate and nitrogenous organic compounds which form oxides of nitrogen when added to the recovery furnace (CSIRO 1989, p.ÿ12).

Acidic pretreatment involves the treatment of pulp with a small amount of elemental chlorine and acidic peroxide or sulphuric acid prior to oxygen bleaching. CSIRO noted some technical difficulties with this procedure (CSIRO 1989, p. 12).

Some participants provided comments on oxygen bleaching. The PPMFA said that in alkaline conditions the oxygen attacks cellulose as well as degrading lignin. This can be rectified by adding magnesium compounds. However, the PPMFA said that it is not usually possible to remove more than half of the residual lignin with oxygen. The PPMFA said that because the oxygen gives only a limited bleaching effect, its use must be followed by a chlorine bleaching sequence.

APM said that oxygen bleaching or delignification reduces lignin levels by 40 to 50 per cent prior to bleaching with elemental chlorine. The resulting organic and inorganic material dissolved from the pulp could be contained in the kraft recovery cycle rather than be discharged into the receiving environment. However, APM said that for its bleached eucalypt kraft pulp needs, there are `limited environmental benefits' in the form of reduced levels of AOX to be gained from using oxygen delignification prior to bleaching with elemental chlorine compared to the costs involved.

The CCSERC referred to a study (Keys 1989, p. 16) which said that oxygen delignification can also reduce the quantity of lignin and related organic material left in the pulp after kraft pulping by about 50 per cent. This results in a reduction of chlorinated organic compounds generated in subsequent chlorine bleaching processes by about 40 per cent and bleach plant discharges by about 50 per cent. The Council quoted a study which said that oxygen delignification reduces acute toxicity by 50 per cent (Bonsor, McCubbin & Sprague 1988, p. 52).

Chlorine dioxide substitution for elemental chlorine

Substitution of chlorine dioxide for elemental chlorine can reduce the formation of chlorinated organics in the effluent. The CSIRO said, however, that complete replacement of elemental chlorine with chlorine dioxide is not practical (CSIRO 1989, p 11).

Chlorine dioxide in bleaching leads to the formation of sodium chlorate in the pulp mill effluent. The CSIRO cited studies which report that chlorate in the effluent from pulp mills producing bleached kraft pulp is toxic to certain seaweeds. The release of this effluent has caused ‘severe habitat destruction’ in the Baltic Sea (CSIRO 1989, p. 19). Some of these problems can be solved through effluent treatment. In addition to effluent treatment, the use of relatively small quantities of oxygen in the extraction stage can reduce the consumption of chlorine dioxide in later bleaching stages (Keys 1989, p. 14).

CHAST indicated that whereas the substitution of elemental chlorine by chlorine dioxide would decrease the formation of organochlorines, it would not eliminate them. It said that chlorine dioxide is a toxic and explosive gas requiring large amounts of energy to produce (CHAST 1989a, pp. 4-6). CHAST said that chlorine dioxide can also generate sodium chlorate in the effluent. Sodium chlorate has a ‘herbicidal action and its presence in the effluent would provide a threat to brown algae which play an important part in marine ecology’ (CHAST 1989a, p. 6).

Extraction with oxygen or hydrogen peroxide

Additional lignin can be removed in the alkaline extraction stage in the bleaching sequence if oxygen gas or hydrogen peroxide is added to the alkali. This can reduce the use of chlorine in later bleaching stages. Oxygen and hydrogen peroxide can also be added at later extraction stages.

The CCSERC referred to a study (Bonsor et al. 1988, p. 52) which said that:

Hydrogen peroxide can be used to extend the delignification of an oxidative extraction stage in a kraft mill, thus reducing the input of chlorine in subsequent bleaching stages. This reduces the organochlorine discharge by a few per cent.

Other modifications

Other process modifications to reduce the formation of organochlorines include enzyme bleaching, ozone bleaching, hydrogen peroxide bleaching, and ultrafiltration.

PATEFA referred to research by the Finnish Pulp and Paper Research Institute into enzyme bleaching to break down lignin. This research shows that the inclusion of enzyme treatment in a chlorine bleaching sequence could reduce the amount of elemental chlorine used by 25 per cent.

Ozone may be used as an alternative to elemental chlorine. The CSIRO said that there are some technical problems with its use, namely it is very reactive and more chlorine dioxide is required in the later stages of a bleaching sequence (CSIRO 1989, p. 12).

Hydrogen peroxide bleaching may be an alternative to chlorine bleaching. The effluent from the hydrogen peroxide bleaching stage can be recycled back to the pulp mill recovery system (Keys 1989, p.20). The CSIRO said that investigations into the use of hydrogen peroxide for bleaching kraft pulp have not resulted in a procedure for producing market quality bleached pulps even when large amounts are applied in many stages (CSIRO 1989, p. 13).

Ultrafiltration of the first alkaline extraction stage filtrate is an emerging technology which concentrates the high molecular weight chlorinated organic material. The CSIRO said that there is a problem with disposing of these materials (CSIRO 1989, p. 13).

Some participants already use some of these process modifications or intend to introduce them. For example, APM's Maryvale pulp mill uses a bleaching sequence which includes treatment of the pulp with a mixture of chlorine dioxide, calcium hypochlorite and chlorine and an extraction stage which uses oxygen, brightening with chlorine dioxide and hypochlorite. The company's objective in 1990 is to operate a bleaching sequence that will commence with a 50:50 mixture of elemental chlorine and chlorine dioxide, followed by extraction with oxygen, and brightening with chlorine dioxide.

APPM is reviewing the bleaching processes used for cotton linters pulp at Shoalhaven. APPM said that 'laboratory-scale research into possible modified bleaching practices for the [Burnie] mill is in progress with environmental, economic and product quality factors all under consideration, but it has yet to be resolved whether any such modifications would form part of [soda anthraquinone] pulping capacity increases'. The company said that 'definite plans' exist for internal measures to substantially lessen the release of soluble organic matter to 'drain at source' with the pulping and chemical recovery sections of the mill over the next three years.

KCA said it intends to eliminate the use of elemental chlorine and hypochlorite and use peroxide for bleaching pulp at the Millicent mill in 1990.

D2 Treatment of waste to abate pollution from bleaching

The treatment of pulp mill wastes, including wastes from chlorine and other bleaching operations, can be undertaken either by methods which are an integral part of the pulping and bleaching process or by external methods which are largely add on.

Integral treatment includes recovery or recycling of energy, water, fibres, and chemicals. Certain modifications to pulping and bleaching processes, for example oxygen delignification and the partial substitution of chlorine dioxide for elemental chlorine, can promote the recycling of bleaching effluent. For example, the CCSERC referred to a study (Keys 1989, p. 14) which stated that the effluent from the oxygen bleaching process must be recycled to the chemical pulping mill recovery system to permit incineration of the compounds that give rise to biological oxygen demand, toxicity, and colour in the plant effluent. APPM said that gaseous emissions at Burnie from bleaching and bleach manufacture comprise chlorine and chlorine dioxide residuals and are controlled by packed tower wet scrubbers using the effluent from the caustic extraction stage of bleaching as the absorption medium.

Some participants provided comments on the recycling of effluents from chlorine bleaching. The PPMFA said that the effluent from chlorine bleaching of chemical pulps cannot be burned together with the pulping effluent in the recovery furnace of a pulp mill because its chloride or salt content would cause corrosion of the furnace.

APM commented that spent bleaching chemicals and extracted lignin material in the liquid effluent from chlorine bleaching cannot be recycled for chemicals or energy (for example by burning).

APPM said that while the recycling of spent bleaching chemicals is not feasible at Burnie, some recycling of waste water occurs within the bleaching operation. The company said that there were no opportunities to recycle spent bleaching chemicals at Wesley Vale.

External treatment of waste after it is discharged from the mill includes the use of precipitators and cyclones for treating stack gases and aeration ponds for the treatment of effluent.

External treatment of pulp mill effluent can consist of primary, secondary and tertiary treatment. Primary treatment of effluent is mechanical and removes much of the coarse suspended solids and reduces the biological oxygen demand of the effluent by about 10 per cent (CSIRO 1989, p. 24). It has been argued that the sludge produced by this treatment of pulp mill effluent containing effluent from chlorine-based bleaching processes may contain organochlorines, including dioxins (Keys 1989, p. 22).

Secondary treatment of the effluent is biological and reduces the biological oxygen demand of the effluent. The CSIRO said that AOX can also be significantly reduced (CSIRO 1989, p. 24).

Several different types of biological treatment are available including aerated lagoons, activated sludge plants, anaerobic treatment plants, trickling filters and physical-chemical treatment. However, it is argued that persistent compounds, including some groups of organochlorines, may be generally resistant to degradation in biological treatment (Keys 1989, p. 22).

Tertiary treatment removes further residual suspended solids, residual biological oxygen demand, nutrient, colour, organochlorines and other toxic materials that remain in the effluent after primary and secondary treatment. Tertiary treatment includes activated carbon absorption, massive lime treatment and foam separation (Keys 1989, p. 22).

Table D1 presents information about the external treatment facilities of some pulp producers that handle bleached effluent.

A number of participants commented on the effectiveness of external treatment of chlorine bleached wastes. PPMFA said that the effluent from chlorine bleaching is subjected to secondary treatment, usually in ‘aerated lagoons’. It said that with ‘good design and operation, this is sufficient to eliminate acute toxicity and, according to a recent report by a panel of experts, greatly reduce or eliminate the chronic toxicity of the effluent provided there is a reasonable degree of dilution by the recipient’ (Scientific Panel on Pulping Effluents in the Aquatic Environment 1989).

APPM said that secondary treatment of effluent at the Burnie mill is unnecessary ‘from the viewpoint of assuring adequate dissolved oxygen levels in the coastal waters recipient’.

APM said that the bleaching sequence used at its Maryvale pulp mill and the external primary and secondary treatment of the pulp mill effluent enables the mill to achieve AOX emissions to the receiving environment which comply with the Commonwealth environmental guidelines for new BEK pulp mills.

Table D1: **Waste treatment of bleaching effluent**

Firm	*Pulp mill location*	*Effluent external treatment facility*	*Receiving environment*
ANM P appendix	Boyer (Tas)	Treatment consists of a single clarification stage in a large clarifier. A second primary clarifier will be operating by June 1990. If the proposed lightweighted coated papers project proceeds, a biological treatment plant will be installed.	Derwent River
APM	Maryvale (Vic)	The bulk of the bleached effluent receives primary treatment at the mill site. The effluent is then subjected to secondary treatment by the Latrobe Water and Sewerage Authority at its Dutson Downs plant.	Lake Cameron
		The remainder of the bleached effluent, together with most of the paper-making process water, receives primary and secondary treatment at mill site before discharge.	Latrobe River
APPM	Shoalhaven (NSW)	Paper recycling plant effluent is currently treated separately in the UASB and DAF cell systems prior to passing through a primary clarifier before discharge.	Shoalhaven River
	Burnie (Tas)	Liquid effluent from bleaching is combined with that of other operations on-site and subjected to conventional primary treatment, that is, sedimentation, in a rake clarifier.	Bass Strait
	Wesley Vale (Tas)	Mill effluent treatment has been by filtration at source. A settling clarifer to further treat combined mill effluent is being installed.	Bass Strait

continued

Table D1: **continued**

Firm	*Pulp mill location*	*Effluent external treatment facility*	*Receiving environment*
Bowater	Myrtleford (Vic)	Primary treatment of effluent on site. This is then subject to secondary treatment byu Myrtleford Shire Sewage Authority under a Trade Waste Agreement. Once chemi-thermo-mechanical type pulping comes fully on-stream, a waste reclaim evaporator will be installed.	Ovens River
		Liquid is discharged in raw state from the site to a drain 11 kilometres away. Expects environmental effects to improve when hydrogen peroxide bleaching is introduced.	Lake Bonney

a UASB is an upflow anerobic sludge blanket which reduces biological oxygen demand. **b** DAF is dissolved air flotation which reduces suspended solids.

Source: ANM, APM, APPM, Bowater and KCA.

E COMMONWEALTH STANDARDS

An important part of the Commonwealth Guidelines for new BEK pulp mills is the setting of minimum standards on emissions into the atmosphere and into the marine system. The following table lists these standards.

Table E1: **Emission limits for new BEK pulp mills**

Pollutant	*Measure*	*Limit*
Emissions to the atmosphere:		
Opacity of the final discharge from	per cent of obscuration	
-recovery furnace		35
-other furnaces		20
-rotary lime kiln		10
-other lime kiln		20
Particulates in the final discharge from	milligrams per normal cubic metre	
-recovery furnace at 12% CO_2		150
-lime kiln at 10% O_2		150
-power boiler at 12% CO_2		225
Sulphuric acid mist and sulphur trioxide	SO_3 milligrams per normal cubic metre	200
Total reduced sulphur from	H_2S milligrams per normal cubic metre	
-recovery furnace at 8% O_2		5
-lime kiln at 10% O_2		10
Hydrogen chlorine	milligrams per normal cubic metre	100

continued

Table E1: **continued**

Pollutant	*Measure*	*Limit*
Chlorine and chlorine compounds other than hydrochloric acid	milligrams per normal cubic metre	200
Oxides of nitrogen at 7% O_2	NO_2 milligrams per normal cubic metre	500
Emissions to receiving waters:		
Total suspended solids	24 hour composite kg per air dried tonne of pulp	8
Biochemical oxygen demand	BOD_5 one day max kg per air dired tonne of pulp	7
Acute toxicity (LC50)	96 hour LC50 rainbow trout	100%
	48 hour LC50 daphnia	100%
Organochlorines	Adsorbable organic halide (AOX) kg per air dried tonne of pulp based on	
	yearly moving average	1
	any one test	2.5
Dioxin, 2,3,7,8 TCDD	Parts per trillion TCDD equivalent in crustacean hepatopancreas	5
Oil and grease contribution	Daily smaple	Not visible

Source: Joint Press Release 1989, Attachment A, pp.13-17.

GLOSSARY

Acute effects **--** those occurring within 3-4 days

AOX **--** adsorbable organic halides, a measure of the quantity of organochorines

Bleaching **--** the process of removing, or brightening, residual lignin from pulp

BOD -- biological oxygen demand, a measure of the capacity of effluent to consume oxygen

CCS pulp **--** eucalypt refiner pulp produced by Australian Newsprint Mills Ltd

Chemi-mechanical pulp **--** a mechanical pulp in which the woodchips are first subjected to chemical treatment

Chemi-thermo-mechanical pulp **--** a mechanical pulp in which woodchips are first subjected to chemical and heat treatment

Chemical pulping **--** pulp produced through the use of chemicals to break down the constituents of pulpwood

Chlorine bleaching -- processes using elemental chlorine and/or chlorine compounds to bleach

Chronic effects **--** those which may take months or years to appear

Cold soda pulp **--** a semi-chemical pulp using caustic soda

Dioxin **--** a class of organochlorine which is persistent in the environment

Elemental chlorine -- chlorine gas

Extended delignification **--** processes designed to reduce residual lignin levels

FAS bleaching -- process using formamidine sulphamic acid as a reductive bleaching agent

Furan **--** a class of organochlorine which is persistent in the environment

Furnish -- the blend of pulps and other materials which make up paper

Kraft pulp -- chemical pulp produced with sodium hydroxide and sodium sulphide

Lignin -- one of the major constituents of wood, the other being cellulose

Mechanical pulping -- pulp produced by a mechanical process (rather than a chemical process) through grinding or refining

Non-wood feedstock -- material, other than wood, which may be used for pulping

NSSC pulp -- a semi-chemical pulp using neutral sulphite

Organochlorines -- organic compounds containing chemically bound chlorine. They are formed whenever chlorine or chlorine-based compounds are used to bleach pulp

Refiner pulp -- mechanical pulps produced through refining, ie passing wood chips through the small gaps between rapidly rotating metal discs

Residual lignin -- lignin remaining in a pulp after the pulping process

Semi-chemical pulping -- a pulping process in which the lignin content of wood is first partially dissolved chemically before the fibres are separated by mechanical means

Soda anthraquinone pulp -- a chemical pulp in which the chemical agent is a mixture of sodium hydroxide and anthraquinone

Sulphate pulp -- ie kraft pulp, a chemical pulp in which the chemical agent is a mixture of sodium hydroxide and sodium sulphide

Sulphite pulp -- a chemical pulp in which the chemical agent is a sulphite such as calcium bisulphite

Thermo-mechanical pulp -- a mechanical pulp in which the woodchips are first subjected to heat treatment

REFERENCES

ABARE (Australian Bureau of Agricultural and Resource Economics) 1990, 'The outlook for the forestry sector', by R. Treadwell and the Forestry Economics Section, *National Agricultural and Resources Outlook Conference*, Canberra, p. 5.

Ahlborg et al. 1988, *Dioxin Risk Assessment*, State Environmental Medical Laboratory, Sweden.

APM (Australian Paper Manufacturers) 1990, 'Organochlorines/Dioxin Formation in Bleaching', *Position Paper no. 3*, p. 11.

Atchison, J.E. 1989, 'Producing pulp and paper from sugarcane bagasse: a worldwide perspective', *Sugar y Azucar*, September, pp. 89-100.

Bonsor, N., McCubbin, N. & Sprague, J.B. 1988, *Stopping Water Pollution at its Source: Kraft Mill Effluents in Ontario*, Report prepared for the Technical Advisory Committee, Pulp and Paper Sector of MISA Ontario Ministry of the Environment, Toronto.

Burns, M. & Associates 1989, *The Environmental Impacts of Travel and Tourism*, Paper prepared for the Industries Assistance Commission.

CHAST (Centre for Human Aspects of Science and Technology) 1989a, *Pulp and Paper Mills: Their Effects on Ecology*, Health and Economy, Sydney.

CHAST (Centre for Human Aspects of Science and Technology) 1989b, *Reply to comments made by authors of the CSIRO Report 'Pulp Mills: Modern Technology and Environmental Protection' on the CHAST publication no. 4 'Pulp and Paper Mills: Their Effects on Ecology, Health and Economy'.*

CSIRO 1989, *Pulp Mills: Modern Technology and Environmental Protection*, report to Senator the Hon. John Button, Minister for Industry, Technology and Commerce, by C.B. Fandry, R.E. Johannes & P.J. Nelson.

FAFPIC (Forestry and Forest Products Industry Council) 1989, *Position Statement: Guidelines & Processes for the Development of Bleached Eucalypt Kraft Pulp Mills*, p. 1.

Industry Commission 1990, *Interim Report on Paper Recycling*, Report no. 2, AGPS, Canberra.

Interdepartmental Working Group on PCDDs and PCDFs 1989, *Dioxins in the Environment,* Pollution Paper no. 27, London.

Joint Press Release (Minister for Industry Technology and Commerce, Minister for Primary Industries and Energy, Minister for the Arts, Sport, the Environment, Tourism and Territories) 1989, *Pulp Mill and Paper Industry Package*, 12 December.

Keenan, R., Sauer, M. & Lawrence, F. 1988, *Dioxin '88, International Symposium on Chlorinated Dioxins and Related Compounds*, Umea, Sweden, p. 181.

Keys, N. *1989, Environmental Effects of Wood-based Pulp Mills*, Office of Senator Jo Vallentine.

Maddern, K.N. & French, J. (APPM) 1989, 'Papermaking properties of some Australian non-wood fibres', *Appita*, vol. 42, no. 6, pp. 433-437.

McPherson, J. 1990, Letter of 23 March to Ankal Pty Ltd, included in Submission no. 223.

National Swedish Environment Protection Board 1989, The Swedish Dioxin Survey: Dioxins in Paper Pulp, *Dioxin Survey Report 4*, Solna.

National Health and Medical Research Council 1989, *Press Statement*, undated.

OECD 1989, *Structural Adjustment in the Pulp and Paper Industry*, Ad Hoc Working Party on Pulp and Paper, Paris, p. 17.

PPI 1990, 'Paper peaks while pulp keeps coming', January, p. 41.

Premier of Western Australia 1990, *Media Statement*, P90/102, 9ÿApril.

Scientific Panel on Pulping Effluents in the Aquatic Environment 1989, *Pulping Effluents in the Aquatic Environment*, a report prepared for the Proctor and Gamble Company.

Simons, H.A. & McLennan Magasanik Associates 1990, *Competitiveness of Australian Forest Industries,* Report to the Forestry and Forest Products Industry Council, Melbourne.

Universities Associated for Research and Education in Pathology Inc. 1988*, Human Health Aspects of Environmental Exposure to Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzo-furans.*

Virta, J. 1986, 'General introduction to the use of non-wood fibres in paper making', *International Seminar on Sound Environmental Management in the Pulp and Paper Industry*, Helsinki.

Western Australian Department of Agriculture 1988, *Kenaf: Potential for a Kenaf Pulp Industry in the Ord River Irrigation Area*, p. 4.