A Comparison of Environmental Licensing Systems in Operation in the Wood Panel Manufacturing Industry in the Northern Hemisphere

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By

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Dedication

This thesis is dedicated to my parents who have been a never-ending source of strength, encouragement and love for me. Without them I would never have made it this far.

ABSTRACT

The objective of this thesis is to compare and contrast environmental licensing systems, for the wood panel industry, in a number of countries in order to determine which system is the best from an environmental and economic point of view. The thesis also examines the impact which government can have on industry and the type of licensing system in operation in a country.

Initially, the thesis investigates the origins of the various environmental licensing systems which are in operation in Ireland, Scotland, Wales, France, USA and Canada. It then examines the Environmental Agencies which control and supervise industry in these countries. The impact which the type of government (i.e. unitary or federal) in charge in any particular country has on industry and the Regulatory Agency in that country is then described.

Most of the mills in the thesis make a product called OSB (Oriented Strand Board) and the manufacturing process is briefly described in order to understand where the various emissions are generated. The main body of the thesis examines a number of environmental parameters which have emission limit values in the licenses examined, although not all of these parameters have emission limit values in all of the licenses. All of these parameters are used as indicators of the potential impact which the mill can have on the environment. They have been set at specific levels by the Environmental Agencies in the individual countries to control the impact of the mill. Following on from this, the two main types of air pollution control equipment (WESPs and RTOs) are described in regard to their function and capabilities.

The mill licenses are then presented in the form of results tables which compare air results and water results separately. This is due to the fact that the most significant emission from this type of industry is to air. A matrix system is used to compare the licenses so that the comparison can be as objective as possible. The discussion examines all of the elements previously described and from this it was concluded that the IPC licensing system is the best from an environmental and economic point of view. It is a much more expensive system to operate than the other systems examined, but it is much more comprehensive and looks at the mill as a whole rather than fragmenting it. It was also seen that the type of environmental licensing system which is in place in a country can play a role in the locating of an industry as certain systems were seen to have more stringent standards attached to them. The type of standard in place in a country is in turn influenced by the type of government which is in place in that country.

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The opinions expressed in this thesis are mine alone and do not purport to represent the views of any other person or organisation.

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CHAPTER 1: INTRODUCTION

1.1 General Introduction

Environmental legislation has been with society for many years, in fact most of this legislation has its origins in health and safety laws. Since the Industrial Revolution great changes have come about in the way in which businesses in general are operated. Today, every business is operated to its optimum, with the objective of achieving the quickest turnover with the maximum amount of product throughput. This has led to a situation whereby the environment has suffered as a consequence, due to the depletion of raw materials and the vast amounts of wastes which are being generated. Pollution is the result of the direct discharge of all industrial and agricultural by-products into the environment. This practice causes imbalances in the physical, chemical and biological surroundings (Misra, 1996).

Growing awareness of environmental problems has been paralleled by increasing political and governmental activity at all levels, (Blowers and Glasbergen, 1996). One of the reasons for this activity is the growth of public interest in such problems. The general public of today realises the importance of conserving natural resources and wishes to live in a clean and healthy environment. This means that they often put pressure on their politicians to enact legislation that is going to protect the environment for future generations. This awareness has given rise to the concept of sustainability, which has its origins in the 1987 Brundtland Report, the basis of which is to protect the resources we have for future generations. Another important reason is the advent of NGOs (Non-Governmental Organisations). Most environmental problems are caused by human interference in physical, chemical and biological surroundings, including interferences caused by the policies of government agencies or business enterprises. Environmental NGOs engage in advocacy work to try and change policies that they perceive as damaging to the environment, (Glasbergen and Blowers, 1995). Since these NGOs are made up of a concerned and often highly educated public, who are usually publicity conscious, they can be a powerful pressure group for the government or business to contend with.

Thus, ways have to be investigated to reduce, reuse or recycle the waste with the last option being disposal of same. The drive to protect the environment and reduce pollution has led to the advent of environmental legislation and subsequently environmental licensing systems. This thesis examines the licensing systems under which particle board manufacturing mills operate, with particular emphasis on Oriented Strand Board (OSB) mills.

The process of manufacturing OSB is quite simple. A summary of the production process at the LP Europe mill is used here as an example, a more detailed explanation is given in Chapter 4, section 4.3. The timber logs are brought on-site via a number of hauliers. When the logs are required they are fed slowly into the mill. Once inside the mill the logs pass along a conveyor belt system to the "debarker" where all of the bark is removed from the log. From there the now debarked logs pass along to the "strander" where the logs are shredded to the required flake size. The strands are dried in one of the four large dryers and once dry they pass to the blenders where Liquid Phenol Formaldehyde (LPF) and MDI (an isocyanate) are added in order to bind the strands together. These strands then pass to the forming line where they are pressed. Once pressed the board is cut to the required size and passed to the shipping end of the factory where it is packaged.

1.2 Research Aims and Objectives

The aims and objectives of this thesis are as follows:

1. To compare the Irish licensing system with its European, American and Canadian counterparts.

2. To compare and contrast the European licensing systems.
3. To examine the impact which the type of Government can have on industry and environmental licensing.
4. To compare and contrast the mill licenses examined in the thesis with the objective of determining the most comprehensive licensing system which is feasible from both an environmental and an economic point of view.

1.3 Site Specifics

Thirteen plants spread around western Europe and north America have been selected for investigation in this thesis. A short description of their location, production process and general parameters of their environmental licence is given below. It should be noted that only coniferous wood is used in the manufacture of OSB.

1.3.1 CSC

This mill is situated beside the village of Cowie which is beside the Firth of Forth and is 40 km west-north-west of Edinburgh, Scotland. Cowie has a temperate climate and is at the eastern edge of the barley growing area of Scotland. The wood for the mill is supplied from all over Scotland. The mill produces OSB. It is quite a large mill with a production capacity of 265,000 m^3/year and it operates under a Local Air Pollution Control (LAPC) which was issued by the Scottish Environmental Protection Agency (SEPA) in 1993. The air emission points listed in this Licence are driers and presses.

1.3.2 Finsa

Finsa is located close to the town of Scarrif in Co Clare. Most of the wood for the mill is sourced locally, circa 100km radius. It manufactures a product called chipboard. It has a production capacity of 120,000 m^3/year and was granted its

IPC licence in 1997 by the Irish Environmental Protection Agency (EPA). The air emission point outlined in the Licence for this mill is the press.

1.3.3 Isoroy

The Isoroy mill is located in a rural area in the south-west region near Bordeaux, France. The wood for the mill is sourced locally. It produces OSB and has a production capacity of 90,000 m^3/year making it the smallest producer examined in the thesis. It is a Classified Installation and was issued its current Licence in 1991 by the Ministere de l'Environnement. The emission point for air emissions is not identified in this Licence.

1.3.4 Kronofrance

The Kronofrance mill is located near a small town called Sully-sur-Loire in a rural area 40km east-south-east of Orleans on the river Loire in France. It has a warm temperate climate and the wood is supplied from the surrounding mountainous areas. It produces OSB and has a production capacity of 300,000 m^3/year. It is a Classified Installation and was issued its current Licence in 1999 by the Ministere de l'Environnement. The air emission point outlined in this mill's Licence is the WESPs.

1.3.5 Kronospan

This mill is situated in the village of Chirk just inside the English border in north-east Wales. It produces chipboard and medium density fibreboard (MDF). It has a production capacity of 180,000 m^3/year and was issued its IPC licence in 1993 by the Environment Agency (EA). The air emission point listed in their Licence is the WESPs.

1.3.6 LP Europe

This mill is situated near the city of Waterford in south-east Ireland. The wood for the mill comes from all over Ireland and the mill has a production capacity of 350,000 m^3/year. The mill was issued its IPC licence in 1995 by the Irish EPA. The air emission point listed in this mill's licence is the WESPs.

1.3.7 Masonite

This mill is situated approximately 4km from the medium sized town of Carrick-on-Shannon in north-west Ireland. It is located on the banks of the River Shannon. The wood for this mill is mainly derived from the north-west of Ireland. It manufactures a product called moulded door facings. It has a production capacity of 140,000 m^3/year and was granted its IPC licence in 1995 by the Irish EPA. The emission points outlined in the Licence for this mill are the press and driers.

1.3.8 Willamette

The Willamette mill is located near the town of Clonmel in Co Tipperary. The wood for this mill is derived from all over Ireland. It produces MDF (medium density fibreboard) and has a production capacity of 350,000 m^3/year. It was granted its IPC licence in 1996 by the Irish EPA. The emission points outlined in the Licence for this mill are the press and driers.

1.3.9 Dawsons Creek

The Dawsons Creek (British Columbia) mill is located 14km from the Alberta border and is roughly 80km north-west of Grand Prairie, Alberta. It is on the east side of the Carmelian continuation of the Rocky Mountains, in east-central British Columbia. It is in a sparsely populated area which has warm summers and cold winters. The wood is supplied from the extensive coniferous forests in the area. It produces OSB and has a production capacity of 332,000 m^3/year. It was issued its current air Permit in 1998 by the local Air Division of the Province of Alberta. The emission point outlined in this mill's air Permit is the driers.

1.3.10 Hanceville

The Hanceville mill is located approximately 10km south of the town of Hanceville. Hanceville itself is roughly 50km north of Birmingham. It is situated in a populated area of low featureless terrain, close to the foothills of the Appalachian Mountains. It has a tropical climate of hot summers and warm winters. The wood is derived from the forests of the Appalachian Mountains. It produces OSB and has a production capacity of 323,000 m^3/year. It was issued its current air Permit by the local Air Division of the State of Alabama in 1996. The emission points outlined in this mills air Permit are the press and drier RTOs.

1.3.11 Jasper

The Jasper mill is located on the outskirts of Jasper which is a small town in east Texas just west of the border with Louisiana. It is just marginally (50-200m) above the Mississippi river delta and wetlands. It has a tropical climate. The origins of the wood could not be ascertained. It is a major producer of OSB and has a production capacity of 398,000 m^3/year. It was granted its current air Permit in 1997 by the Air Division of the State of Texas. Jasper has press and drier RTOs as a means of pollution abatement.

1.3.12 Roxboro

The Roxboro (North Carolina) mill is located 5km outside of the town of Roxboro which is 13km south of the Virginia border. It is situated in a reasonably densely populated area which is well developed both industrially and agriculturally. The foothills of the Appalachian Mountains are approximately 40km to the west. The area itself is lowlying, only 50-200m above sealevel. It is however, at the end of a major afforested area. It produces OSB and has a production capacity of 332,000 m^3/year. It was issued its current air permit in 1998 by the local Air Division of the State of North Carolina. The emission points outlined in this mill's air permit are the press and drier RTOs.

1.3.13 Swan Valley

The Swan Valley (Manitoba) mill is located in a sparsely populated area 44km north of the US State of North Dakota. It is located on a very flat featureless "plain" and is on the boundary between warm continental and cold continental climates. The wood for the mill is sourced locally. It produces OSB and has a production capacity of 398,000 m^3/year making it the joint largest mill with Jasper examined in this thesis. It was issued its current air permit in 1997 by the Air Division of the Province of Manitoba. The Swan Valley mill has press and Drier RTOs as a means of pollution abatement.

Figure 1.1 Map of OSB Mills

CHAPTER 2: RESEARCH METHODOLOGY AND LICENSING SYSTEMS

2.1 Prelude

The aims of this chapter are to explain the research methodology and to examine how and why environmental licensing came into being in each country and to take a brief look at the principles behind each system.

2.2 Research Methodology

During the course of this thesis a methodology was devised by which the licenses for the mills studied were obtained. This methodology can be seen in Appendix 1.

The matrix system which was devised in order to compare the mill licenses examines a number of chosen parameters and notes their presence or absence. These parameters were chosen on the basis that their presence at high levels are indicative of an adverse impact on the environment.

The Emission Limit Values (ELVs) in the results tables are presented in the units in which the licence is written. This may be either mg/Nm^3, mg/m^3 or kg/hr. In order to facilitate proper comparison, the mg/Nm^3 ELVs were converted to mg/m^3.

Originally, seven mills were contacted in America and three is Canada and asked for their co-operation in compiling data for this thesis. From this number, three mills were chosen in America as being a representative sample and two in Canada. They were deemed to be representative as they contained similar ELVs and licence conditions as a number of the other mills.

In Ireland the other three wood processing plants, Willamette, Masonite and Finsa, were contacted for their licenses even though they do not make Oriented Strand Board (OSB). They were contacted in order to examine the differences within the Irish licensing system in the wood panel manufacturing industry.

2.3 Origins of the Environmental Licensing Systems

There are a number of different environmental licensing systems in operation in the countries that are examined in this study. However, whilst each system may have subtle differences, there are generally four basic groups:

- Classified Installations (France)
- IPC (Integrated Pollution Control) systems (Ireland, Scotland and Wales)
- Local Air Pollution Control systems (Scotland and Wales)
- Permit systems (America and Canada)

Each of these groups will now be examined in more detail.

2.3.1 Classified Installations

France has had laws on environmental protection for nearly 200 years. It is primarily the law of July 19, 1976, which governs their licensing system, but the origins of this law go back to 1810. In 1810 a general purpose law classified installations causing nuisances or risks. This remained largely unaltered until December 1917, when consequent to the chemical warfare practised during World War 1, specific controls for hazardous, unhealthy or troublesome factories was brought into being. These laws remained in force until 1976 when they were replaced by the law of July 19th, which in turn introduced the concept of Classified Installations.

In France the Government department which is responsible for environmental licensing is the Department for the Prevention of Pollution and Risk. The structure of this department will be examined in greater detail in the subsequent chapter, it is the concept behind the licensing system and its origins which are of interest here. The French system operates by classifying industries into two major sections: (1) Substances and Preparation and (2) Activities. These are then further broken down into sub-sections. The wood, paper and cardboard industries fall under Schedule 2-7 of the Activities section.

The 1976 legislation, which has not been amended, implements the "polluter-pays" principle by forcing the operator to pay for all the costs and measures needed to reduce pollution or limit risks, (Ministere de l'Environnement, 1995). The only changes to it have been to incorporate a broader range of industries e.g. the genetic modification of organisms and quarries. In addition the powers of the Department of the Environment have been increased in relation to penalties, scope of risks and the general concept of greater protection for the environment.

Setting-up a classified installation nearly always requires a building permit that must be filed for at the same time as the request for authorisation or the filing of a declaration under the legislation on classified installations. The two procedures are separate, but the building permit cannot be granted before the public inquiry is completed, (Ministere de l'Environnement, 1995).

Whilst the Prefect may authorize requests and supervise the entire process it is ultimately the Ministere de l'Environnement which is in charge of the implementation of legislation on Classified Installations. The Department for the Prevention of Pollution and Risks is in turn in charge of conducting actions aimed at reducing the pollution, nuisances and risks of the these activities on the environment.

2.3.2 Integrated Pollution Control Systems

The Integrated Pollution Control (IPC) system is the predominant environmental licensing system in operation in Europe today. This is due to the fact that an IPC licence takes account of the effect that an activity will have on the environment as a whole. Most of the older systems issued separate licences to cover air, water and waste emissions and each of these licences had a separate body in control of its issuance and compliance. That system was not very effective due to the fact that a company would often put in place abatement technologies which simply transferred the pollution from one environmental medium to another, which in turn may have been less stringently controlled. Thus, the whole basis behind the IPC system is that a licence is issued which covers all environmental media and this licence is controlled by one competent body (usually an Environmental Protection Agency). This according to Drake (1994) has the advantage of taking a holistic approach, ensuring that substances which are unavoidably released to the environment are released to the medium to which they will cause the least damage. It embodies the precautionary principle "prevention is better than cure".

The IPC system is derived from the French system of "Classified Installations". In fact it was France who was the main instigator behind the "integrated" Directive and the Directive amending the Seveso Directive, (EPA 1998b). The IPC system is used in Scotland and Wales as well as Ireland, but in Scotland and Wales it is used in conjunction with Local Air Pollution Control (LAPC). The Welsh mill, Kronospan, falls under the IPC licensing category and is subject to Best Practicable Environmental Option (BPEO) for its abatement equipment. The Scottish mill, CSC comes under a LAPC Licence and this will be explained in more detail in the next subsection.

The legal and historical basis for the introduction of IPC in Ireland stems from the establishment of the Irish Environmental Protection Agency in 1993. Prior to this it was the Local Authorities (LA) that had the primary responsibility for environmental protection, (EPA, 1998a). The Agency took over the role of the licensing of large or complex activities with significant polluting potential whilst the LA continued to have responsibility for licensing of those activities not specifically listed in the EPA Act, 1992, (EPA, 1995). The Act applies to certain defined "activities". Section 3 defines an activity as "any process, development or operation specified in the First Schedule". The First Schedule lists 13 classes of activity, most of which are divided into sub-classes, (Doyle, circa 1998). The class of interest to this thesis is number 8, which covers wood, paper, textiles and leather and this class became licensable on 16th of May, 1994, (EPA, 1996a). Appendix 2 illustrates the basics of the licensing procedure, (EPA, 1996b).

Once a licence has been granted, the Agency is the body who is responsible for monitoring compliance and in the case of non-compliance can bring into action the enforcement mechanisms.

Ireland, due to the fact that it is a member of the European Union has come under a lot of pressure to implement EU environmental laws and regulations. The Treaty of Rome (1960) established the EEC, the precursor to the EU. During the 1960s there was increased public awareness of the problems facing western Europe. As part of the Accession Treaty, which brought Ireland, the UK and Denmark into the EEC, the First Environmental Action Programme was published. Following on from the Brundtland Report (1987) entitled "Our Common Future" the concept of sustainability was introduced. This was followed in 1990 by the Dublin Declaration on the Environment by EC Heads of State "Action by EC to be based on Principles of Sustainable Development".

2.3.3 Local Air Pollution Control (LAPC)

In Scotland and Wales the principal legislation is Part 1 of the Environmental Protection Act, 1990 and associated regulations. The legal controls in Scotland and Wales are however quite different and this is explained in detail in 3.3.3 and 3.3.4. The Act as it applies to Scotland allows for two categories of industrial process to be regulated under different systems. Part "A" processes fall under IPC licensing, whilst Part "B" processes are controlled solely in respect to air under Local Air Pollution Control (LAPC).

SEPA have deemed that the emissions from the CSC Forest Products company (in Scotland) falls under the LAPC category of licensing. LAPC processes are considered to pose less of an environmental risk than IPC processes overall. The principal emission for these activities relates to releases to air. In these cases Best Available Technology Not Entailing Excessive Costs (BATNEEC) is used and relates to air emissions only.

2.3.4 Permit Systems

The type of environmental control mechanism which are in operation in America and Canada are called Permit Systems. This system is quite similar to what was in place in Ireland before the IPC system was introduced.

In this thesis the main focus of interest is on air emissions as this is the major emission from the OSB manufacturing process and the 1970 Clean Air Act is the main piece of legislation covering air emissions from areas, stationary and mobile sources. It authorises the EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The counterpart of this Act is the 1977 Clean Water Act which gave the EPA the authority to set effluent standards on an industry basis and set water quality standards. The most recent piece of environmental legislation for reducing the amount of pollution is the Pollution Prevention Act of 1990 which looks at cost-effective changes in production, operation and raw material usage, (http://www/epa/gov/earth1r3/r6high.htm).

Due to the fact that America and Canada both have federal governments (cf. Chapter 3), it is the State and Provincial authorities that are in charge of environmental control. What this means, is that the federal government can pass legislation on air pollution control and it is then the duty of the State/Provincial government to adopt this legislation as it sees fit.

This system works generally on the basis that the company in question must have an air permit to operate. This permit may be acquired from the local Air Quality Division. A number of emission limit values (ELVs) will be contained in this permit as well as certain operating conditions, for example, how much production the mill is allowed per annum or what the operating temperatures of the regenerative thermal oxidizers (RTO's) must be. This air permit must be renewed every number of years.

For other emissions, for example waste, a special permit is required to dispose of hazardous waste. This permit may be obtained from the Waste Division of the local State when there is sufficient waste on-site to dispose of. General refuse may be disposed of without a permit as long as records are kept of quantities and destinations.

The situation is similar with water emissions, it is only if you have an emission, which requires some form of treatment that you need a permit to release it, and this permit is obtained from the local Water Quality Division.

This is a general outline of how the Permit system works. Of course the system varies from state to state and province to province. Some states/provinces have much stricter controls on emissions than others and some states enforce these laws in a much more stringent manner than others do. The main disadvantage of this system is that it can lead to fragmentation as no one person has an overview of how the mill is performing on an environmental basis.

CHAPTER 3: GENERAL DESCRIPTION OF ENVIRONMENTAL PROTECTION AGENCIES

3.1 The Effect of Government on Environmental Legislation

The countries, which are examined in this thesis, have basically two different types of government – unitary and federal. Ireland, France, Scotland and Wales fall into the unitary category while America and Canada are in the federal. Each category will now be examined from the perspective of how it functions and the effect that this has on the type of environmental legislation which is in place, in that country.

3.1.1 Unitary

A unitary state is basically a democratic one whereby there is one vote per person. The state is seen as a whole and the government acts for the good of the country which corresponds to the wishes of the majority of the people since it is the people who voted that particular government in. In all countries there is a Head of State, usually a President, occasionally a Royal person or his/her representative, who in most cases is not the chief executive (France is the exception), but rather a figure who is intended to be "above" day-to-day politics, with a number of significant symbolic, procedural and diplomatic functions, (Gallagher *et al*, 1990). Whilst Ireland, Scotland, France and Wales all fall under this general category, there are a number of specific differences between these countries which will now be examined in more detail.

Ireland is a democratic republic where the people directly elect the government. The majority party forms a Government, the head of which becomes the Taoiseach and it is they who run the country. There is a directly elected figurehead President who is Head of State and who has a number of symbolic and procedural functions.

France, like Ireland, is a democratic republic with a directly elected Parliament, the head of which is the Prime Minister. It also has a directly elected President, but unlike Ireland, the French President is both Head of State and of the Government. In fact the President is influential in choosing the Prime Minister. If a new party is elected to a majority in the Parliament, the President has veto rights over who becomes Prime Minister. Thus whilst the President may not directly run the country, he/she does so indirectly by choosing the person whom they want for the Prime Minister's job.

In Scotland there has been a number of developments recently whereby the UK Parliament has set up a Scottish Parliament and devolved a number of powers to it. Scotland has a monarchical democracy with the Queen as the non-elected Head of State. The principal role of the Scottish Parliament is to legislate for matters affecting Scotland, in areas such as education, health, criminal law, the environment and industrial support. Matters such as defence, foreign policy and the broad economy are still run by Westminster, (www.bbc.co.uk/politics97). The Scottish Parliament (with its 129 members) has the power to raise or lower the basic rate of income tax to collect additional monies. The head of Parliament is the First Minister who is chosen from the largest party. The Secretary of State for Scotland remains a member of the UK government to liase between Scotland and Westminster – and to look after Scottish interests within fields such as defence which remain under London control, (www.bbc.co.uk/politics97).

Similarly to Scotland, Wales has now also got some powers devolved from the UK Parliament and has its own Assembly, which has 60 members. However, the Queen remains as the Head of State. The Assembly has the powers to make secondary legislation for such matters as local government, environment, agriculture, transport and roads etc. The primary legislative ability is still retained by the UK Parliament at Westminster. The Secretary of State for Wales continues to sit in the Cabinet to represent Welsh interests and will be able to attend meetings in the Assembly to participate in its debates, but not to vote, (www.bbc.co.uk/politics97).

The two main differences between the Scottish Parliament and the Welsh Assembly are:

1. The Scottish Parliament can overturn existing UK legislation and introduce legislation in areas not retained by Westminster, the Welsh Assembly can only amend Westminster legislation in the areas devolved to it.
2. The Scottish Parliament has powers to vary the basic rate of income tax whilst the Welsh Assembly is reliant solely on funding from central government.

The Welsh Assembly basically democratises the existing functions of the Secretary of State for Wales, while the powers of the Scottish Parliament are far more extensive than those of the Scottish Secretary, (www.bbc.co.uk/politics97). Whilst both Scotland and Wales are described as having a unitary system, in reality they are both in an evolutionary state towards a federal system within the UK.

In a unitary state the fact that the government is ultimately answerable to the general public this arguably leads to a very open and transparent environmental legislation/control system.

3.1.2 Federal

America and Canada operate a federal system. The electoral systems, the method of election to the Houses of Legislature/Parliament and the election/appointment and functions of the Head of State varies significantly between the US and Canada, but that does not concern us here. This system is basically one where the country is broken up into a number of states (America) or provinces (Canada). The federal government (the seat of which is located in the capital city) is responsible for foreign affairs, fiscal matters etc and passes general laws on issues such as environment, forestry, fisheries etc. It is then the responsibility of each state or province to implement this legislation as it sees fit. Each state or province has its own ruling government which is in charge of the day-to-day running of the state/province. The US State system is headed by a directly elected Governor and a Legislature. The Canadian Province system has a Legislature which elects a Premier.

This type of system, whilst necessary for large countries, can lead to inconsistencies in environmental regulations. This is due to the fact that whilst each state has to adopt the laws passed by the federal government, it is left up to each state as to how these laws are translated into state regulations. This means that whilst one state may adopt the law in its most stringent form, another state may adopt it in an altogether more lenient form, which can lead to one state having an unfair economic incentive for large business to set up there over another state. Thus, this system does not, in general, lend itself to strict environmental control systems.

It is interesting to note that whilst Ireland, France, Scotland and Wales may have a unitary system of government in operation, the EU as a whole is more like a federal system, whereby Brussels passes legislation and each member country must then implement it within a given time frame. Thus the EU suffers, albeit to a lesser degree, some of the same problems that America and Canada have in implementing their federal system, and even more clearly important as the Nice Treaty vote showed, it also has a democratic deficit.

3.2 The Impact which Government can have on Industry

In Chapter 2 it was seen that the number of environmental laws and regulations which are in operation in each country was quite extensive and covered all areas of the environment. Whilst each country wants to maintain a clean and healthy environment, it also wants to attract industry. Industry fulfills many vital social needs and many not so vital social wants. However, as a result of the resources they consume, the processes they apply or the products they manufacture, businesses are major contributors to environmental destruction usually meaning pollution, but it also means jobs and money, (Blowers and Glasbergen, 1996).

Thus, each government must take this into account when preparing environmental legislation and achieve a working balance. This can be a major problem for governments, and four broad approaches can be recognised for overcoming this:

1. The free market approach and self-regulation – what this essentially means is, it allows the free market to operate, whilst providing education and information to consumers to allow them to make more informed choices. An example of this is the eco-labelling initiative which shows consumers which products are produced in an environmentally friendly manner.
2. The reformist approach and financial incentives – this approach is based on the idea that firms, consumers and markets need incentives in moving towards more environmentally superior outcomes. These incentives are in the form of taxes and subsidies.
3. The interventionist approach and legislation – this approach suggests that there should be direct controls on businesses. A need for legislation to force the most polluting branches of industry to improve their performance is central to this. For this approach to be successful there needs to be increased international regulation, co-operation between governments and a degree of protectionism against governments not adhering to agreed international standards.
4. The radical approach – radicals would put an increased reliance on co-operation and partnership (rather than competition and individualism). Their approach is one which questions whether the present structure of capitalism is capable of bringing about sufficient environmental improvements on an

international scale to reverse current destructive trends, (Blowers and Glasbergen, 1996)

To date, the main impact of government on the environmental performance of industry has been through the development of environmental legislation. The main problem with this approach is the lack of international co-operation. For example, if one country puts very strict limits on a particularly hazardous waste, the way in which some industries get around this is to export the waste to an underdeveloped country which is grateful for the money which it can earn for accepting it (although there is currently EU legislation preventing this within the internal EU market). Thus, this approach can result in trade barriers between countries, unless a common approach is adopted by all. Of course, the problem is not always between one country and another, it can also occur within a single country. As described earlier the USA has a federal system of government. This means that one state may have more lenient environmental controls than another state and so be more attractive to a large industry which is looking for somewhere to set up a manufacturing plant.

Thus, whilst government is ultimately responsible for regulating and controlling industry, it is also at its mercy to an extent. It must protect the environment and the people within its care, but it must also remain attractive to and viable for industry. For this reason, most governments have set up EPA's which have the role of protecting the environment and regulating industry, whilst the government then is free to attract new industry to the country.

3.3 General Description of Environmental Protection Agencies (EPA's)

Before examining the mill licences in detail it is important to understand where these licences originated. In order to accomplish this, the Agency's (or Environmental Protection Agency's) which issued these licences must first be understood. The aim of this section is to take a brief look at the Agencies themselves in order to comprehend the background to the licensing system which is in operation in each country.

The Agency's will be examined under the following headings:

- How and when the Agency was set up
- The internal structure of the Agency
- The type of licensing system/pollution abatement system which the Agency operates.

3.3.1 France

The Ministry of the Environment in France was established in 1971 and its mission is to "monitor the quality of the environment; protect nature, prevent, reduce or totally eliminate pollution and other nuisances and enhance the quality of life". To perform this mission, the Ministry has a number of specific powers:

- Regulating and managing fishing, hunting, water resources and classified installations, as well as the management of waste disposal and the control of noisy activities
- Proposing and installing an environmental dynamic in the economic and social field, (www.environnement.gov.fr/english.htm).

Due to the fact that the Ministry's role is so large, a number of decentralised departments as well as the expertise of a number of attached organisations assist it in fulfilling this role. The Central Administration consists of four departments, the department of interest to this thesis is the Prevention of Pollution and Risks. This is the department, which deals with the regulation and licensing of industry.

Within France, 26 Regional Departments of the Environment (DIREN) together with the Industrial Environmental Services of the 24 Regional Departments for Industry, Research and the Environment (DRIRE) are in charge, under the

Regional Prefect's authority, for locally implementing the policies defined at the national level,(www.environnement.gov.fr/english.htm).

The way in which the department regulates industry is through a system whereby large companies are listed as "Classified Installations", (Ministere de l'Environnement, 1995). This legislation implements the "polluter-pays principle" by forcing the operator to pay for all the costs and measures needed to reduce pollution or limit risks.

3.3.2 Ireland

The Irish EPA is an independent, almost semi-judicial body, which was established under the 1992 Environmental Protection Agency Act and came into being on the 26th July 1993. Prior to the establishment of the EPA it was the responsibility of the relevant Local Authorities in each county to issue "single media licences" which are individual licences issued in accordance with relevant legislation, e.g. air emissions under the Air Pollution Act, 1987 and wastewater effluent under the Water Pollution Acts, 1977 and 1990.

The EPA has a full-time Executive Board, which consists of the Director General and four other executive Directors. There are four divisions within the organisation, the Licensing and Control division is the one of interest to this thesis. The headquarters of the organisation are in Wexford but it also has five regional offices and four sub-offices.

The main reason that the EPA was set up was "to licence and control large scale activities having the potential to cause significant environmental pollution" (www.epa.com). It is important to note at this stage that whilst the EPA are responsible for licensing the large industries, it is the Local Authorities who regulate the smaller less polluting industries as well as other responsibilities such as landscape protection. The EPA took over the powers and staff of An Foras

Forbartha (which was the body responsible for water research) but it did not take over the Regional Fishery Boards which, amongst other duties, play an independent role in water pollution prosecutions, (EPA, 1998a).

The Irish EPA has quite far reaching powers both to licence and to control. It is therefore not surprising that it was put in charge of the implementation and running of the Integrated Pollution Control Licensing system. This system was introduced "for all the scheduled activities throughout the country, using best available technology not entailing excessive costs (BATNEEC) to eliminate or limit releases to the environment, and to minimise impacts on the environment ", (EPA,1995).

3.3.3 Scotland

The Scottish Environmental Protection Agency (SEPA) was set up under the Environmental Act, 1995 and became fully operational on the 1st April 1996. SEPA has as its principal aim/mission statement: "to provide an efficient and integrated environmental protection system which will both improve and contribute to the Governments' goal of sustainable development".

It is a non-departmental Public Body that was, prior to devolution, accountable to the Secretary of State for Scotland. It is currently accountable to the Scottish Executive. SEPA, once operational took on the duties and responsibilities of the following bodies:

- The 7 River Purification Boards
- The 56 District and Islands Councils in respect of their functions as:
  - ⇒ local enforcing authorities for releases of substances into the air
  - ⇒ waste regulation authorities
- Her Majesty's Industrial Pollution Inspectorate

(SEPA, 1998a).

However, along with those it inherited, SEPA also has a range of new powers covering water, land and air.

SEPA's Head Office is in Stirling, but it also has 21 other offices throughout Scotland. SEPA is basically made up of a Main Board and Three Regional Boards. The Main Board which comprises of a Chairman, a Deputy Chairman and 10 members (including the Chief Executive) has the ultimate responsibility for the Organisation. Members of the Board are appointed by the new Scottish Executive, and the normal term of office for a non-executive Board member is four years, (SEPA, 1998b). The day to day running and management of SEPA is the responsibility of the Chief Executive, supported by the Management Team, (SEPA, 1998b). A member of the Main Board chairs each of the Three Regional Boards.

Additional power and duties continue to be given to SEPA, stemming from the Environment Act, 1995 and through regulations implementing EU Directives, (SEPA, 1998a). Scotland, like Ireland, operates an Integrated Pollution Control licensing system (IPC). In Scotland the IPC system was established under Part 1 of the Environmental Protection Act of 1990.

Similarly to Ireland, the whole basis of the Scottish IPC system is the principle of Best Available Technology Not Entailing Excessive Costs (BATNEEC). BATNEEC must be used "in the operation of prescribed processes to prevent releases to the environment, but where this is not practicable, any releases are to be minimised and rendered harmless", (SEPA, 1998b). In addition to this SEPA insists on BPEO, which stands for Best Practicable Environmental Option. What this means is that if there are releases to more than one environmental medium "the BPEO must be secured so that pollution of the environment, taken as a whole, is minimised", (SEPA, 1998b).

SEPA also operate a permit scheme called Local Air Pollution Control (LAPC) for industries which are deemed to be less polluting and thus do not require an IPC licence. The operation of this system was explained in Chapter 2.2.3.

3.3.4 Wales

The Welsh and English Environment Agency (EA) was established under the 1995 Environment Act and came into operation on the 1st April 1996. The Agency is a non-departmental public body, which means that it works for the public whilst having duties and powers of its own, (http://www.environment-agency.gov.uk).

The mission statement of the Agency includes the phrase "to help ensure a better environment in England and Wales for present and future generations", (EA, 1999b).

Prior to the establishment of the Agency the HMIP (Her Majesty's Inspectorate of Pollution) and the NRA (National Rivers Authority) in conjunction with the local authorities were in charge of all environmental concerns. In July 1991 it was announced that it was the government's intention to create a unified Environmental Agency, (Bell, 1997).

The basic internal structure of the EA is as follows – there is a Board of 15 members appointed by the Secretary of State for the Environment, The Secretary of State for Wales and the Minister for Agriculture, Fisheries and Food. This board also includes a Chairman and a Chief Executive. The board members were formerly responsible to the Ministers for all parts of the organisation and performance and are there to ensure the EA meets its legal duties (www.bbc.co.uk/politics97/devolution/wales/shtml), but with the current devolution situation, the EA in Wales is now responsible to the newly established National Assembly. Since the environment is one of the areas which have been devolved to the National Assembly, it is this body which will be responsible henceforth for the appointment of board members.

The EA has seven regional offices. The office in Cardiff is responsible for the EA in Wales. Each region has a general manager, and each area has an area manager. They (the area managers) make decisions and manage the area to ensure that the needs of the local community are met, (EA, 1999a).

Similarly to the Licensing Authorities in Ireland and Scotland, the EA operates a system of IPC licensing.

3.3.5 USA

Unlike the other countries that have been examined above, the USA has a somewhat different method of environmental licensing. This is due to the fact that America has a federal government and that whilst it is the federal government's responsibility to draw up general national policies, it is the role of the state legislatures to adopt these policies and implement them at a local level.

The Environmental Protection Agency (EPA) is the federal body that is responsible for protecting the environment and regulating industry. It was established on December 2, 1970 and it is an independent agency in the executive branch of the federal government. The main role of the Agency is to implement federal laws that Congress have passed.

The Agency itself is made up of a number of departments which specialise in a particular area of expertise, for example the Air Enforcement Division is responsible for judicial and administrative enforcement activities under the Clean Air Act and the Noise Control Act. There are similar departments for enforcement/clean up, water, waste and international relations to name but a few.

Due to the size of the USA, the EPA has divided up the country into nine regions. Each of these regions has an office where the EPA is based and this office is used to co-ordinate with the authorities within that region. The relationship between the federal EPA and the state environmental departments is critical.

In the USA, most of the federal statutes recognise that the States should have primary responsibility for regulating and enforcing environmental concepts. To this end most states carry out basic regulatory and enforcement functions due to the fact that they have a much greater knowledge of the local area and people. Thus, the federal EPA pursues national environmental objectives and supports the individual states in building their own environmental programs, which are uniquely suited to the environmental problems found in each State.

The mills, which are subsequently discussed in this thesis, are in two different regions, regions 4 and 6.

REGION 4

Region 4 covers the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee. The States of interest to this study are Alabama as this is where the Hanceville mill is and North Carolina, which contains the Roxboro mill.

REGION 6

Region 6 covers the States of Arkansas, Louisiana, New Mexico, Oklahoma and Texas. The State of Texas contains the Jasper mill.

Whilst each region has Acts and regulations in place to regulate/protect water and waste, the main focus of legislation in the US is air. This is covered under the previously cited Clean Air Act of 1970. This Act also gave new enforcement powers to the EPA. The Agency is able to fine violators and the Act also increased the penalties for violating it. The Act introduced the concept of Permits for large sources that release into the air; it is these permits which regulate the air emissions at the mills in, Hanceville, Roxboro and Jasper.

3.3.6 Canada

The Canadian Environmental Assessment Agency (CEAA) was set up under The Canadian Environmental Assessment Act, 1992 and this Act was then implemented in January 1995 (www.ceaa.gc.ca/agency/descript.htm). The CEAA replaced the Federal Environmental Assessment Review Office (FEARO).

The CEAA reports directly to the Minister of the Environment of the Federal Government in Ottawa and operates independently of any other federal department or Agency. The mission statement of the CEAA is: " To provide Canadians with high quality federal environmental assessments that contribute to informed decision making in support of sustainable development", (CEAA, 1998).

Canada does not operate an integrated licensing system. Rather, the permitting system which the CEAA operates has greater emphasis on air pollution control and is quite similar to the US permitting system. A Canadian licence generally details the Emission Limit Values (ELVs) for the specific parameters as well as general operating parameters, such as amount of production per year or at what temperature the Regenerative Thermal Oxidizers (RTO's) must operate. The licence also details the reporting procedure required for the mill. The Permit may also mention in general terms water pollution prevention measures, noise and ambient monitoring. In this manner, the CEAA appears to be moving towards a more integrated form of licensing similar to that of the IPC system.

CHAPTER 4: ENVIRONMENTAL PARAMETERS, CONTROL TECHNOLOGIES AND OSB MANUFACTURE

4.1 Introduction

Pollution is not a new phenomenon, it has been with us ever since the Industrial Revolution. It can be defined in many ways but perhaps the simplest way is to describe it as any parameter, (be it water, noise or air), which affects detrimentally the environment in which we live work or use for recreation.

Initially, pollution was only considered from a health point of view and emission values on major pollutants were set to protect public health. As time passed, it was realised that the effect pollution was also having on the environment required specific environmental laws and regulations to be enacted. The origins of these laws and regulations have already been examined, what this chapter will look at are a number of parameters which when present at elevated levels are indicative of pollution, the two types of air abatement equipment used in the mills and the basics of the manufacturing process of Oriented Strand Board (OSB). Each pollutant will have its sources examined and explained as well as taking a look at its environmental and health and safety implications.

4.1.1 Formaldehyde

The resin which is used on-site at a number of the mills which have been investigated in this thesis is a phenol formaldehyde (LPF) resin which is 0.1% pure. Formaldehyde is the component that is deemed to have the greatest potential environmental impact. It is one of the simplest aldehydes (HCHO), and, because of its extreme reactivity, even with itself, it cannot be readily isolated or handled in the pure state. It is used principally to produce synthetic resins and adhesives. This use accounts for 75% of the total production of formaldehyde, (Parker,1997).

Formaldehyde's primary significance is due to the impact which its presence can have on human health. Its vapours are irritants to the skin, eyes and mucous membranes. It is also an irritant to all parts of the respiratory system and it can be absorbed through the skin, (Keith and Walker, 1995).

4.1.2 MDI

Diphenylmethane diisocyanate, colloquially known as MDI, is also used in the manufacture of OSB. As its name suggests it is an isocyanate and it is immiscible with water, but, it will react with water to produce inert and non-biodegradable solids.

There are no MDI releases to the atmosphere from the OSB manufacturing process. The MDI is consumed in the press due to the temperature and pressure and in this inert form it is contained in the board. The waste MDI (produced by the calibration of resin pumps and resin spills) is disposed of by high temperature incineration. MDI is a respiratory irritant and potential respiratory sensitiser – repeated inhalation of vapour or aerosol at levels above the occupational exposure limit could cause respiratory sensitisation. Symptoms may include irritation to the eyes, nose, throat and lungs, possibly combined with dryness of the throat, tightness of the chest and difficulty in breathing, (ICI, 1997).

4.1.3 Particulates

In the air pollution field, the terms particulate matter, particulates, particles, and aerosols are used interchangeably and all refer to finely divided solids and liquids dispersed in the air, (Meyers, 1998). The solids or liquids can be either organic or inorganic in nature. Particle sizes from combustion sources are in the 1 to 100 micrometer range, although particles smaller than 1 micrometer can occur through condensation processes, (Babcock and Wilcox, 1978).

Particulates are the main source of haze that reduce visibility, (http://www.epa.gov). Other environmental effects include soiling of surrounding areas and aggravation of adverse effects of sulphur dioxide (SO_2) (Babcock and Wilcox, 1978). They can cause or exacerbate human respiratory illnesses. Especially harmful to the human respiratory system is the fraction of mid-sized particles, PM_{10}, (Pepper et al, 1996). Particulates can also aggravate cardiovascular disease and damage lung tissue and some are even carcinogenic, (Masters, 1998).

4.1.4 Volatile Organic Compounds

Volatile Organic Compounds, known as VOCs, include any organic carbon compound that exists in the gaseous state in the ambient air, (Meyers, 1998). These compounds consist of molecules containing carbon and hydrogen and include aromatics, olefins and paraffins. VOCs are liberated during the burning of fuel, solvents, paints, glues and other products. Cars are also an important source of VOCs, (www.epa.gov/oar/oaqps/pegcaa.html).

Emissions of VOCs are important because some are toxic by themselves and most are precursors of ozone and other species associated with photochemical smog, (Meyers, 1998). Smog can cause respiratory problems, eye irritation, damage to vegetation and reduce visibility, (Babcock and Wilcox, 1978).

4.1.5 Nitrogen Oxides

Although nitrogen forms eight different oxides, commonly collectively known as NO_x, the principal air pollutants are the two most common oxides, nitrogen oxide

(NO) and nitrogen dioxide (NO_2), (De Nevers, 1995). NO_x are produced by natural processes, including bacterial action in the soil, lightning and volcanic eruptions and by human activity during combustion processes at temperatures higher than about 1000°C. The principal emissions of oxides of nitrogen from human activities are from the combustion of fossil fuels in stationary sources (heating, power generation) and in motor vehicles (internal combustion engine), (Elsom, 1987).

NO_x has been identified as a precursor to ozone and smog formation, (Babcock and Wilcox, 1978).

4.1.6 Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless gas emitted during the incomplete combustion of fuels. CO is emitted during any combustion process, and transportation sources account for about two-thirds of the CO emissions, (Meyers, 1998). CO can also be produced as a consequence of the atmospheric oxidation of hydrocarbons, (Jackson and Jackson, 1996).

The primary environmental significance of CO is its effect on human and animal health, (Babcock and Wilcox, 1978). It is an asphyxiant, i.e. it interferes with the blood's ability to carry oxygen from the lungs to the body's organs and tissues. When inhaled, it readily binds to haemoglobin in the bloodstream to form carboxyhaemoglobin (COHb). Haemoglobin, in fact, has a much greater affinity for CO than it does for oxygen, so even small amounts of CO can seriously reduce the amount of oxygen conveyed throughout the body, (Masters, 1991). Depending on the concentration and exposure time, it can cause impaired motor skills and physiological stress, (Babcock and Wilcox, 1978).

4.1.7 Sulphur Dioxide

Sulphur dioxide (SO_2) is released into the atmosphere from both natural and anthroprogenic sources. The principal natural source of SO_2 is volcanic eruptions, but these are sporadic and do not come close on an annual basis to anthroprogenic sources. Fossil fuel combustion produces roughly 85% of the anthroprogenic emissions, (Bridgman, 1990). The only significant noncombustion sources of sulphur emissions are associated with petroleum refining, copper smelting, and cement manufacture, (Masters, 1991).

SO_2 is a source of acid rain, which is produced when SO_2 combines with water droplets to form sulphuric acid (H_2SO_4), (Pepper *et al*, 1996). Acid rain is an environmental problem because not only does it damage buildings and sensitive architectural structures, it can also do damage to vegetation and crops. In extreme cases, leaf chlorosis (whitening) and necrosis (death) are obvious. However, at lower concentrations, damage resulting in reduced growth without visible lesions may occur, (Jackson and Jackson, 1996). Also, SO_2 and other tropospheric aerosols containing sulphur are believed to affect the radiation balance of the atmosphere, which may cause cooling in certain areas, (Pepper *et al*, 1996). It is a respiratory irritant and can cause shortness of breath, enhanced likelihood of lower respiratory tract illness and chronic lung disease, (Jackson and Jackson, 1996).

4.1.8 Biological Oxygen Demand

The degree of oxygen consumption by microbially-mediated oxidation of contaminants in water is called the biological oxygen demand (BOD). This parameter is commonly measured by determining the quantity of oxygen utilized by suitable aquatic micro-organisms during a five-day period, (Manahan, 1993). The BOD test is used as an accurate measurement of water pollution. A high BOD is indicative of water that is very polluted and thus requiring a high degree of treatment in order for it to be either released safely to another water body (in the case of a discharge) or for use for some other specific purpose. Since BOD is a measure of water pollution, it also indicates what that water is fit for, eg. whether or not it is fit to drink or fit for use for recreational purposes etc.

4.1.9 Chemical Oxygen Demand

Chemical oxygen demand (COD) is a measure of the amount of oxygen required to oxidize the organic matter – and possibly some inorganic materials – in a water sample, (Pepper *et al,* 1996). There is usually a direct ratio between COD and BOD.

The COD test is used as an indicator of pollution in any particular water body or waste and is thus a measure of what its polluting potential is. For example if an effluent has a very high COD then it has the potential to pollute a water-body (the degree of pollution depending on the size of the water-body) to which it will be released unless some form of treatment is carried out. Similarly to BOD, COD is also used as a measure of water pollution in a water body and so indicates what that water is fit for, i.e. it determines if the water is used for drinking water or used for recreational purposes etc.

4.1.10 pH

Molar concentrations of the hydrogen ion [H^+], range over many orders of magnitude and are conveniently expressed by pH, which is defined as:
$pH = - \log_{10} [H^+]$, (Manahan, 1993).

pH indicates the nature, i.e. acidic or basic, of a liquid and it has no direct health effect.

4.1.11 Nitrates

Nitrates [$(NO_3)^-$] may pollute both groundwater and surface water. Groundwater pollution involves the risks associated with consuming high-nitrate water, while surface water pollution can lead to eutrophication – increased algal growth and oxygen depletion, (Pepper *et al*, 1996). There are many sources of nitrates including crop production, animal confinement operations, industries, geologic formations and excessive use of fertilizers. A specific toxic effect of the nitrate ion is a condition of infants called methahaemoglobinemia (blue-baby syndrome), in which haemoglobin is converted to a form which cannot carry oxygen to the tissues. Severe cases can result in mental retardation, (Bunce, 1993).

4.2 Factors in Control Equipment Selection

There are a number of factors that must be considered prior to selecting a particular piece of pollution control/abatement equipment. In general, they can be grouped into three categories: environmental, engineering and economic.

Environmental

1. Equipment location
2. Available space
3. Ambient conditions
4. Availability of adequate utilities (i.e. power, water etc.)
5. Maximum allowable emission
6. Aesthetic considerations (eg. visible steam or water plume)
7. Contribution of pollution control system to other media pollution (i.e. a piece of equipment may itself produce large amounts of toxic waste)
8. Contribution of pollution control system to plant noise levels.

Engineering

1. Contaminant characteristics (i.e. physical and chemical properties, concentration etc.)
2. Design and performance characteristics of the particular control system (i.e. size, weight, reliability and dependability etc.).

Economic

1. Capital cost (eg. equipment, installation, engineering etc.)
2. Operating cost (utilities, maintenance etc.)
3. Expected equipment lifetime and salvage cost.

It is also very important when assessing a piece of equipment to consider compliance with current emission standards and anticipate future standards and also to evaluate the feasibility of a proposed equipment design, (Buonicore, 1994).

Due to the fact that air pollution control equipment appears to be the major element in most of the licences examined in this thesis, a closer investigation of two of the most popular pieces of equipment will now be undertaken.

4.2.1 Wet Electrostatic Precipitators

Wet Electrostatic Precipitators (WESPs) are one of the most popular methods in use for removing fine solids from gas streams. Collection efficiency can be expected to be 99.8% or greater of inlet gas loading, (Babcock and Wilcox, 1978). In the production of particleboard the drying of the wood is a major source of organic and particulate emissions. Conventional devices like baghouses, scrubbers or cyclones are quite suitable for inorganic particles, but inappropriate for the organic fraction, (Louisiana-Pacific, 1997).

The cleaning of the exhaust gas takes place in four steps as follows:

1. Cooling by pre-moistening, grid separation and condensation of high molecular hydrocarbons
2. Scrubbing for saturation, separation of remaining dust and water soluble substances
3. Wet Electrostatic Precipitator to eliminate wood tar, aerosols, fine particles and odour
4. Treatment of the circuit water for internal disposal of sludge (no waste water is produced as this water is recycled through the system), (Hydroair, 1995).

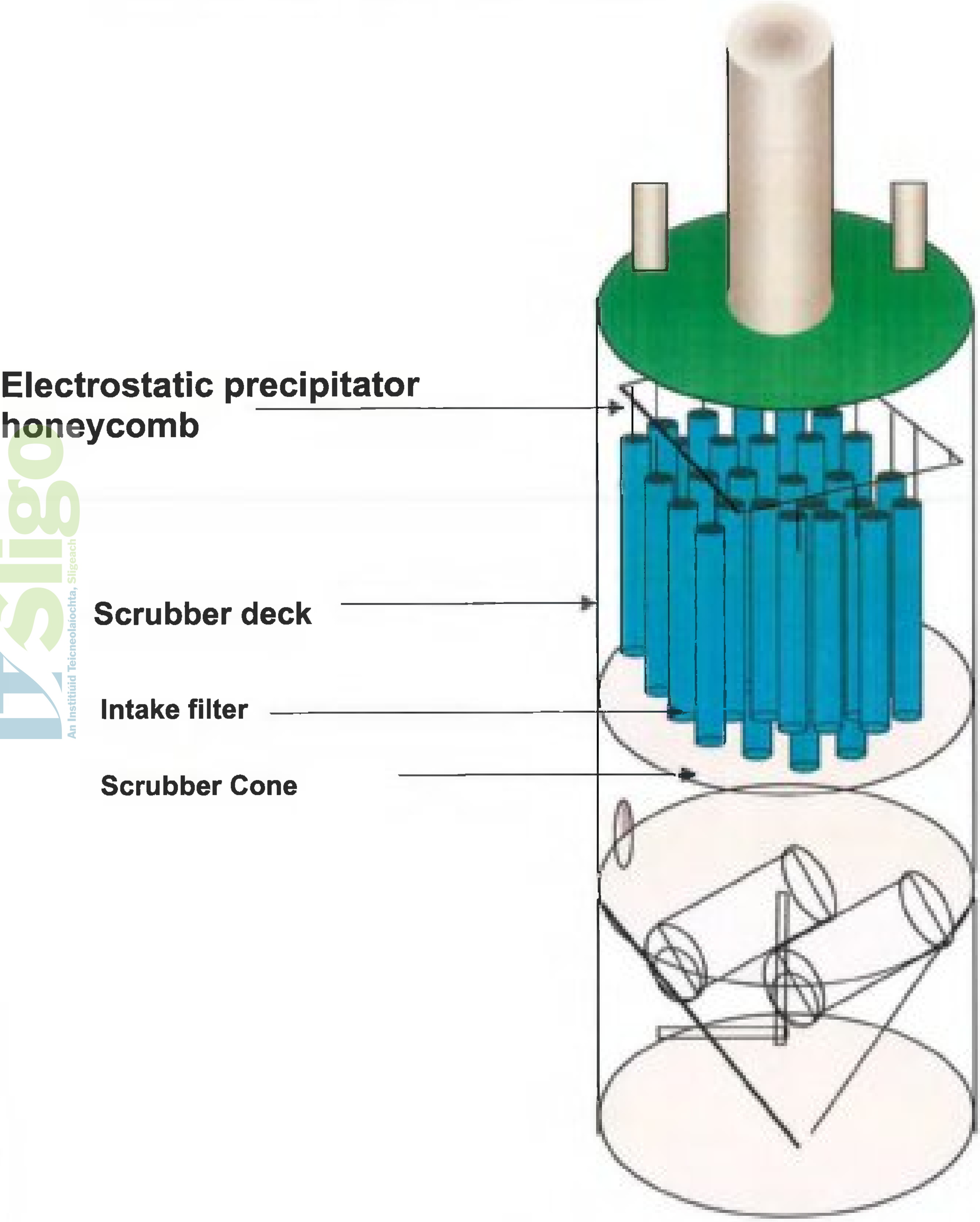
Before entering the collection area, emissions are moistened with the recirculated water in the in-built scrubber section of the WESP. Pre-moistening serves many functions the most important being to remove water-soluble particles.

Once the air has been suitably conditioned, it enters the electrified area of the WESP. In this section, particles are charged and collected on a wet surface. The water layer around the particle and the water film on the collector surface prevents permanent adhesion of the particles to the collecting surface. This section contains two electrodes, a positive and negative. The positive electrode is the collector and has a large surface area for this purpose. The negative electrode is a source of electrons and is called the emitter electrode. In contrast to the collector, it has a small surface area. Minimising the area increases the electrostatic field intensity near the electrode, thereby increasing its ability to emit electrons at a lower applied voltage. The electrons collide with and attach to particles present in the air stream, lending them a negative charge. Once charged, the particles are pulled toward the collector due to the electrostatic field, (Hydroair, 1995). Particle collection in an electrostatic precipitator is essentially a process of mass transfer through a moving gas, in a net direction that is normal to the collecting surface, (Strauss, 1971).

Periodically the electrostatic plates are washed down with an overhead spray to flush any collected particles that may have gathered there. To eliminate and collect water droplets, a mist or droplet eliminator is used in the top section of the unit, thus preventing them from escaping out the top of the WESP and causing a nuisance.

Due to the fact that a lot of water is used in this type of system, recycling of water is necessary. The water is removed from the base of the cone and passed through a decanter, which removes a large proportion of the suspended solids. These suspended solids or sludge are subsequently burnt in the on-site furnace. The cleaned water is then recycled to the WESP and is reintroduced at both the premoistening stage and above the ESP.

FIG 4.1: A WET ELECTROSTATIC PRECIPITATOR



4.2.2 Regenerative Thermal Oxidizers

Regenerative Thermal Oxidizers (RTO's) provide an effective control technology for air toxins as well as VOC emission compliance. Key parameters for the destruction of hydrocarbons includes the three T's – time, turbulence and temperature – as well as the availability of oxygen. Thermal oxidation relies on the breakdown of hydrocarbons by raising the temperature to promote conversion to carbon dioxide and water.

The basic operating principle of an RTO is the air stream to be processed is fed through a ceramic heat exchange bed, which preheats the air before it enters the central combustion chamber. The hot, purified gases are then exhausted back through another heat exchanger, which absorbs the energy from the air stream and stores it for the next cycle, (Pennington, 1996).

This type of system can use up to three ceramic filled beds that are alternately heated by the hot combustion gases and cooled by the incoming air to be treated. Waste gases enter the system and pass upwards through one or more heated beds (heat exchangers), which preheat the gases to almost the final oxidation temperature. The preheated gases then enter a combustion chamber and are raised to the final oxidation temperature and held at that temperature to achieve a high destruction efficiency, (Anon, 1995).

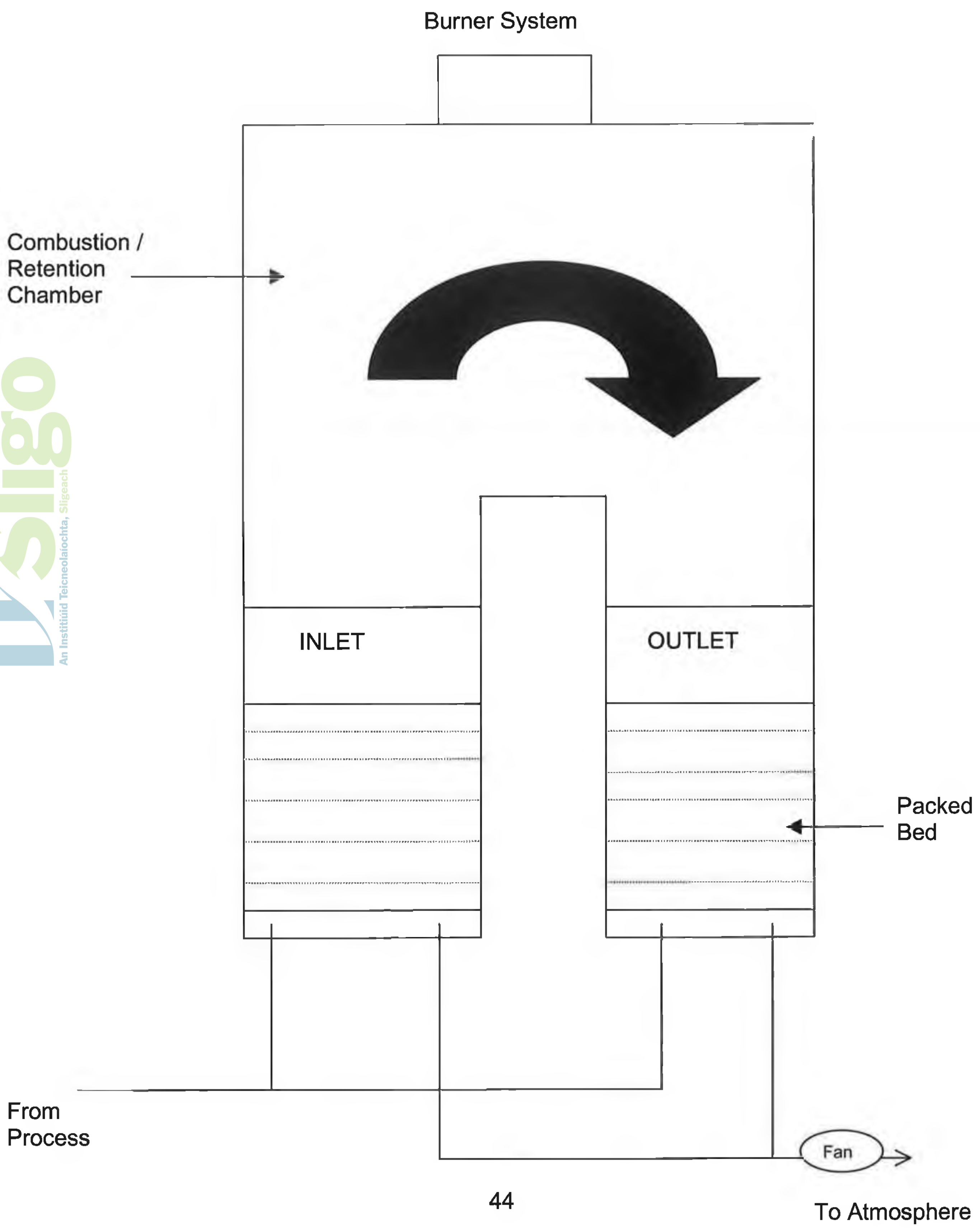
The purified hot gases exit the combustion chamber through one or more different ceramic beds cooled in the earlier cycle. Heat from the gases is absorbed by the beds, before the gases discharge to the atmosphere at an outlet temperature only slightly higher than the inlet temperature. A remaining bed is continuously being purged to ensure a high overall efficiency. The thermal efficiency of these systems is high, and at operating temperatures of 700 – 1100^{o}C with residence times of up to 1 second, destruction efficiencies of up to 99% can be achieved, (Anon, 1995).

RTO's have been proven as a control technology for VOCs, formaldehyde, CO, particulates and NO_x, (Seiwert, 1994).

Another major advantage of using an RTO is that it is capable of thermal energy recoveries of +95% and they generally lend themselves better to higher process exhaust flow rates, (Seiwert, 1995). The heat transfer media used is generally a temperature and chemical resistant material such as chemical porcelain, (Seiwert, 1995).

Periodically, RTO's require a process called "bake-out". This is where the temperature is raised and any particulate build-up is literally burnt off. The first indication that a bake-out may be necessary will usually be the RTO system's inability to produce the desired process airflow rate, even with the exhaust fans running at full speed, (Huntington Energy Systems, circa 1990).

FIG 4.2 : A REGENERATIVE THERMAL OXIDIZER



4.3 What is OSB?

Oriented Strand Board (OSB) is an environmentally friendly timber based structural panel. It has become one of the most popular building products in the United States since it was first commercialised on a large scale by the Louisiana-Pacific Corporation almost two decades ago. One of the main attractions of this product is that it uses small diameter timber, which comes from the tops of trees and from forest thinnings. This pulpwood material, a normal by-product of forest management, is ideally suited for OSB production.

OSB is made from precisely engineered strands of wood compressed with moisture resistant resin at high temperature and pressure. The main timber species used in the manufacturing process are Lodgepole pine *Pinus contorta* and Sitka spruce *Picea sitchensis*, (Louisiana-Pacific, 1995).

4.3.1 The benefits of OSB

1. Outstanding strength properties - comparable to chipboard.
2. Excellent dimensional stability - in a wide variety of environmental conditions.
3. High rigidity - resists deflection and bending.
4. High water resistance/water tolerance - exhibits none of the stresses characteristic of veneer-based products that can lead to distortion, splitting and delamination.
5. Repeatable quality and product consistency - not dependent on character of individual log.
6. Predictable working characteristics - saws readily with consistent results.
7. Excellent fastener-holding - resists splitting even when nailed close to panel edge, (Louisiana-Pacific, 1995).

4.3.2 OSB Manufacture – Process Outline

The process of manufacturing OSB is quite simple and involves a number of steps. The production process of the LP Waterford mill is outlined as a typical example of how the board is made:

1. The timber logs are brought on-site via a number of hauliers which are contracted to do so by Coillte (the State owned Irish Forestry and Timber Company). The hauliers are obliged to bring the logs to the factory only during pre-specified hours on certain days. This is a requirement of the IPC licence so as to cause the minimum amount of noise and inconvenience to neighbours.

2. Once the lorries have been weighed in at the weighbridge and inspected to ensure that the quality of the timber is good, the log-loading equipment in the log-yard unloads the lorries.

3. The logs are stacked and sorted into particular bays according to their species and quality. When logs are required in the plant, they are removed from their bays and placed in the log infeed conveyor, using the log-loading equipment, from where they are fed slowly into the plant.

4. Once inside the plant the logs pass along a conveyor belt system to the "debarker" where all of the bark is removed from the log, (the bark is used as supplementary fuel in the furnace). From there the now debarked logs pass along to the "strander" where the logs are shredded to the required flake size (this size varies with the product being made at any one time). These flakes are then stored in the wet bins until they are required for use.

5. The strands are dried in one of the four large dryers. All of the emissions from the dryers are passed through the WESP in order to clean them before emission to atmosphere.

6. Once dry the strands pass to the blenders where LPF [liquid phenol formaldehyde] and MDI (an isocyanate) are added in order to bind the strands together. A blender is basically a large rotating drum where the dry flake strands and the resins are blended together.

7. The strands then pass to the forming line where they are arranged in such a manner that they are not all aligned in one direction (this happens in the forming heads which are located on the main line), and from here the product passes to the press where it is put under enormous pressure (approximately 3000 Psi) and heat (ranging from 215 to 218 ^{o} C) in order to bind it together in the proper manner. Like the dryers, all emissions from the press are passed to the WESPs for treatment before allowing them to vent to atmosphere.

8. The board is then cut to the required size and passed to the shipping end of the factory where it is packaged and stored until it is required.

CHAPTER 5: EXPLANATION OF THE MATRIX SYSTEM

It has been decided that for the purpose of this study that a matrix system will be used to compare and contrast the mills from the individual countries that have been studied and described herein. The basis of this system is that each mill will be individually assessed and included in an overall profile of their licence. These parameters are listed in Table 5.1 below. If the mill licence contains any of these parameters it will be indicated by an "X" in the appropriate box. If the parameter is not included it will be illustrated by the symbol " - " indicating that the assessment of the parameter is not applicable to the licence under review.

Table 5.1: Licence parameters to be included as headings in the developed matrix.

Air	Water	Waste	Noise
Formaldehyde	BOD	General Refuse	Presence of ELVs
MDI	Suspended Solids	Hazardous Waste	
Particulates	COD		
Volatile Organics	pH		
Nitrogen Oxides	Ammonia		
Carbon Monoxide	Nitrates		

Sulphur Dioxide	Total Phosphorus		
Opacity	Heavy Metals		
Dioxin	FOG		

When all the licence parameters have been tabulated, it will be possible to profile the individual licences quickly and effectively using the developed matrix system. This system is also advantageous for the simultaneous comparison of different licences.

The licenses will be broken down into the air and water results associated with each particular mill. This is done because these two elements are the main focus of the licenses. This in turn aids in the comparison of the mills on an individual basis. The results section will look at the European mills versus the American and Canadian mills as well as comparing the mills within each of these two geographical regions.

In the discussion, all of the aforementioned separate elements will be compared. The determination of the most effective licensing system is in the identification of the system which allows the company to be competitive while minimising the total impact on the surrounding environment.

SECTION 2. RESULTS

TABLE 1 : EUROPEAN RESULTS SUMMARY

PARAMETERS	MILL LICENCES							
	LP Europe, Ireland	Kronospan, Wales	CSC, Scotland	Isoroy, France	Kronofrance, France	Willamette, Ireland	Masonite, Ireland	Finsa, Ireland
	IPC Licence	IPC Licence	LAPC	Classified Installation	Classified Installation	IPC Licence	IPC Licence	IPC Licence
Formaldehyde	X	X	X	-	X	X	X	X
MDI	X	-	-	-	-	X	-	-
Particulates	X	-	X	X	X	X	X	X
Volatile Organics	X	-	X	-	X	X	X	X
Nitrogen Oxides	X	-	-	-	X	X	X	X
Carbon Monoxide	X	X	-	-	-	X	X	X
Sulphur Dioxide	X	-	-	-	-	-	X	X
Opacity	-	-	-	-	-	-	-	-
Phenol	X	-	-	-	-	-	X	-
Dioxin	X	-	-	-	-	X	-	X
BOD	X	X	-	X	X	X	X	X
Suspended Solids	X	X	-	X	X	X	X	X
COD	-	X	-	X	X	-	-	X
pH	X	X	-	X	X	X	X	X
Ammonia	X	X	-	X	-	X	X	X
Nitrates	-	-	-	-	X	-	X	-
Total P	X	-	-	-	X	X	X	X
Phenol	X	-	-	-	X	X	-	-
Heavy Metals	X	-	-	-	-	-	-	-
FOG	X	X	-	-	-	X	X	X
Formaldehyde	-	X	-	-	-	-	-	-
General Refuse	X	-	-	X	X	X	X	X
Hazardous Wastes	X	-	-	-	-	-	X	X
Noise	X	-	-	X	X	X	X	X

X ELV present

\- No ELV present

TABLE 2 : USA AND CANADIAN RESULTS SUMMARY

PARAMETERS	MILL LICENSES				
	Swan Valley, Canada	Dawsons Creek, Canada	Hanceville, USA	Jasper, USA	Roxboro, USA
	Air Permit	Air Permit	Air Permit	Air Permit	Air Permit
Formaldehyde	X	X	X	X	-
MDI	-	-	X	X	-
Particulates	X	X	X	X	X
Volatile Organics	X	X	X	X	X
Nitrogen Oxides	X	-	X	X	X
Carbon Monoxide	-	-	X	X	X
Sulphur Dioxide	-	-	-	X	-
Opacity	-	-	X	-	X
Phenol	X	-	X	-	-
Dioxin					
Water ELVs	X	-	-	-	-
General Refuse	X	-	-	-	X
Hazardous Wastes	X	X	-	-	X
Noise	X	-	-	-	-

Note: This table denotes whether a particular mill has air, water, waste or noise parameters mentioned in their licence. As can be seen, most of the USA mills do not have any if these parameters present in their licence.

X ELV present
\- No ELV present

TABLE 3 : MILL LICENSES AIR EMISSION REFERENCE POINTS

MILL	REFERENCE EMISSION POINTS
LP Europe	Hydroair (WESPs)
Kronospan	Hydroair (WESPs)
CSC	Driers[1] and Press[2]
Isoroy	Point source
Kronofrance	Hydroair (WESPs)
Swan Valley	Press RTO's[1] and Drier RTO's[2]
Dawsons Creek	Drier
Hanceville	Press[1] and three driers[2]
Jasper	Press RTOs[1] and Drier RTOs[2]
Roxboro	Press RTOs[1] and Drier RTOs[2]
Willamette	Press[1] and Driers[2]
Masonite	Press[1] and Driers[2]
Finsa	Press

Note: The above table is used as a reference for Tables 4, 5, 6 and 7. Where there is more than one emission point for a mill the first emission point is given the subscript [1] and the second emission point the subscript [2].

TABLE 4 : SUMMARY OF EUROPEAN AIR ELVs (mg/m^3)

MILLS	PARAMETERS							
	HCHO	MDI	PM	VOCs	NOx	CO	SO_2	OPACITY
LP Europe	X	X	X	X	X	X	X	-
Kronospan	X	-	X	X	-	-	-	-
CSC	X	-	X	X	-	-	-	-
Isoroy	-	-	-	X	-	-	-	-
Kronofrance	X	-	X	X	X	-	-	-
Willamette	X	X	X	X	X	X	-	-
Masonite	X	-	X	X	X	X	X	-
Finsa	X	-	X	X	-	-	-	-

- No ELV present

TABLE 5 : EUROPEAN AIR ELVs (mg/m^3)

MILLS	PARAMETERS							
	HCHO	MDI	PM	VOCs	NOx	CO	SO_2	OPACITY
LP Europe	12	0.1	20	130	200	600	10	-
Kronospan	20	-	20-50	8-20	-	-	-	-
CSC	20	-	20	130	-	-	-	-
Isoroy	-	-	-	30	-	-	-	-
Kronofrance	20	-	100	150	500	-	-	-
Willamette	6[1] – 20[2]	0.07	20[1] – 50[2]	100[1] – 130[2]	300	300	-	-
Masonite	4[1] – 15[2]	-	5[1] – 20[2]	50[1] – 100[2]	200	100	10[1] – 40[2]	-
Finsa	10	-	50	130	-	-	-	-

- No ELV present

TABLE 6 : SUMMARY OF COMPARISON OF EUROPEAN AND AMERICAN/CANADIAN AIR PARAMETERS (kg/hr)

MILLS	PARAMETERS							
	HCHO	MDI	PM	VOCs	NOx	CO	SO_2	OPACITY
LP Europe	X	X	X	X	X	X	X	-
Kronofrance	X	-	X	X	X	-	-	-
Swan Valley	X	-	X	-	-	-	-	-
Dawsons Creek	X	-	X	X	-	-	-	-
Hanceville	X	X	X	X	X	X	-	X
Jasper	X	X	X	X	X	X	X	X
Roxboro	-	-	X	X	-	-	-	-

X ELV present
- No ELV present

TABLE 7 : AIR RESULTS (KG/HR)

MILLS	PARAMETERS							
	HCHO	MDI	PM	VOCs	NOx	CO	SO_2	OPACITY
LP Europe	1.75	0.01	2.95	18.95	29.5	87	51	-
Kronofrance	3	-	15	22.5	75	-	-	-
Swan Valley	0.288[1] – 0.306[2]	0.051[1]	7.50[1] – 18.50[2]	1.0008[1] – 3.96[2]	3.24[1] – 23.4[2]	-	-	20%
Dawsons Creek	0.5	-	3.5	3.5	-	-	-	-
Hanceville	0.19[1] – 0.16[2]	0.003[1]	4.47[1] – 4.37[2]	2.15[1] – 11.29[2]	5.82[1] – 18.23[2]	9.45[1] – 35.44[2]	-	20%
Jasper	0.71[1] – 0.67[2]	0.045[1]	4.35[1] – 6.14[2]	2.37[1] – 6.70[2]	5.45[1] – 13.69[2]	16.60[1]	0.005[1] – 0.50[2]	10%
Roxboro	-	-	3.25[1] – 10.23[2]	1.47[1] – 3.62[2]	6.80[1] – 18.60[2]	8.40[1] – 16.78[2]	-	20%

Units kg/hr
\- No ELV present

TABLE 8 : MILL LICENSES WATER EMISSION REFERENCE POINTS

MILLS	REFERENCE EMISSIONS POINTS
LP Europe	Sewage Treatment Plant[1] and Discharge to River Suir[2]
Kronospan	Discharge to River Afon Bradley
CSC	-
Isoroy	Point Source*
Kronofrance	Point Source
Willamette	Discharge to River Anner after Wastewater Treatment Plant
Masonite	Discharge to River Shannon
Finsa	Settling Tank at back of Plant[1] and Settling Tank at back of glue plant[2]

* Point Source means that the effluent discharge is from a single unidentified source in the licence.

TABLE 9 : EUROPEAN WATER ELVs RESULTS SUMMARY

MILLS	PARAMETERS						
	BOD	SS	COD	pH	Ammonia	Nitrates	Total P
LP Europe	X	X	-	X	X	-	-
Kronospan	X	X	-	X	X	-	-
CSC	-	-	-	-	-	-	-
Isoroy	X	X	X	X	X	-	-
Kronofrance	X	X	X	X	-	-	-
Willamette	X	X	-	X	X	-	X
Masonite	X	X	-	X	X	X	X
Finsa	X	X	X	-	X	-	X

\- No ELV present

TABLE 10 : EUROPEAN WATER RESULTS

MILLS	PARAMETERS						
	BOD (mg/l)	SS (mg/l)	COD (mg/l)	pH	Ammonia (mg/l)	Nitrates (mg/l)	Total P (mg/l)
LP Europe	20[1[- 50[2]	30[1]	-	6 – 9[1&2]	10[1&2]	-	-
Kronospan	20	100	-	6 - 9	5	-	-
CSC	-	-	-	-	-	-	-
Isoroy	1980	1500	1980	7 - 8	530	-	-
Kronofrance	30	35	125	5.5 - 8.5	-	-	-
Willamette	200	300	-	6 - 9	10	-	5
Masonite	20	30	-	6 - 9	10	15	3
Finsa	80[1] – 40[2]	160[1] – 30[2]	200[1] – 300[2]	-	5[1&2]	-	3.5[1] – 2.0[2]

Units mg/l

- No ELV present

TABLE 11 : MILL PRODUCTION CAPACTIES (m^3/yr)

MILLS	Production Capacity (m^3/year) (approximate)	Year of Licence Issue
LP Europe	350,000	1995
Kronospan	180,000	1993
CSC	265,000	1993
Isoroy	90,000	1991
Kronofrance	300,000	1999
Swan Valley	398,206	1997
Dawsons Creek	331,838	1998
Hanceville	322.989	1996
Jasper	398,206	1997
Roxboro	353,960	1996
Willamette	350,000	1996
Masonite	140,000	1995
Finsa	120,000	1997

SECTION 3. DISCUSSION

CHAPTER 6: DISCUSSION

In this section a number of items will be discussed, including the following:

6.1 the relationship between the political system in a country and the implementation of environmental standards

6.2 an examination of the individual licenses as regards the scope of the licence and the conditions contained therein

6.3 an examination of the air emissions treatment options and the results tables

6.4 an examination of other emission limits

6.5 the deficiencies or excesses of the various licensing systems

6.6 future developments.

These items will be discussed with a view to comparing the different types of licensing systems which are in operation in the countries of interest and determining which system is best from an environmental and economic perspective.

The original proposal for this thesis stated that the enforcement mechanisms and the penalties for non-compliance in the various countries would also be examined but these two elements were found to be unfeasible upon investigation. The reason for this is that whilst the EPAs stated that they had strict reporting procedures and enforcement mechanisms, none of the Agencies would actually set down in writing what these were. The reason the EPAs did not want to do this is that each non-compliance is a separate incident and they did not want to be tied to a particular course of action.

The reporting procedures in the various licenses were examined but it was found that the only licenses which had the reporting procedures listed in any detail were the four Irish mills. Due to the fact that the Irish mills were all in the same industry and all reporting to the one EPA there was no point comparing/contrasting them as they had basically the same requirements.

6.1 The Relationship between the Political System in a Country and the Implementation of Environmental Standards

As described in Chapter 3 there are two basic forms of democratic government, unitary and federal considered in this thesis. A unitary system is one whereby the Government is directly elected by the people and there is usually a Head-of-State who has a number of symbolic, procedural and diplomatic functions, (Gallagher,1990). Whilst Ireland, France, Scotland and Wales all fall within this category of Government, there are a number of differences in how each system works (cf. Chapter 3) and indeed those in Scotland and Wales are in an evolutionary state.

Due to the fact that in a unitary state the government is directly elected by the people it cannot afford to be seen to be ignoring environmental matters and must be seen to have, at the very least, a minimum set of standards in place. This is due to the fact that the government representatives are directly elected by the people and thus must satisfy their constituents once elected if they want to enter Office again. This is borne out in each of the countries, most of which have Integrated Pollution Control Licensing (IPC) systems in place (the exception being the Local Air Pollution Control permit system in Scotland). On the other hand the governments are also responsible for attracting new industries to their countries, thus creating employment and helping their national economies. As discussed in Chapter 3, section 3.2 the way in which governments have overcome this problem is to set-up independent EPA's who have taken over the role of protecting the environment and regulating industry, thus leaving the government free to attract new industry to their country.

In the federal system of government the country consists of a number of States (America) or Provinces (Canada). The federal government is responsible for passing laws on such issues as finance, foreign affairs, environment, fisheries, forestry as well as broad matters in regard to education, marriage laws, social legislation, although much of the detail concerning the latter is devolved to the states themselves. Like the unitary governments, both the USA and Canada have set up a EPAs to protect the environment as a whole and to regulate industry.

Because of the nature of its constitution and the size of the country, America in particular and Canada to a degree, have had to delegate responsibility for environmental licensing to the States/Provinces for both legal and administrative reasons. Thus, the federal EPA has issued what are known as "delegations" to certain States/Provinces. What this means is that if a State is "delegated" for waste then it is allowed by the federal EPA to issue waste permits and draw up its own waste plans. In other words it has been deemed by the federal EPA to have similar standards to itself and have an efficient system of control and regulation in place and is therefore capable of governing itself environmentally. However, this has led to a lack of uniformity in the manner in which the EPA directives are implemented. This lack of uniformity can lead to economic barriers whereby one mill has much stricter ELVs to adhere to than another similar mill in a different State. It is quite noticeable that practically all of the mills in North America are within 50kms of a state or national boundary, this must be more than a coincidence.

As was previously mentioned, the federal EPA draws up the regulations and the States implement them as they see fit. There is a certain minimum standard which must be implemented, but after that it is at the discretion of the State as to what the standard is set at. This has one main obvious disadvantage in that certain States will have more stringent limits than others leading to lack of uniformity as was previously mentioned. This will be compounded if they are in environmentally sensitive locations and so will be unattractive to industry. This means that ultimately certain States will have unfair (?) economic advantages over other States for industrial development due to the fact that they have lower environmental standards. On the other hand, if a State has no natural forestry and therefore no hope of ever having a wood processing mill located in it, it is very easy for it to set high ELVs for that particular industry and which are in effect meaningless. Thus, it is very important that the reasons behind ELVs are investigated before deciding if a State has high environmental requirements or not. The only way that this may be overcome is that the States which have the higher environmental standards should also be the States which have the greatest resources, be they natural or anthroprogenic, but this is unlikely to happen for economic and social reasons. Thus, overall this system does not, in general, lend itself to strict environmental control systems.

The European Union is basically a federal system, whilst its individual members generally operate a unitary form of government albeit with a variety of electoral systems which produce different types of government. Brussels passes legislation and each member state must implement this legislation within a given time frame as a minimum. Just like in the USA and Canada, each State is allowed to implement stricter controls/standards then is set down in the EU legislation but this then raises the question of unfair competition between member states. This point will be demonstrated later in this discussion.

As was explained in CHAPTER 3, section 3.2 there are four broad approaches which can be taken when preparing environmental legislation:

1. The free market approach and self-regulation (e.g. eco-labelling) which is becoming much more popular in recent years due to the realisation that an environmentally friendly product is much more marketable than one which is seen to harm the environment. This has led to the introduction of Environmental Management Systems (EMS) and other such initiatives as the

Forestry Stewardship Council (FSC) which is working towards making all forests sustainable.

2. The reformist approach and financial incentives (i.e. taxes and subsidies) which is popular in some countries but generally it lead to trade barriers and lack of competitiveness in the market-place.
3. The interventionist approach and legislation which is the route that most countries take whereby the "polluter-pays" principal operates. The IPC system is an example of this. Like the taxes and subsidies approach it can lead to unfair economic advantage for countries which have less stringent controls than others and so introduce trade barriers for companies. The way to avoid this is for increased international co-operation between governments as well as strict penalties for not adhering to agreed international standards.
4. The radical approach which is based on anticapitalism and is antiglobilisation (i.e. increased reliance on co-operation and partnership), no countries have adopted this approach, (Blowers and Glasbergen, 1996).

6.2 An Examination of the Individual Licenses as regards the Scope of the Licence and the Licence Conditions contained therein

The Irish mills of LP Europe, Willamette, Masonite and Finsa all have IPC licenses which are very detailed. Each licence contains ELVs for air, water and noise and details waste management on-site and off-site, as in disposal of wastes off-site. The licenses also contain conditions on recording and reporting requirements, for example disposal records and analysis of wastes, as well making it necessary for each site to have an emergency response plan. When viewed as a whole, these licenses are very comprehensive and cover all aspects from emission limit values and analysis of emissions, to reporting requirements. Generally, the air testing frequencies for these mills are quite high, in that they would test at least once a month and in some cases bi-monthly.

In contrast to this the Scottish mill (CSC) is only required to test its air emissions once per quarter. The regulatory Authority (SEPA) was unwilling to tender document sin regard to any other waste matter emanating from the CSC mill. As was previously described in Chapter 2, section 2.3.3 this mill has a Local Air Pollution Control Permit which means that only air emissions are covered by the Permit. They are required to monitor drier inlet and outlet temperatures as are the Irish mills. The monitoring is carried out on a continuous basis and this is used as a measure of how much pollutants are being emitted. The scientific basis behind this monitoring is that the higher the temperatures the greater the amount of pollutants being emitted. However, it is interesting to note that SEPA appears to rely more on this continuous monitoring as a measure of environmental performance than the other Agencies. For example the Irish EPA requires air emission testing (3-4 hour period) on a fortnightly basis at the LP Europe mill, whilst SEPA require air testing on a quarterly basis only. Earlier on in this chapter economic barriers were mentioned and the above is a good example. The cost implication of fortnightly testing as opposed to quarterly testing is very significant especially since both mills monitor dryer inlet and outlet temperatures on a continuous basis. The Irish LP Europe mill therefore has much higher stack monitoring costs than its direct competitor the Scottish CSC mill and so has higher environmental compliance costs to contend with.

Kronospan, which is situated in Chirk, Wales has a much more detailed licence as it, like LP Europe, has an IPC licence. This licence details ELVs for air and water. Emission testing is carried out on the first Wednesday of each second month unless otherwise specified by the EA. They must also monitor the drier inlet and outlet temperatures. The mill is required to report all complaints, non-compliances and results to the Agency. The EA, like SEPA, require less frequent testing than the Irish EPA (once every two months as opposed to once per fortnight), thus they also rely, albeit to a lesser degree, on continuous monitoring. There is no mention of waste or noise in this licence, thus it is not quite as comprehensive as the Irish licenses and so has comparatively lower environmental compliance costs..

Kronofrance and Isoroy are both based in France but Kronofrance had their licence issued in 1999 while Isoroy had theirs issued in 1991. They both come under the terms of "Classified Installations". There is quite a significant difference in the ELVs between the two mills and this will be discussed in detail in the subsequent section. Both mill licenses cover air, water, waste and noise in their scope but the ELVs attached to Kronofrance are much stricter than those attached to Isoroy. Also Kronofrance's licence sets out testing frequencies (ranging from monthly to annual) and reporting requirements. It also is the only licence which mentions a plan for the closure of the mill and how the environmental impacts will be mitigated and this is a very important aspect of any industry and should be included in all environmental licenses. The new Irish licenses that are currently being issued are much closer to Classified Installation licenses in that a mill closure plan and energy consumption are included. This marks a step towards uniform licensing for the one industry within Europe.

The American mills of Hanceville, Jasper and Roxboro are all quite similar. They each specify production capacities which cannot be exceeded in any one year. In addition the maximum number of hours which the RTO's are allowed to operate in any one year is specified, this is quite different from the Europe mills. Both of these conditions effectively limit the amount of emissions which the mills can have. In order to increase production capacities the mills would have to apply for a new licence. In general it appears that the Departments in charge of air emissions at Hanceville, Jasper and Roxboro require monitoring to be carried out upon mill start-up to determine the quantity of the emissions and once this pattern has been established, ELVs are set and continuous monitors are installed on the pollution abatement equipment. These monitors must be calibrated and maintained properly and records kept for inspection. This is a similar approach to monitoring used by both SEPA and the EA. The State Departments appear to rely heavily on continuous monitoring and once the quantity and pattern has been established they have confidence in these continuous monitors. Stack testing is still occasionally carried out, but it is on a much less frequent basis than in the EU countries generally and in particularly in contrast to Ireland. It is also interesting to note that the State Departments are more interested in how much production the mill is allowed per year and the number of operating hours of the RTO's than the amount of pollutants emitted. It is a very different way of limiting pollution potential than the European method which relies more heavily on testing frequency and control. It can be argued that the American system is more environmentally conscious whereas the Irish system is more public conscious. The Department has the powers to ask for testing to be carried out at any time but they appear to be satisfied if the mill complies with the continuous monitoring programme. Thus, the American mills have a much smaller annual expenditure on sampling and reporting than the European mills.

The Canadian mills of Swan Valley and Dawsons Creek have quite similar licenses to the European mills. The Swan Valley licence covers an ambient air quality management plan, a meteorological station, an ambient surface-water quality plan, a groundwater monitoring plan as well as water emissions and waste management. The mill is required to stack test once every two years for the air ELVs specified in addition to continuous dryer temperature monitoring. Also set out in the Licence are water ELVs which when exceeded, all water emissions must stop immediately. Waste disposal and segregation are also mentioned in the licence.

The Dawsons Creek mill licence also mentions waste but not in as much detail as the Swan Valley licence (TABLE 2). The licence refers the reader to the "The Provisions of Waste Management Act (Part2, Section10)" for specifics as regards waste. The licence does require an ambient monitoring plan for PM_{10} and formaldehyde as well as quality assurance of the laboratories used for analysis, although they are still much more lenient on frequency of testing than their European counterparts.

It was seen that the Canadian mill licenses are much more detailed than their American counter-parts and seem to be moving towards a more European method of integrated licensing. However, they require much less frequent monitoring than the other more established integrated systems examined.

6.3 An Examination of the Air Emission Treatment Options and the Results Tables

In the licenses examined in this thesis there were four main types of emission points:

a) Wet Electrostatic Precipitators (WESPs)
b) Regenerative Thermal Oxidizers (RTOs)
c) Driers
d) Press Vents

Of this list only a) and b) are treatment options, the other two are a means whereby the process emissions are vented straight to atmosphere. In selecting a form of pollution abatement equipment there are environmental, engineering and economic factors to be considered as was detailed in Chapter 4, section 4.2. Usually the principal of BATNEEC (Best Available Technology Not Entailing Excessive Cost) is employed but Agencies are moving towards BAT (Best Available Technology) with the advent of IPPC licensing (cf. section 6.6).

Of the above list, the WESPs offers the most complete form of treatment in that the greatest range of pollutants are removed through this single type of control technology. They can achieve a 98.8% collection efficiency for fine solids removal from a gas stream (Babcock and Wilcox, 1978). They are basically a wet scrubber system which also incorporates an electrostatic precipitator for removal of insoluble particles. They are the main treatment technology in operation in the wood processing industry in Europe.

In contrast RTOs are used in the mills in America and Canada and are generally used in conjunction with another form of abatement technology, in many cases a wet scrubber. RTOs are mainly used to treat emissions of Volatile Organic Compounds (VOCs), but it can be used to control other air toxins as well, (Seiwert, 1994). This method relies on the breakdown of the hydrocarbons by raising the temperature to promote conversion to carbon dioxide and water.

The emissions that come from the driers and the press vents are process emissions which are vented straight to atmosphere without any pollution abatement. Because of their greater threat to the environment it can be assumed that these mills would have lower Emission Limit Values (ELVs) than mills which do have pollution abatement equipment. At first glance this apparent contradiction is in fact quite a sensible operating system and ensures that companies which put in place costly abatement equipment in place are rewarded indirectly for doing so. This will be further examined below.

The mill licenses were critically examined according to the matrix system that was described in Chapter 5. Basically this comprises of a list of parameters which were chosen as a representative group of what most of the licenses contained and the parameters which were the best indicators of environmental pollution.

TABLE 1 is a summary of the European mill licenses results. The countries which each of the mills are located in and the type of licensing system which they operate under are summarised in Table 6.1 as follows:

LP Europe	Ireland	Integrated Pollution Control System (IPC)
Kronospan	Wales	IPC

CSC	Scotland	Local Air Pollution Control System (LAPC)
Isoroy	France	Classified Installations
Kronofrance	France	Classified Installations
Willamette	Ireland	IPC
Masonite	Ireland	IPC
Finsa	Ireland	IPC

Thus, apart from the CSC mill, all of the other mills are subject to IPC or a type of integrated licensing. Upon further examination of TABLE 1, it is obvious that the Irish mills are subject to the most comprehensive set of standards with each of the mills having a far greater range of parameters within which they must operate than any of their European counterparts. In fact of all of the European mills, LP Europe has more parameters to measure for, twenty of the twenty-four chosen parameters, compared to Kronofrance (which has a similar production capacity cf. TABLE 11) and which is required to monitor only thirteen parameters.

The mill which has the least number of parameters to monitor is Isoroy and this is most likely due to the fact that since it is a much older mill and has a much smaller production capacity than the others, this would most probably have been taken into account when its present licence was being issued. The mill was built as a result of the Marshall Plan and its current environmental licence was issued in 1991. It is a well recognised fact that it is much more expensive to retrofit pollution abatement equipment that it is to install it in a new plant. Thus, if very stringent ELVs were imposed on Isoroy it would more than likely have closed the mill. What may also been taken into account is the fact that the mill is located in a poorly populated area and so public health effects were not as important an issue as if the mill was situated in the middle of a town. This latter theme will be revisited later in regard to other mills.

The CSC mill only has to monitor three of the chosen parameters which is by far the lowest requirement for any of the European mills. This is due to the fact that, as was previously explained, this mill is subject only to a LAPC permit and as such is required to monitor for air emissions. It is presumed that this mill requires a water and waste permit also for its releases/wastes, but this information was not furnished by the Scottish Environmental Protection Agency (SEPA) when they were contacted in regard to this research.

TABLE 2 gives a summary of the American and Canadian mill licenses. All of these mills operate under a single air permit system that they obtain from their local Air Quality Division and this permit must meet certain federal standards as a minimum . The countries which each of these mills is located in is summarised as follows in Table 6.2:

Swan Valley	Canada
Dawsons Creek	Canada
Hanceville	America
Jasper	America
Roxboro	America

Due to the fact that the major environmental impact of the wood processing industry is air emissions this is the area which is concentrated on in America and in their permitting system in Canada. In TABLE 2 the presence or absence of water, waste and noise controls are noted, although these parameters are dealt with under separate permits and are outside the major thrust of this thesis.

All of the mills in North America have approximately the same production capacities 323,000 – 398,000 m^3/year (cf. TABLE 11), with Swan Valley and Jasper being equal largest and Hanceville the smallest. Of these mills Swan Valley has the greatest number of parameters to monitor for in its licence. This is due to the fact that this licence details appropriate waste disposal and water and air management plans as well. As was previously discussed this is very similar to the European IPC system. Dawsons Creek and Roxboro also mention waste management in their licenses but not in the same detail as Swan Valley. However, as against this the Swan Valley mill has the lowest number of air ELVs.

TABLE 3 lists the air emission reference points from which the values are taken for TABLES 5 and 7. TABLE 4 (European mills) and TABLE 6 (mainly North American mills) are solely indicative of whether an ELV exists or not. The detail is in TABLES 5 and 7 respectively. For example, the air ELVs listed for LP Europe relate to the Hydroair (WESP) units, which are their main method of air pollution control equipment. Where there are two results given for a particular parameter, e.g. the Hanceville formaldehyde result TABLE 7, then the first result relates to the press ELV (i.e. 0.19 kg/hr) and the second result relates to the driers ELV (i.e. 0.16 kg/hr). Thus the way in which the results are listed in TABLES 5 and 7 relates to the order of the reference points listed in TABLE 3.

TABLE 4 is a summary of what air parameters the European mills have ELVs for. At a glance it can be seen that the Irish mills cover the greatest number of the chosen parameters. This indicates that these licenses are much more comprehensive. It is also a reflection of the much more detailed monitoring required by the Irish EPA.

TABLE 5 details the ELVs for each of the European mill licenses. Of the European mills LP Europe and Kronofrance have the largest production capacities and so it would be expected that they would have the strictest ELVs as they would be viewed as having the greatest potential to pollute. In fact LP Europe has ELVs for seven of the eight chosen parameters whilst Kronofrance only has ELVs for four of the eight. Upon closer observation of TABLE 5 it is clear the LP Europe has much stricter ELVs than Kronofrance. For example, the ELV for particulate matter (PM) for LP Europe is 20 mg/m^3 whilst for Kronofrance it is 100 mg/m^3. A similar trend can be seen in regard to the ELVs for formaldehyde (HCHO), VOCs and oxides of Nitrogen (NO_x).

Kronospan and CSC both have ELVs for only three of the eight parameters with both of them having the same standards for HCHO. The main difference between the two mills is in regard to their VOCs ELVs, with Kronospan having an ELV of 8-20 mg/m^3 and CSC having a much higher ELV of 130 mg/m^3.

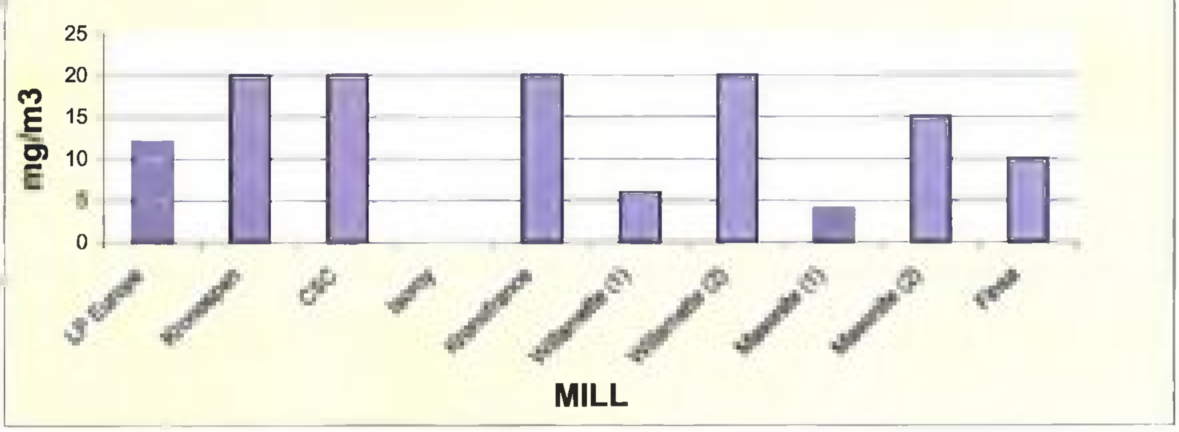
Isoroy only has to monitor one of the eight chosen parameters as part of its licence. As was mentioned previously, this mill is one of the oldest and was built as a result of the Marshall Plan (the redevelopment of France after World War 2). The West and South-West of France was planted with pine as part of the Marshall Plan and Isoroy was eventually built in order to take advantage of this resource. Compared to the other mills examined in this thesis it has a very small production capacity, 90,000 m^3/year and so would appear to have a much lesser potential environmental impact than the other mills, and as mentioned before the cost of retrofitting pollution abatement equipment would probably have closed the mill.

Finally it should be noted that with the single exception of the ELV for VOCs at Kronospan and Isoroy, LP Europe ELVs are as strict as and usually more strict (for example HCHO, MDI, NO_x, CO and SO_2) than the ELVs elsewhere in Europe.

The other mills listed in TABLE 5 are the Irish mills of Willamette, Masonite and Finsa. These mills are not OSB producing mills like most of the other mills in the thesis, but they do fall under the pulp and paper producing industry category and since all three are located in Ireland they are of interest herein. These mills have very similar ELVs to LP Europe for the chosen parameters. Whilst the parameters vary slightly the ELV may be marginally larger for one parameter and then marginally less for another parameter, there is a definite trend to be seen in the licensing of the Irish mills to have the same ELVs. Thus, at least within Ireland there are similar environmental standards set for the wood industry. This is a step which should be repeated in Europe initially and eventually internationally.

In summary Graph 6.1 below is an overview of the formaldehyde results for the European mills and the relatively small differences between the mills can be seen at a glance.

Graph 6.1 Comparison of European Formaldehyde ELVs



The other main parameter where a variation can be seen in the ELVs in the European mill licenses is VOCs. Graph 6.2 details the ELVs for each European mill.

Graph 6.2 Comparison of European VOC ELVs

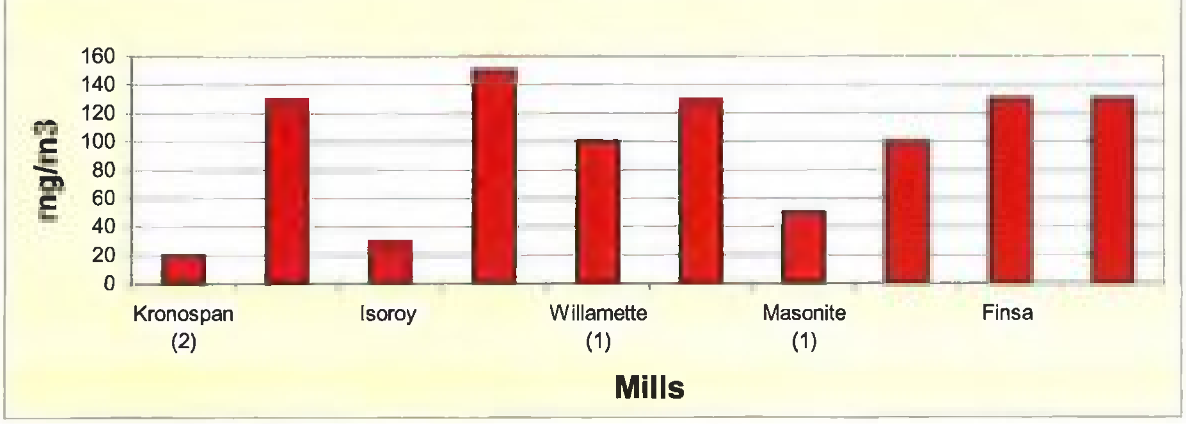


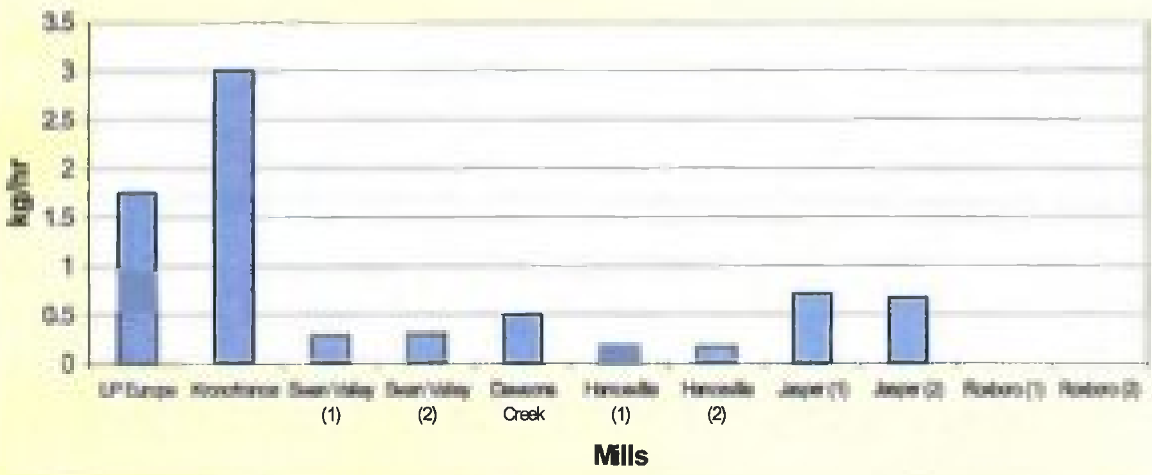
TABLE 6 is a summary of the comparison between the European OSB mills of LP Europe and Kronofrance and the North American OSB mills as regards their air ELVs. It allows the comparison of the chosen parameters which have ELVs present in the different mill licenses.

TABLE 7 records the actual ELVs which were noted to be present in TABLE 6. LP Europe and Kronofrance were selected as representatives of the European OSB mills' licence limits. All of the mills in this TABLE have production capacities of >300,000 m^3/year and <400,000 m^3/year (cf. TABLE 11). Upon observation of this, at first glance it seems that in general all of the American and Canadian mills have similar ELVs. But what must be taken into account is the fact that the mills at Swan Valley, Jasper and Roxboro all have pollution abatement equipment in place whilst Dawsons Creek and Hanceville do not, (cf. TABLE 3). Thus, whilst Hanceville may have comparatively lower ELVs compared to the other mills, this only reflects the fact that since it has no RTO's it has a higher potential threat to the environment, but this is nullified by the imposition of very low ELVs.

Kronofrance has significantly higher ELVs for HCHO, PM, VOCs and NO_x. The ELVs for the LP Europe mill are seen to be lower than those of the Kronofrance mill and comparable to their American and Canadian counterparts for MDI, PM and NO_x ELVs. It has higher ELVs for HCHO, CO and SO_2. The Kronofrance and LP Europe mills ELVs reflect the fact that both of these mills use WESPs as their pollution abatement technology as opposed to RTOs for the mills at Swan Valley, Jasper and Roxboro. As was previously mentioned Dawsons Creek and Hanceville have no RTOs. WESPs have a much higher pollutant removal efficiency than RTOs and are recognised as being BATNEEC for this industry. There appears to be a contradiction in terms here, the plants with the better equipment have high ELVs, but this basically reflects the greater certainty that the Agencies have in the constant use of this equipment and its effectiveness as a treatment technology. Thus, a mill with them as their pollution abatement equipment is a much lower environmental pollution threat than a mill which uses another type of technology.

Graph 6.3 below details the formaldehyde ELVs for the European versus the American and Canadian mills.

Graph 6.3 Comparison of European and American/Canadian Formaldehyde ELVs



6.4 An Examination of other Emission Limits

As was explained earlier in this discussion, all of the European mills (apart from the CSC mill in Scotland which operates under an LAPC permit) have water ELVs listed in their licence. The Americans and Canadian mills require a separate permit for water discharges. Looking solely at the European mills TABLE 8 lists the reference emission points for the water values that are summarised in TABLE 9 and detailed in TABLE 10.

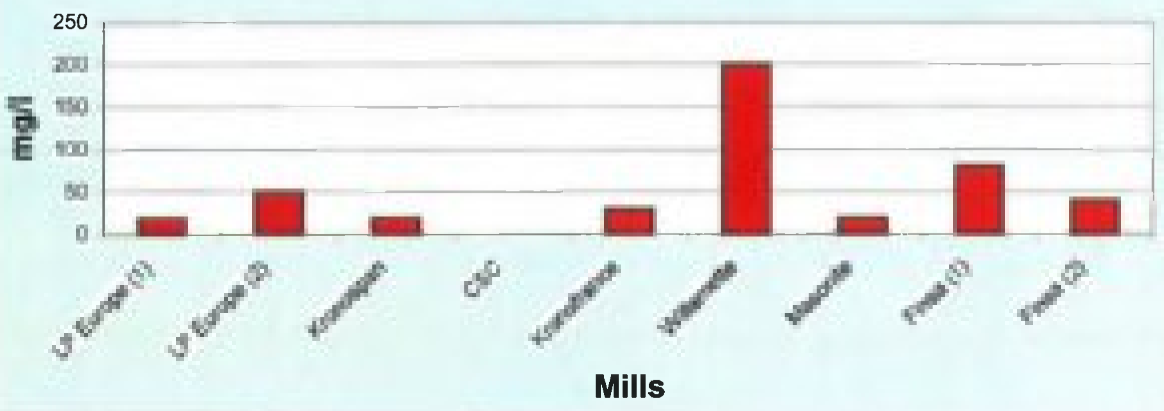
Upon examination of TABLE 10 it can be seen that if LP Europe and Kronofrance are compared, they have very similar ELVs for BOD, SS and pH. In addition whilst LP Europe has a limit for ammonia, Kronofrance does not, but the latter has a limit for COD whilst LP Europe foes not. Thus, whilst they differ in their air ELVs, both mills have similar discharge limits on their water emissions. This reflects the fact that IPC licensing has its origins in the French system of Classified Installations (Chapter 2, section 2.3.2) and the Irish EPA appear to have looked at the standards which the French require for their mills. This is a very good approach as it will lead to harmonisation of standards within the EU for the same industry.

Kronospan also monitor for four of the seven chosen parameters and it is interesting to note that these are the same four as LP Europe monitor for, suggesting that these may be the most environmentally significant parameters for this industry. Kronospan have similar BOD and pH ELVs to LP Europe, they have a higher SS ELV (100 mg/l as opposed to LP Europe's' 30mg/l) and a lower ammonia ELV (5 mg/l as opposed to 10mg/l). Basically a "swings-and-roundabouts" situation. As was the case with the air ELVs, Isoroy is the mill with the highest water ELVs detailed in their licence and indeed they are a quantum leap higher, for example 1500 mg/l suspended solids versus 100 mg/l at Kronospan and 530 mg/l ammonia versus 10 mg/l for LP Europe.

It is interesting to compare the Irish mills' ELVs. Of the four mills, LP Europe are required to monitor for only four of the selected parameters whilst Masonite monitors for six of them, and Willamette and Finsa both monitor for five of them. Whilst BOD, SS and ammonia are common to all four each of the other parameters is in at least two of the licenses. The fact that LP Europe has the lowest number reflects the fact that LP Europe does not use water in its process, the water which it treats is storm water and domestic water, whilst the other three mills all have process water to treat. Given that fact, it is interesting to note that LP Europe have quite strict water limits, with much lower SS and BOD ELVs than both Willamette and Finsa. All of the Irish mills, excepting LP Europe, have phosphate limits. This reflects the increasing concern with phosphate levels in Irish inland waters.

Graph 6.4 gives an overview of the BOD ELVs for the European mills, minus the Isoroy mill ELV. This was taken out as it was so much (anamalously) higher (for reasons detailed above) than the rest of the mills that it was masking the differences between the other mills.

Graph 6.4 Comparison of BOD ELVs for the European mills



As was previously mentioned, the American and Canadian mills require separate permits for water and waste. It was decided to focus on the air emission permits for these mills for this thesis, as this was the major environmental impact of this type of industry. Only the Swan Valley mill has a water ELV, for example a BOD of 30 mg/l on its water discharge point. This production of OSB does not use any process water so water pollution is not a major pollution potential for this industry. However, it is important to know the basic concept of how the waste and water permits work.

Basically for solid non-hazardous waste, the mill itself does not have to have a permit for disposal because it is the landfill which accepts the waste that operates under the permit. This permit licences the landfill as to who it can accept general refuse from and defines what general refuse actually is. This means that private industry must categorise its waste through Material Safety Data Sheets (MSDS), testing or operator knowledge. Hazardous waste is treated totally differently. A company must have a permit to store, and in some instances treat through incineration, hazardous waste. If the company is a "small quantity" generator then they may be allowed to treat the waste on-site; if not they have to dispose of it via a licensed disposal operator.

Water emissions are handled under the Clean Water Act which allows individual states to operate a water program so long as it is as stringent as the federal EPA limits. All emissions require a permit which can be obtained from the local Water Pollution Control Division. Appendix Tables 1 and 2 illustrates the differences which can occur within single regions. Two states from Region 4 (North Carolina and Alabama) and two states from Region 6 (Louisiana and Arkansas) were compared to see if differences existed within the regions. It was seen upon examination of these tables that there were significant differences within the regions themselves. This highlights the issue of certain States having an unfair competitive advantage over other States due to more lenient controls. In general the States within the regions had a similar amount of parameters to test for, but significant differences in the designated ELVs do occur.

As an example of this fact water emission limits for two different States in Regions 4 and 6 were examined. It was found that there were considerable variations in ELVs for the same parameter for the same type of body of water within the one region (cf. Appendix 3). It was seen that the ELV for faecal coliforms in North Carolina is 200/100 ml sample whilst in Alabama the ELV for the same parameter is 1,000/100ml and both of these states fall within Region 4. This is quite a significant variation and it can also be seen in this table that some States require a greater number of parameters to be tested for than in others.

6.5 An Examination of the Deficiencies or Excesses of the Various Licensing Systems

Already in this chapter the impact which the type of government in operation in any particular country can have on the environmental legislation was discussed both from a theoretical and practical point of view. This was followed by a detailed examination of the mill licenses from the various countries and whilst there were broad comparisons in some aspects in other there was quite a contrast. Now these two items will be assessed in conjunction with one another in order to examine the deficiencies or excesses which are present in the various licensing systems.

Firstly, the IPC system shall be examined as this is the predominant form of environmental control which is in operation in Europe. As was explained in Chapter 2, section 2.3.2, the IPC system originates from the French system of Classified Installations. In general, this system is a very good one as the mill/industry is assessed for all of its environmental impacts and this is then licensed in one document. This has a number of advantages:

1. The mill management have one document which controls all of its emissions – this cuts down drastically on paper-work
2. The authorities (usually the EPA) have more control over the mill as one person (the Inspector) is responsible for the mill
3. It allows the mill to build a sound working relationship with the Control Authority
4. It allows the public to have clear and extensive access to information pertaining to the licensed industries in their area
5. The emissions from the industry are managed better – as one department deals with all results and better records of non-compliances with the licence can be kept.

In summary the main advantage of this type of system is that industry can be strictly regulated. However, as we have seen that is not always the case. Whilst Isoroy is possibly an unfair example, the fact is that social implications necessitated that its ELVs were more lenient than elsewhere. In addition some aspects of the integrated licenses, for example water ELVs at the LP Europe mill have no real bearing on the working of the plant. The production process of OSB does not use water and so by having strict limits there is a two-fold cost: - [1] equipment and analytical costs and [2] recording and reporting costs. It is arguable that this money would be better spent on air emissions treatment budgets.

Thus, this strict regulation can also be the main disadvantage. Take for example the case of the Irish mill, LP Europe, and the Scottish mill, CSC. Whilst the production capacity of LP Europe is somewhat larger (cf. TABLE 11), basically the emissions from the two processes would be of the same nature. In Ireland the mill has been deemed to have a serious potential to pollute and so has had to obtain an IPC licence (from the EPA), but in Scotland the Control Authority there (SEPA) obviously did not deem the mill to have such a potential and this mill has been issued with an LAPC. Throughout this thesis the word "product" has been used in the general sense of OSB. At this stage it should be pointed out that OSB is a collective name for a series of oriented strand boards whose principal variations is in the thickness of the board and the quantity and type of resin used. These product specifications do have an effect on the amount of emissions generated. In Ireland, with its fortnightly stack testing regime, it is not always feasible to test stack emissions on all the board types over the course of the year. To achieve such a regime would necessitate significant interference with the production schedule. On the other hand, a mill which has to stack test only once per quarter may not have some product lines tested even once in a three year period and thus will suffer no interference with production schedules. Subtle items like the above are often not taken into account by the licensing Agencies. This is compounded by the fact that different mills produce different ranges of board in varying quantities depending on market demand. This could either allow companies to manipulate the time of testing or put undue demands on then to test emissions during the production of limited "runs".

This raises the general issue of making a country uncompetitive and introducing economic burdens into the market-place. Why should two companies who make the exact same product, albeit in different countries, be considered a serious potential polluter in one country and not in the other. If a system as stringent and as costly to a company as IPC is to be imposed in on country then it should be implemented across the board within a defined community for all of that particular industry. This means that the European Union should draw up a set of guidelines as to what industries require an IPC licence to operate and this should then be implemented in each country. Ideally this should be an international standard, but it most definitely should at least be operational in the EU.

It is also interesting to note the way in which a system can change over time. Take for example Ireland. The first mill to receive an IPC licence in Ireland was the LP Europe mill. This mill uses MDI, an isocyanate which is a respiratory irritant (ICI, 1997), in its production process. When the Irish EPA were drawing up a licence for this mill they put an ELV on the MDI, which would be based on tests at the exit of the WESP stack. Research has shown that MDI once it enters the press becomes trapped in the board in an inert form, and so there can never be an emission to atmosphere of MDI. This has been borne out in stack testing at the mill over the last number of years. This point was obviously taken into account when drawing up the licence for Masonite (which also uses MDI) as there is no limit for it in their licence. It is interesting to note that the US and Canadian Control Authorities (the local Air Quality Divisions) have not put a limit on MDI in any of the mills apart from one, Hanceville (and this mill has no pollution abatement equipment attached to it). This illustrates that it is internationally accepted that there is no way in which there can be a release of MDI from the process after it has entered the press.

The noise limits attached to Masonite's licence are also significantly higher than the limits in LP Europe's licence and this also shows some progressive thought by the Irish EPA.

The American and Canadian licensing systems consist of a number of permits. As was described earlier a permit is required for air emissions, water emissions and the storage and disposal of hazardous waste. This system is reminiscent of the system which was in operation in Ireland prior to the introduction of the IPC system. The advantages of this type of system are :

1. It was decided that a central control authority would be unfeasible due to the size and varied topography of the country
2. At the time, problems regarding cross-media pollution had not been considered as in the majority of situations it appeared only one environmental media was under threat
3. The system was a reaction by government to assuage public opinion by being seen to do something

On the other hand, the main problems/disadvantages associated with this type of permit system are as follows:

1. Generates a lot of paperwork –can be difficult for the mill to keep track of all of the different aspects of the various permits
2. Makes it more difficult for the mill to develop a working relationship with the Control Authorities as they are dealing with a number of people in a number of departments
3. Makes it more difficult for the Control Authorities to keep track of whether the mill is in overall compliance with their permits or not as no one person is dealing with them
4. Can lead to problems whereby an industry transfers pollution from one environmental medium to another as one Control Authority Department may be more lenient to deal with

5. Makes the system confusing for the general public – can be quite difficult to understand and necessitates dealing with a lot of paper-work
6. Can lead to non-uniformity – States implementing EPA Federal Directives to different standards (as was previously discussed).

During the course of this thesis, the setting up and some operational procedures of the various Environmental Protection Agencies have been examined in detail. In Chapter 3, section 3.3 each Agency was described in detail and its roles and responsibilities listed. Like anything else, when it comes to any one particular process, it is the industry itself which is the expert in that field. If a problem arises within a particular industry, then they are usually the ones who have the answer. If the EPA has a good working relationship with that industry, then a solution which is beneficial to both the industry and the environment can usually be worked out much quicker. It can also be an important factor in deciding where a mill/factory is to be situated, i.e. the type of role which the relevant Control Authority sees itself in. If the Control Authority is totally adversarial then it will make the general running of the mill/factory more difficult. If, on the other hand, the Control Authority is willing to listen to and co-operate with the industry, then that will make the whole situation much easier to deal with and thus that country/state will be much more attractive to the company when it is choosing where to site the mill/industry.

The point is that the Irish EPA has a direct relationship with industry due to the fact that they regulate the companies directly, unlike the US and Canadian Agencies where the companies are regulated at the State level (once the State is "delegated") and so have no direct contact with the federal EPA.

In Poland there is also an OSB mill which was initially part of this research. The Polish Government were contacted with a view to investigating the type of environmental licensing system which is operated there. Their system is very different to either the IPC system or the Permit system in that they have no formal licensing system as such. The basis of their system is that large companies pay the Government an annual fee which goes into a "Superfund". When the government has to clean up any pollution incident anywhere in the country it then uses this "Superfund". The advantage of this system is that there is a readily available supply of money to deal with any environmental incidents that may occur. For example, if there were a similar system in Ireland then it would have been available to ensure that the Silvermines site would have been remediated earlier and more quickly.

The disadvantages of this system are:

- It is a reactive form of management in that it does not seek to prevent incidents from happening rather it just reacts to them once they have occurred
- There is no limits set on what industries may emit or do
- It takes a more global approach than local – i.e. the local community may suffer so that another site which is deemed to be of more importance is cleaned up rather than their site
- There is no guarantee that there will be enough money to clean-up all of the industrial sites.

Overall, this form of environmental management seems to have more disadvantages than advantages.

It was also part of the scope of this thesis to examine the enforcement policies of the various EPA's. However this was not possible due to the fact that these policies are so flexible that the EPA's would not put them in writing because they wished to maintain their flexibility. They all have similar powers of enforcement in that an inspector can enter a premises at any time and take samples or carry out an audit without the permission of the owners. They also all have similar fines and prison sentences can be imposed by the courts on serious repeat offenders. However, it must be stressed that the flexibility of an EPA quickly becomes a factor in the decision making process of a foreign investor. If an EPA is known to take a "soft-line" then industries will gravitate towards that country. If, on the other hand an EPA is considered to be "hard", and it is important here to stress the word "considered", it may not actually be "hard", then investment will go elsewhere. This may in fact multiply itself a) self-justification by companies will endorse this "hardness" and b) once a country gets a "hard" reputation it can take decades to reverse it. Two examples of how perception could play a very negative role on the decision-making process in regard to Ireland are as follows: - [1] having to incur a cost testing for parameters which are basically meaningless, foe example measuring air emissions for MDI and [2] time scheduled testing which could interfere with the production schedule.

6.6 Future Developments

The development of interest for the foreseeable future is that of IPPC which stands for Integrated Pollution Prevention and Control. The IPPC system was established under the EU Directive on IPPC 96/61/EEC, which was adopted in 1996 and is due to be transposed into Irish Legislation by the end of 2001.

<u>There are a number of significant differences between IPC and IPPC:</u>

1. Additional aspects of pollution are included, e.g. noise and vibration
2. Larger numbers of potentially polluting activities are covered, e.g. food and drink industry
3. Requires a number of issues such as eco-efficiency, waste minimisation and energy efficiency to be tackled in a more explicit way than under IPC
4. Requires BAT instead of BATNEEC – this change carries a significant cost implication for industry. It is unclear at the time of writing this thesis whether or not all companies which come under IPC and IPPC will have BAT applied to them. If they do then existing companies will have to retrospectively fit upgraded pollution abatement equipment which has the potential to cost vast amounts of money. What seems to be the more likely route is that BAT will

only apply to new companies which are being licensed. The main difference for the operating mills will be the inclusion of a mill closure plan and energy consumption control and both of these proposals are to be welcomed. A similar charging scheme will be employed with IPPC as was with IPC.

The way forward in Europe appears to be in the vein of an integrated approach to environmental management with one licence covering all environmental media and one licensing authority. In theory this should lead to uniformity and remove any unfair economic barriers, for example between LP Europe, Kronofrance and the CSC mills. However, in this thesis, significant differences have been highlighted. The type of government and societies acceptance or non-acceptance of EU Directives will play a major role in determining the success of a centralised approach.

America seems to be content with their segregated approach to managing the environment due to the size of their country. The Federal EPA feel that they manage the environment best by delegating environmental media to States which have proven that they are fit to manage these media. Industry in America generally deals with the State as regards their environmental licences, it is generally only if there is a serious problem that the Federal EPA become involved. The only area of concern here is the non-uniformity which can occur as regards States implementing Federal Directives.

Canada appears to be moving more towards the European system of integrated environmental management. This can be seen in the mill licenses for Swan Valley and Dawsons Creek where other environmental media are at least mentioned apart from air.

The other main area of future developments is that of sustainable development. Already certain industries are taking on initiatives which are linked with this concept. Take for example the Forest Stewardship Council (FSC) of the wood industry. This council certifies timber products as containing a defined percentage of wood which comes from sustainably managed forests. Thus for the timber product to be certified to FSC standard, the forest has first to be certified. Then the mill itself must get certification and to do this it must prove that it has a chain of custody from the forest right through the production process and shipping. The whole drive behind sustainable development is the growing environmental awareness of the consumer and the advent of licensing systems such as IPPC.

SECTION 4. CONCLUSIONS

CHAPTER 7: CONCLUSIONS

7.1 General Conclusions

1. Overall the IPC system was seen to be the best system from an environmental point of view:
   - This system covers releases to all environmental media and sets multi-media limit values in the licence accordingly
   - It is seen to be the best system from an industry and a control point of view as it allows a close working relationship to develop
   - Seen to be a transparent system which is readily accessible by the general public

2. The Irish IPC system was seen to cover the most comprehensive list of parameters. The LP Europe mill was seen to have a similar standard (and in many cases higher) than its international counterparts.

3. Mills with high quality state-of-art emissions treatment systems are allowed higher ELVs because it was recognised that such equipment will protect the environment.

4. The Irish mills were seen to have quite strict ELVs on their water emissions compared to the European mills.

5. The cost of testing, both by its frequency and number of parameters, is adding a significant cost burden to companies which are located in countries where high frequency testing is demanded. If such costs are deemed to be necessary, not withstanding the cost implication, then maybe the government in consultation with the particular Environmental Agency should consider a

20% write-off bonus on capital allowances for such equipment and testing, similar to that for mineral exploration expenditures introduced in the Finance (Taxation of Certain Mines) act, 1974. This would assist both the environment and the attraction of Ireland as a place for industrial development.

6. The main disadvantage of the IPC system is the fact that it may be unattractive economically for a company setting up in a country that has it in place as its licensing system. This could be overcome if there was some form of European, or better still international, standard which would be comparable to the IPC system. This would eliminate any potential competitive barriers and set an environmental level playing field for all.

7. The type of government which is in place in any particular country (i.e. unitary or federal) was seen to have a major impact on the type of environmental administrative system which is in place in that country. Generally, countries that have a unitary form of government (e.g. Ireland and France) were seen to have a much more defined environmental regulation system than countries with a federal government (e.g. the USA).

8. All of the Control Authorities were seen to have similar roles and responsibilities. However, the European Agencies were thought to have a better working relationship with industry, which is beneficial to both sides, than the American EPA due to the fact that there is direct contact between the national Agency and the individual mill.

9. The US EPA, which is often regarded as an all-embracing national environmental control Agency, is not so all-embracing and individual states have a lot of flexibility in dealing with industry.

10. The American system of establishing ELVs for air emissions after mill start-up has advantages over the European system of setting them prior to start-up. This is due to the fact that ELVs set after mill start-up are more realistic of what the emissions actually are and the quantity of emissions. Once this is established appropriate ELVs can be set in the licence/permit rather than setting unrealistic/unattainable ELVs as some of the European systems tend to do.

7.2 Usefulness of the Matrix System

1. This system is particularly useful as it is very objective. The mill licence either has a chosen ELV present or it does not.

2. Following this each licence is examined individually for its ELVs and the values for all the parameters can be viewed simultaneously in the summary tables. This is an advantage as it means that a better overall perspective is achieved when examining a licence's ELVs.

3. This system could be useful to EPA's or Governments which are interested in following a licensing system similar to IPC or IPPC. For example, the Polish Government may at some time in the future decide that they want to change their system in line with other European countries. This thesis would then be useful to them as they could use it as a basis for changing their system.

4. This system would be useful for Companies which are interested in siting a mill in a country which is covered by this thesis or indeed using it for comparative purposes if they were looking at alternative countries.

5. This system is useful for mills which are included in this thesis or mills which produce a similar product to view how their licence compares with other mill licenses.

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SECTION 6. APPENDICES

APPENDIX 1

Appendix 1: Methodology of Research

Contacted Companies for copy of their Environmental Licence

↓

Contacted Government Dept of Environment in various countries for information on who was responsible for licensing industry

↓

Contacted EPAs in various countries for information on their internal structures and roles

↓

Conducted a Literature Review

↓

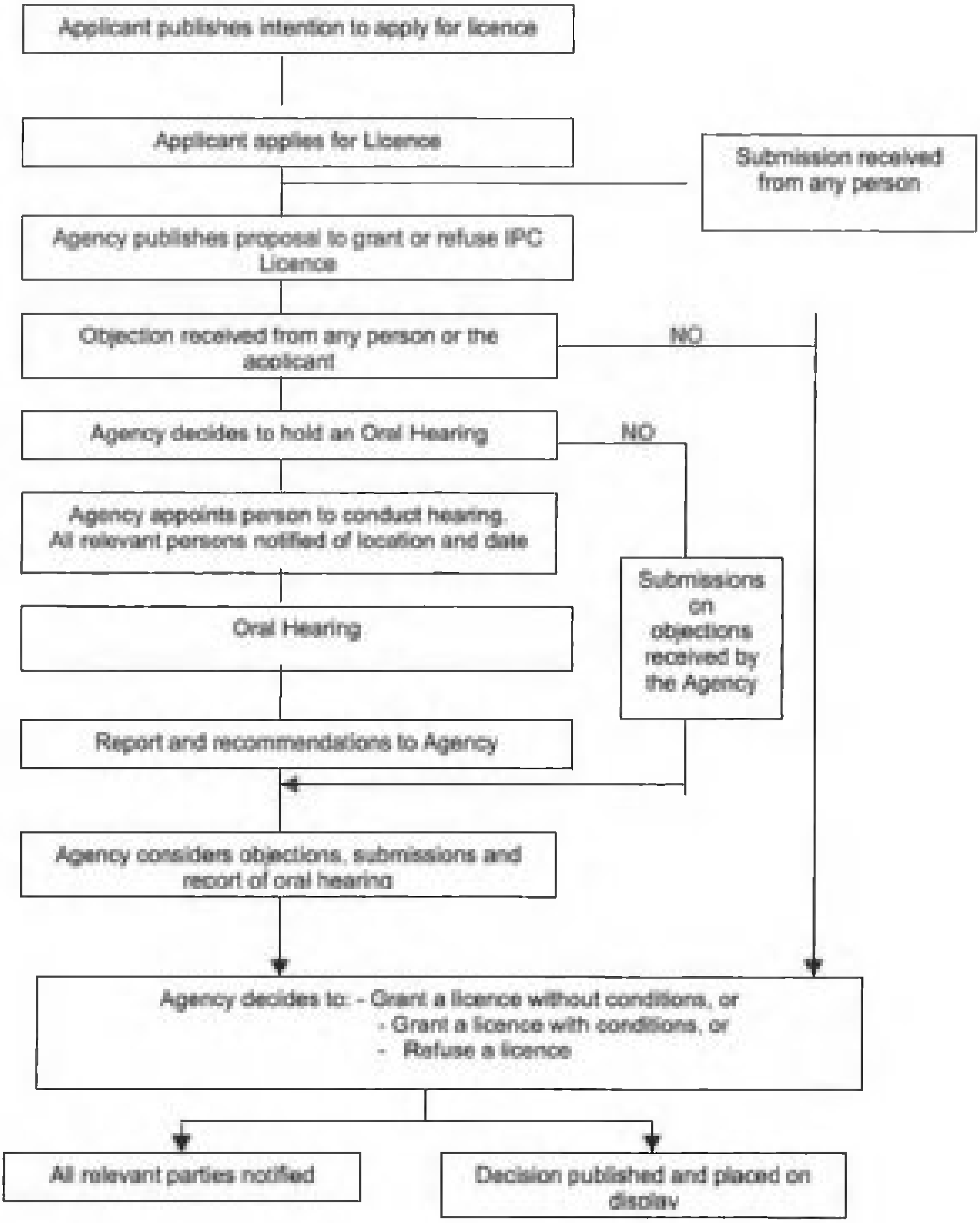
Devised Matrix system

↓

Compiled results tables from information sent in by Companies and EPAs

APPENDIX 2

Appendix 2: IPC Licensing Procedure



APPENDIX 3

Appendix 3: Regions 4 and 6 Water ELVs comparisons

REGION 4		
	MILLS	
Parameters	**North Carolina**	**Alabama**
Chlorophyll a	40 ug/l	No
Dissolved Oxygen	5.0 mg/l	<5.0 mg/l
PH	6-9	6-8.5
Temp	> 2.8 ^{o}C	>5 ^{o}F
Faecal Coliforms	200/100 ml	1,000 /100ml
Oils	Yes	No
Floating Solids	Yes	Yes
Turbidity	>50 NTU	>50 NTU
Toxic Substances	Yes	Yes
Action levels for Toxics		
Cu	7 ug/l	
Fe	1.0 mg/l	
Ag	0.06 ug/l	
Zn	50 ug/l	
Cl	230 mg/l	
Radioactive substances	Yes	Yes

REGION 6		
	MILLS	
Parameters	**Louisiana**	**Arkansas**
Dissolved Oxygen	>5.0 mg/l	6.0 mg/l
pH	6-9	6-9
Temp	> 2.8 ^{o}C	>5 ^{o}C
Faecal Coliforms	200/100 ml	200 /100ml
Oils	No	>10 mg/l
Total Dissolved Solids	500 mg/l	Yes
Turbidity	No	>25 NTU
Toxic Substances	Yes	Yes
Action levels for Toxics		
Cu	10 ug/l	
Pb	30 ug/l	
PCBs	2.00 ug/l	0.4 ug/l
Aldrin	3.00 ug/l	3.00 ug/l
Cl		
Radioactive substances	No	Yes