BENCHMARKING OF THE ENVIRONMENTAL PERFORMANCE OF THE GUNNS LIMITED MILL IN NORTHERN TASMANIA

Submitted to

PULP MILL ASSESSMENT PROJECT
DEPARTMENT OF PREMIER AND CABINET GPO
OFFICE OF THE SECRETARY EXECUTIVE DIVISION

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SUMMARY

EKONO has benchmarked the expected environmental performance of the Gunns Limited mill (Gunns Mill) against the performance of 53 bleached kraft market pulp mills in North America, Europe and South America. The annual average discharge data from 2005 were used for the 53 comparison mills. The data for the expected performance of the Gunns mill were provided by the client.

Table S.1 summarizes the benchmarking results for the parameters for which data were available for from the Gunns mill, and the number of the other mills with data in EKONO's files is at least ten.

Table S.1 List of Parameters Included in the Benchmarking and the Position of the Gunns mill.

Figure No.	Parameter	No. of Mills	Position of the Gunns Mill
1	Flow	47	2
2	BOD_5	44	9
3	Suspended Solids	47	5
4	COD	32	8
5	AOX	48	23
6	Colour	13	3
7	Phosphorous	37	8
8	Nitrogen	20	3
9	SO_2	44	14
10	NO_2	48	18
11	CO_2	45	5
12	CO	31	7
13	TRS	17	1
14	Total sulfur	49	6
15	Particulate	47	7
16	PM_{10}	26	1
17	$PM_{2.5}$	20	1

Within the 17 parameters listed in Table S.1, the expected performance of the Gunns mill is within the five best mills for eight of the parameters.

It is not expected that a single mill would be best in all categories. It is also not possible to single out one mill as the best performing mill, because different parameters are emphasized in different regions depending on mill location and the local environmental restrictions.

STATEMENT OF COMPETENCY

EKONO Inc. was established in the USA in 1967 as a subsidiary of a Finnish Company, and was incorporated in the State of Washington in 1973.

EKONO specializes in process, energy and environmental engineering for the pulp and paper industry. Since its establishment in the USA, EKONO has completed consultancy, study and engineering projects for well over 100 customers.

Since 1994 EKONO has collected environmental performance and permit information from the pulp and paper industry in North America, South America and Europe. EKONO's environmental database is updated annually. The updated performance and permit information is published in EKONO's annual publication "Environmental Performance, Regulations and Technologies in the Pulp and Paper Industry".

The benchmarking study of the expected performance of the proposed Gunns Limited pulp mill in Tasmania has been completed using the environmental performance data from over 50 bleached market kraft pulp mills in EKONO's database.

1. INTRODUCTION

The objective of the benchmarking study is to provide the Tasmanian Government (Client) with information about the expected environmental performance of the Gunns Limited mill (Gunns Mill) in Northern Tasmania in comparison with kraft market pulp mills in selected jurisdictions and to benchmark of some specific issues as defined below.

The specific issues covered are:

- Fuel source for the lime kiln and its contribution to the green house gas emissions
- Samples of recovery boiler stack height in relation to boiler capacity in North America and Europe
- Use of integrated versus non integrated chemical plants (ClO_2 plant) in bleached kraft mills
- Use of tertiary versus secondary effluent treatment in bleached kraft mills
- Development of TCF and ECF production in bleached kraft industry
- Use of closed loop technology (i.e., recovery of bleaching effluents) in bleached kraft industry.

The environmental benchmarking includes data from 53 bleached kraft market pulp mills in the following areas:

- North America
- South America
- Nordic Countries
- EU, except Nordic Countries

The effluent parameters that were benchmarked included:

- Effluent flow
- BOD_5
- TSS
- COD
- AOX
- Colour
- Phosphorus
- Nitrogen.

The air parameters that were benchmarked included:

- SO_2
- NO_2
- CO_2

- CO
- TRS
- Total sulfur
- Particulates
- PM_{10}
- $PM_{2.5}$

All parameters were benchmarked as total emission or discharge per ton of pulp produced. The data from the existing mills are mainly from 2005. In some occasions missing 2005 data have been replaced with data from 2004. The expected performance data of the Gunns mill have been used for comparison. The Gunns Mill data was provided by the Client.

This benchmarking has been based on public data from environmental agencies, company environmental reports, EMAS reports, public directories, and EKONO file data. While all reasonable care has been taken in preparing the data, EKONO cannot accept any liability or responsibility for the accuracy of the data contained in the report.

The main results of the benchmarking are shown in Figures 1 - 17 of this report. These figures compare the ***expected annual average environmental performance*** for the Gunns Limited mill with available data for the ***reported annual average performance*** of 53 bleached kraft market pulp mills for 2005.

2. BENCHMARKING OF THE ENVIRONMENTAL DISCHARGES OF GUNNS LIMITED PULP MILL

2.1 General

2.1.1 Gunns Mill Environmental Performance

The expected performance of the Gunns mill is shown in Table 2.1.

Table 2.1. Environmental Discharges from the Gunns Mill

Parameter	Unit	Production Specific Discharges Annual average
Flow at 1,100,000 ADt/yr	m^3/ADt	20.3
BOD_5	kg/ADt	0.22
COD	kg/ADt	9.4
AOX	kg/ADt	0.14
Suspended Solids	kg/ADt	0.41
Colour	kg/ADt	10.0
Phosphorous	kg/ADt	16.2
Nitrogen	kg/ADt	50.7
SO_2	kg S/ADt	0.29
NO_2	kg NO_2/ADt	1.541
CO_2	kg CO_2/ADt	93.8
CO	kg/ADt	1.54
TRS	kg/ADt	0.01284
Total sulfur	kg S/ADt	0.1
Particulate	kg/ADt	0.246
PM_{10}	kg/ADt	0.18
$PM_{2.5}$	kg/ADt	0.147

2.1.2 Database Coverage

EKONO's database contains data from 53 bleached kraft market pulp mills. The distribution of the mills and jurisdictions is as follows:

	No. of Mills	Total Production in 2005 Million ADt/a
Canada	20	6.9
USA	10	3.5
Finland	6	2.3
Sweden	8	3.2
Western Europe	5	1.7
South America	4	4.1
Total	53	21.7

Not all of the mills measure and report the same parameters. Effluent flow, AOX, TSS, NO_2, total sulfur, and particulate are the parameters that EKONO has data for highest number of mills (47-49 mills). These include the TCF mills, where the AOX discharge is zero by definition.

2.1.3 Methodology

The benchmarking graphs illustrate the effluent discharge and air emission data in the form of bar charts for different parameters. The annual average data in EKONO's database have been sorted in ascending order. The data from a specific mill is shown as a bar in the chart. Location of the mills in different geographical areas is shown in patterns and colours.

2.2 Benchmarking Graphs

2.2.1 General

Figures 1-17 show the benchmarking graphs prepared using the data in EKONO's database. As stated above, the expected performance of the Gunns mill was used. For the rest of the mills, annual averages for 2005 were used. Only parameters that EKONO possess data for a minimum of ten mills are shown in Figures 1-17.

The Gunns mill expected performance in the benchmarking graphs is identified as a red bar.

2.2.2 Effluent Flow

Figure 1 shows the effluent flow as m^3/ADt of pulp. EKONO's database contains effluent flow data for 47 kraft market pulp mills. The total production of these mills is approximately 20.7 million tons per year. This production includes the future production of the Gunns mill. The expected performance of the Gunns mill is shown for 1,100,000 ADt/year production level. The position of the expected performance of the Gunns mill is number 2.

2.2.3 Effluent BOD_5

Effluent BOD_5 is shown in Figure 2. The Scandinavian countries measure and report BOD_7. The BOD_7 figures have been converted to BOD_5 using the following formula:

$$BOD_5 = 0.85 \times BOD_7$$

44 out of 53 mills report BOD. The total production of these 44 mills including Gunns mill is about 19.2 million ADt/year. Several mills in Scandinavia do not report BOD because it is not typically a regulated parameter any more.

2.2.4 Effluent TSS

EKONO's database contains TSS information from 46 mills representing a total kraft market pulp production of about 20.7 million ADt/year. Figure 3 illustrates the TSS discharges from these 47 mills. The Gunns mill discharge position is number 5 among the mills.

2.2.5 Effluent COD

COD data exists from 32 bleached kraft market pulp mills. The total production among these mills is about 15.4 million ADt/year. Many of the US and some Canadian mills do not report COD. As shown in Figure 4, the Gunns mills expected discharge is number 8 in the range.

2.2.6 Effluent AOX

Figure 5 illustrates the effluent AOX discharges in 2005. The expected AOX discharges from the Gunns mill are number 23 out of 48 mills. It should be noted that the 53 mills include three TCF mills, where the AOX discharges are zero by definition.

2.2.7 Effluent Colour

Figure 6 shows the effluent colour discharges from 13 bleached kraft market pulp mills. As shown, the Gunns mill is number 3 in this category. Colour is typically only regulated in the mills that discharge to small rivers. For example, none of the European mills have colour limits in their permits.

2.2.8 Effluent Phosphorous

Figure 7 shows the effluent phosphorous discharges from 37 bleached kraft market pulp mills. As shown, the Gunns mill is No. 8 in this category.

2.2.9 Effluent Nitrogen

Figure 8 shows the effluent nitrogen discharges from 20 bleached kraft market pulp mills. As shown, the Gunns mill is number 3 in this category.

2.2.10 SO_2 Emissions

SO_2 emissions from 44 bleached kraft market pulp mills is shown in Figure 9. As shown, the SO_2 emissions from the Gunns mill are number 14 out of 44 mills with a total production of about 18.4 million ADt/year.

2.2.11 NO_2 Emissions

Figure 10 illustrates the NO_2 emissions from 48 bleached kraft mills with a total production of about 19.9 million ADt/year. The Gunns mill is ranked number 18 out of the 48 mills.

2.2.12 CO_2 Emissions

Figure 11 shows the CO_2 emissions from 45 mills. EKONO's database for CO_2 emissions includes information of direct emissions from combustion of fossil fuels only. The Gunns mill is ranked number 5 out of the 45 mills with a total production of about 19.9 million ADt/year.

2.2.13 CO Emissions

Figure 12 shows the CO emissions from 31 mills. The Gunns mill is ranked number 7 out of the 31 mills with a total production of about 11.3 million ADt/year.

2.2.14 TRS Emissions

Figure 13 shows the TRS emissions from 17 mills. The Gunns mill is ranked number 1 in this category.

2.2.15 Total Sulfur Emissions

Figure 14 shows the total sulfur emissions from 49 mills. The Gunns mill is ranked number 6 out of the 49 mills with a total production of about 20.3 million ADt/year.

2.2.16 Particulate Emissions

Figure 15 shows the particulate emissions from 47 mills. The Gunns mill is ranked number 7 out of the 47 mills with a total production of about 19.8 million ADt/year.

2.2.17 PM_{10} Emissions

Figure 16 shows the PM_{10} emissions from 26 mills. The Gunns mill is ranked number 1 in this category.

2.2.18 $PM_{2.5}$ Emissions

Figure 17 shows the $PM_{2.5}$ emissions from 20 mills. The Gunns mill is ranked number 1 in this category.

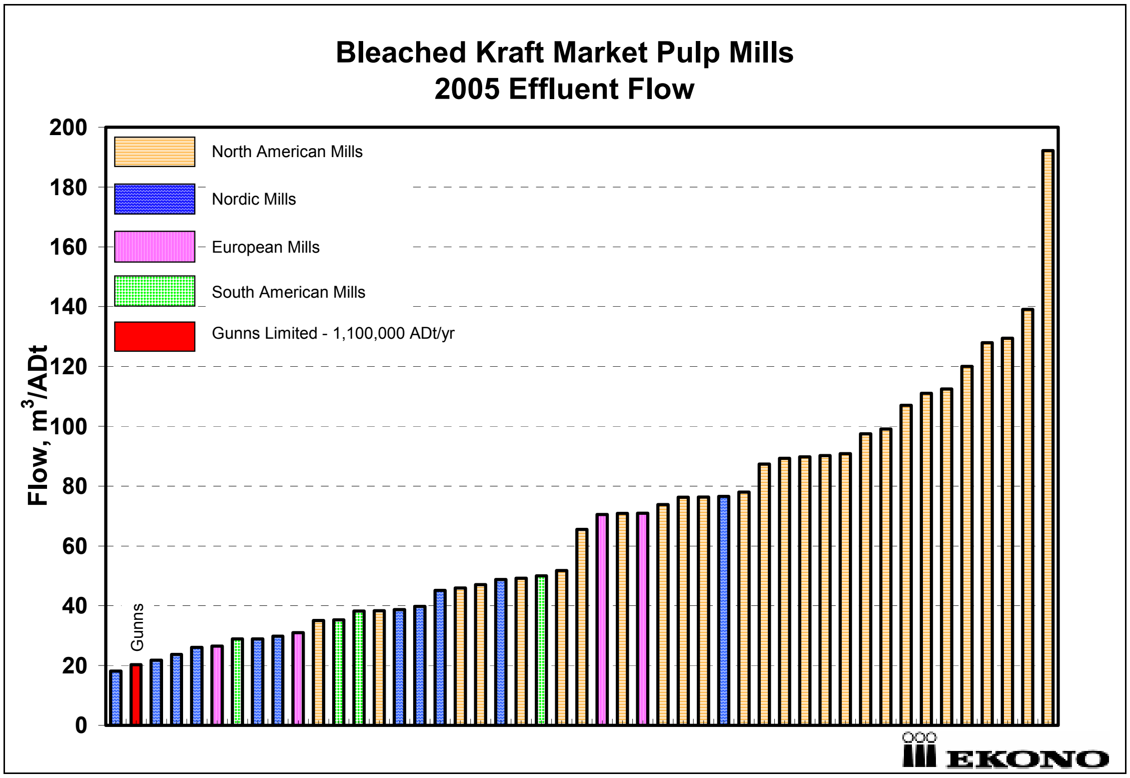

Figure 1 **Effluent Flow from Bleached Kraft Market Pulp Mills in 2005**

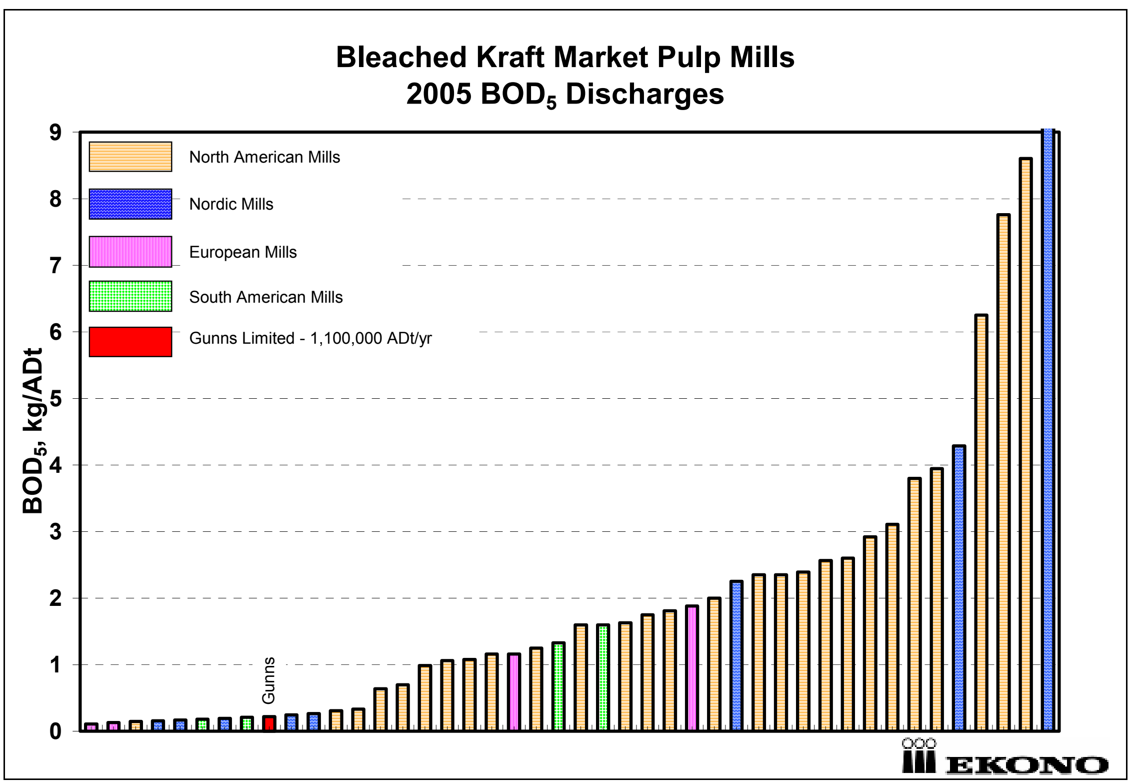

Figure 2 **Effluent BOD_5 Discharges from Bleached Kraft Market Pulp Mills in 2005**

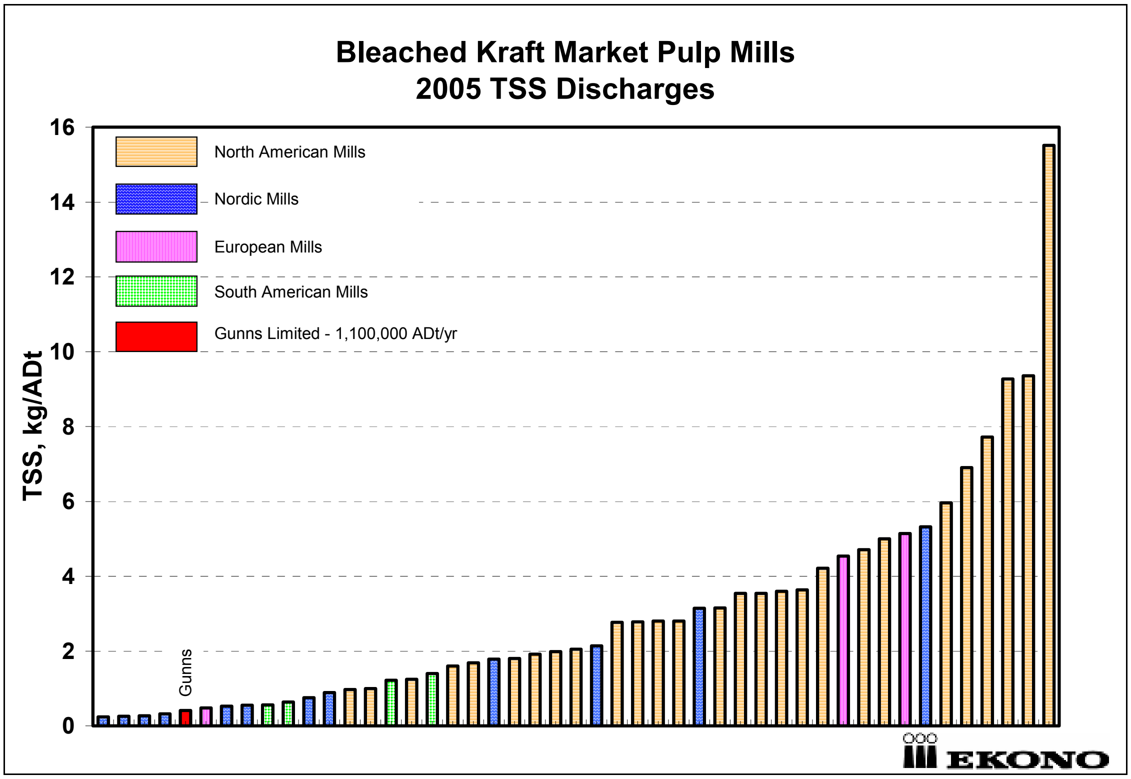

Figure 3 Effluent TSS Discharges from Bleached Kraft Market Pulp Mills in 2005

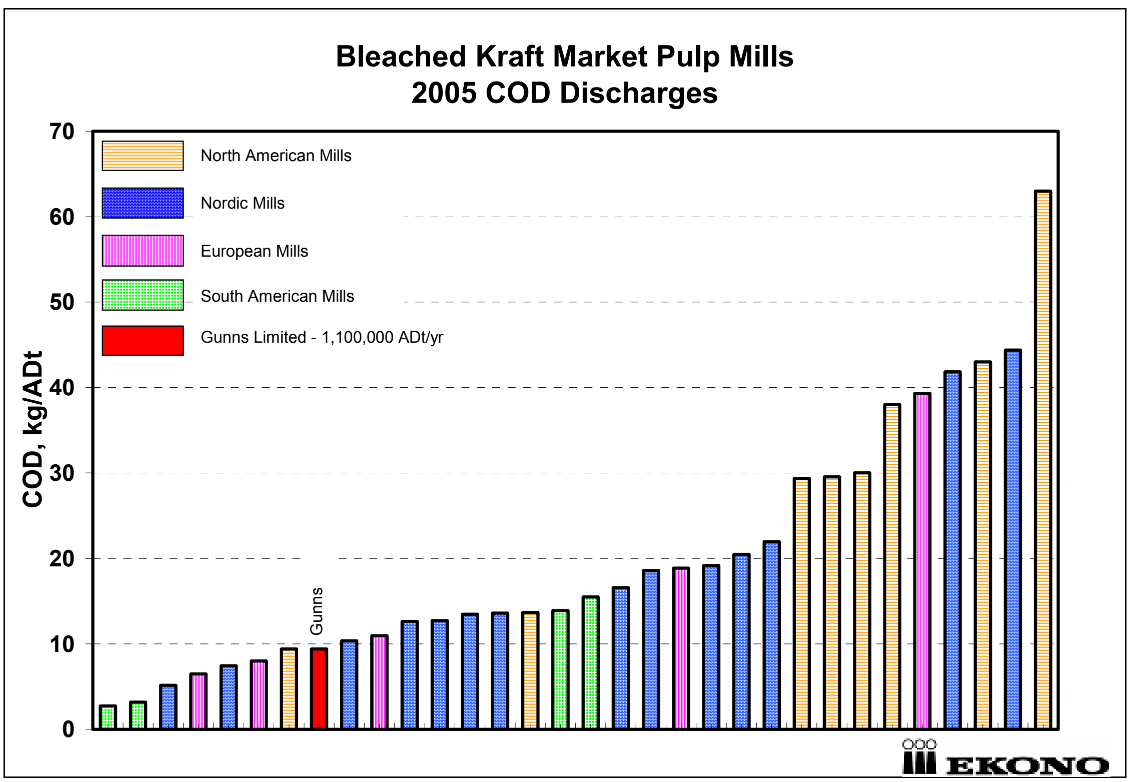

Figure 4 Effluent COD Discharges from Bleached Kraft Market Pulp Mills in 2005

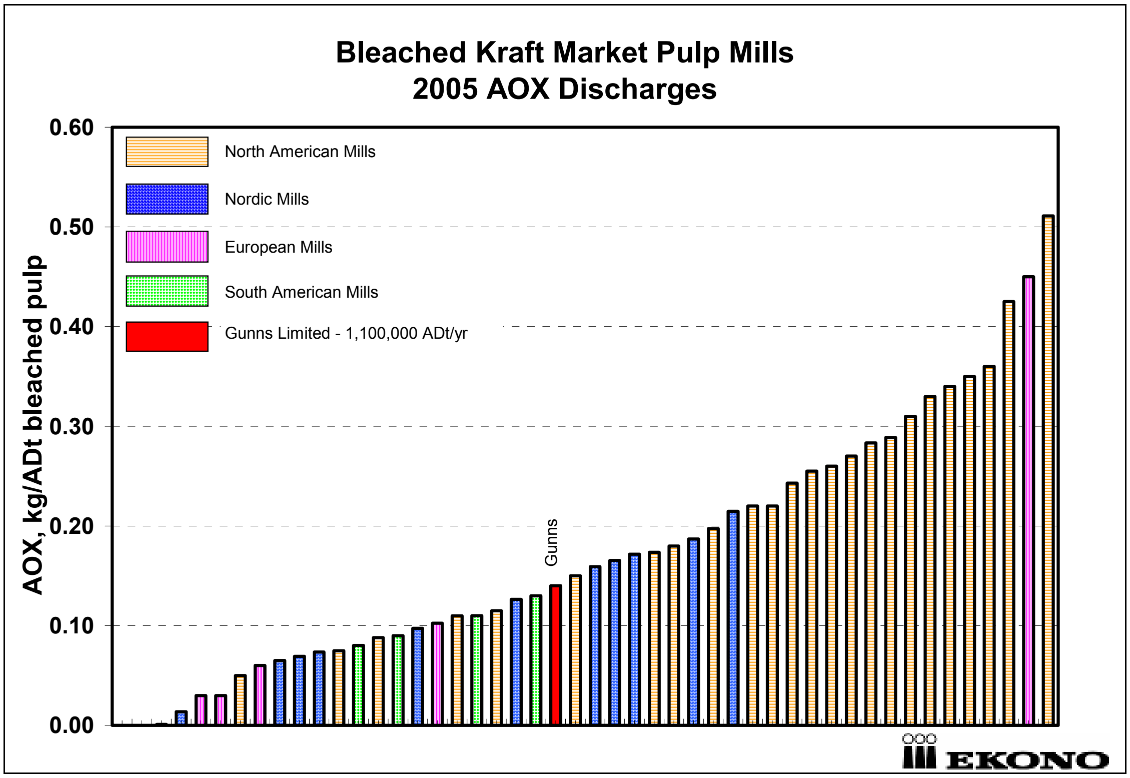

Figure 5 **Effluent AOX Discharges from Bleached Kraft Marked Pulp Mills in 2005**

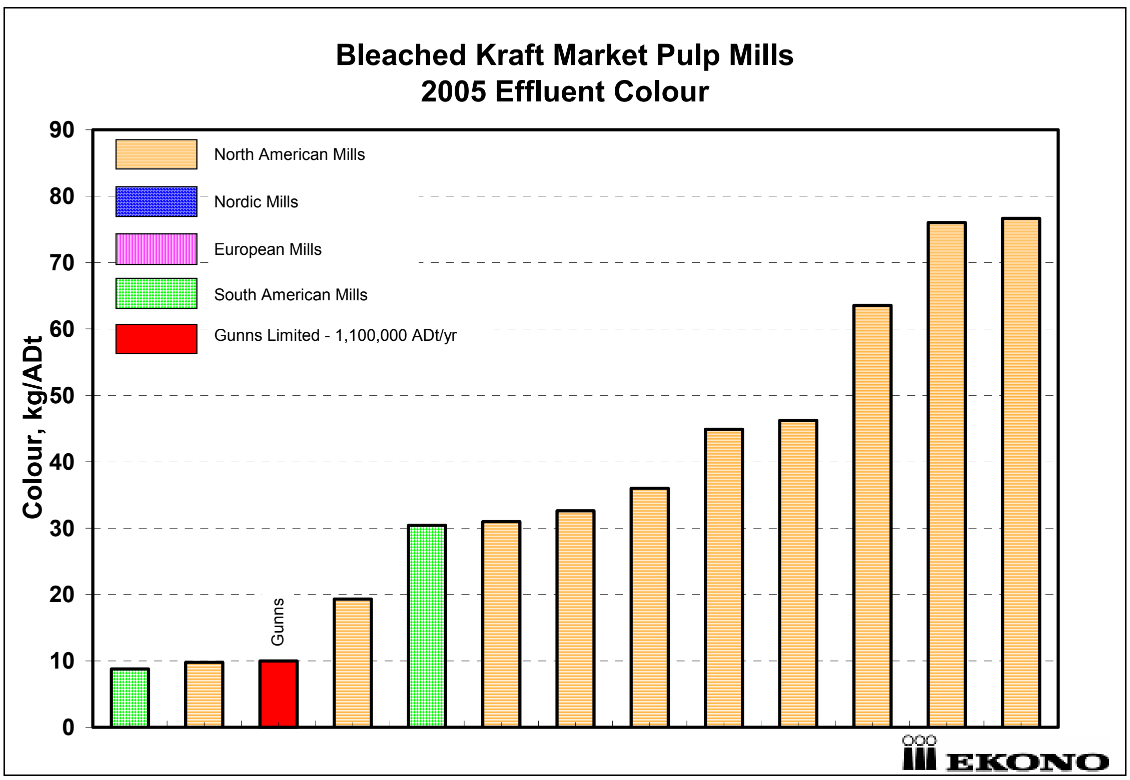

Figure 6 **Effluent Colour Discharges from Bleached Kraft Market Pulp Mills in 2005**

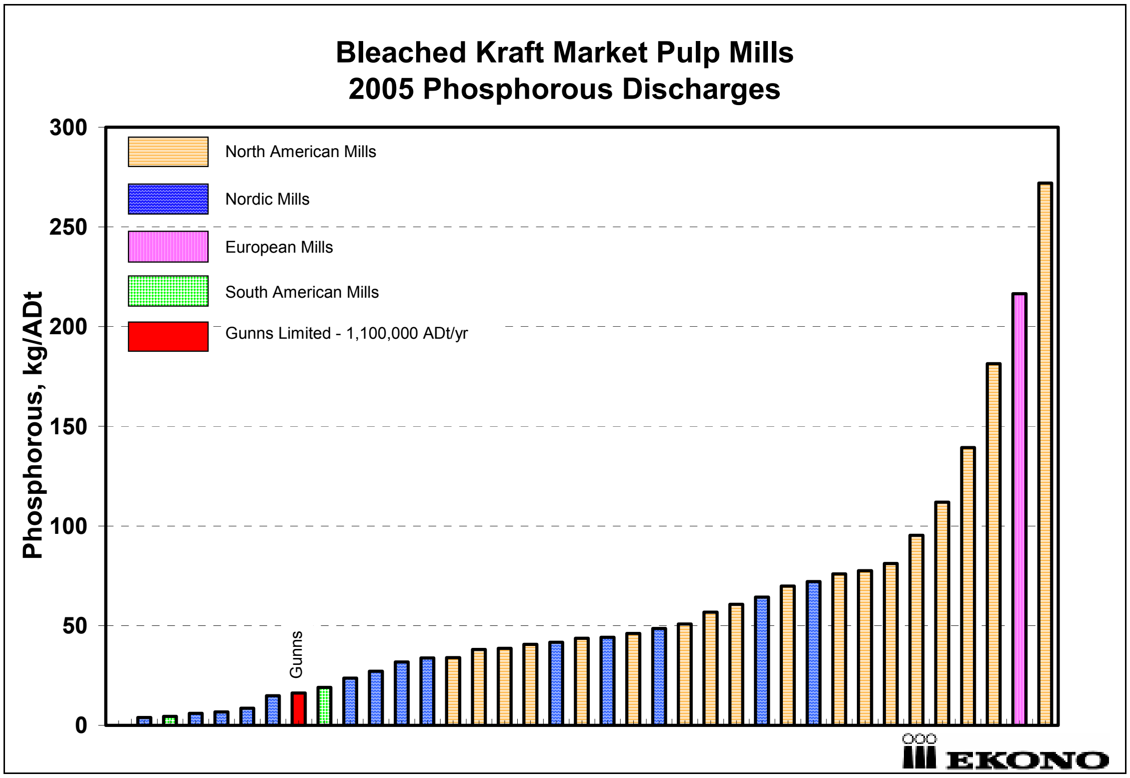

Figure 7 Effluent Phosphorous Discharges from Bleached Kraft Marked Pulp Mills in 2005

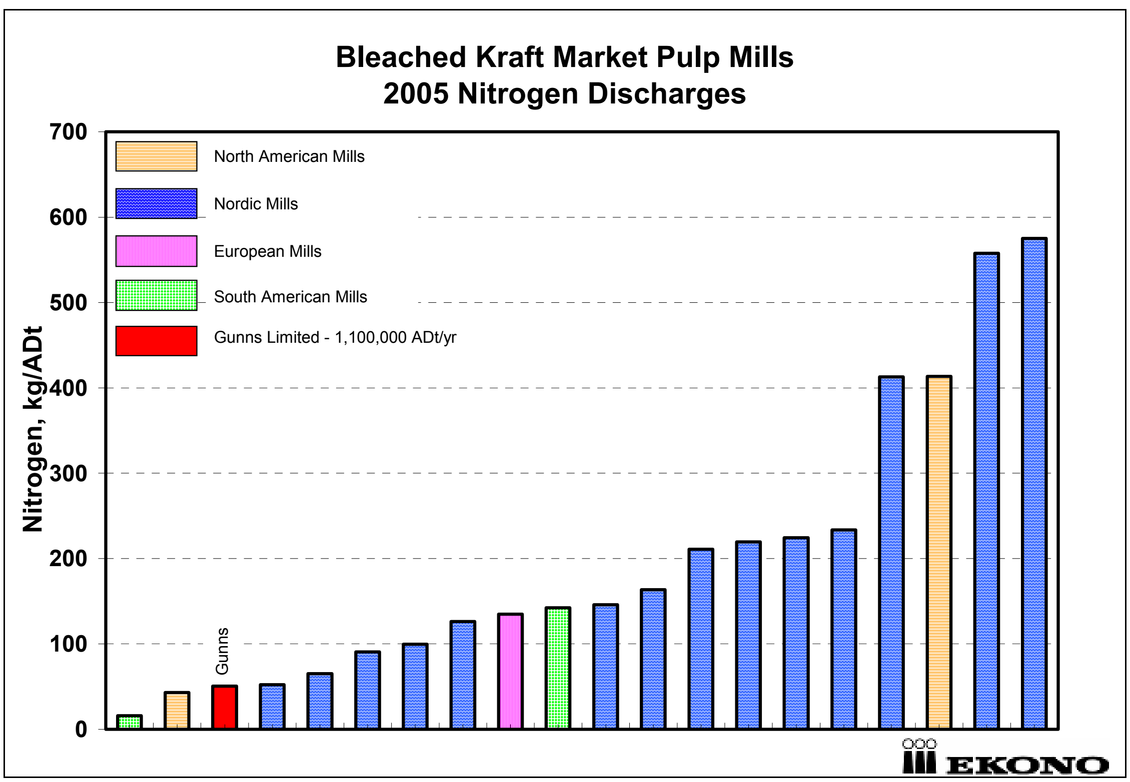

Figure 8 Effluent Nitrogen Discharges from Bleached Kraft Market Pulp Mills in 2005

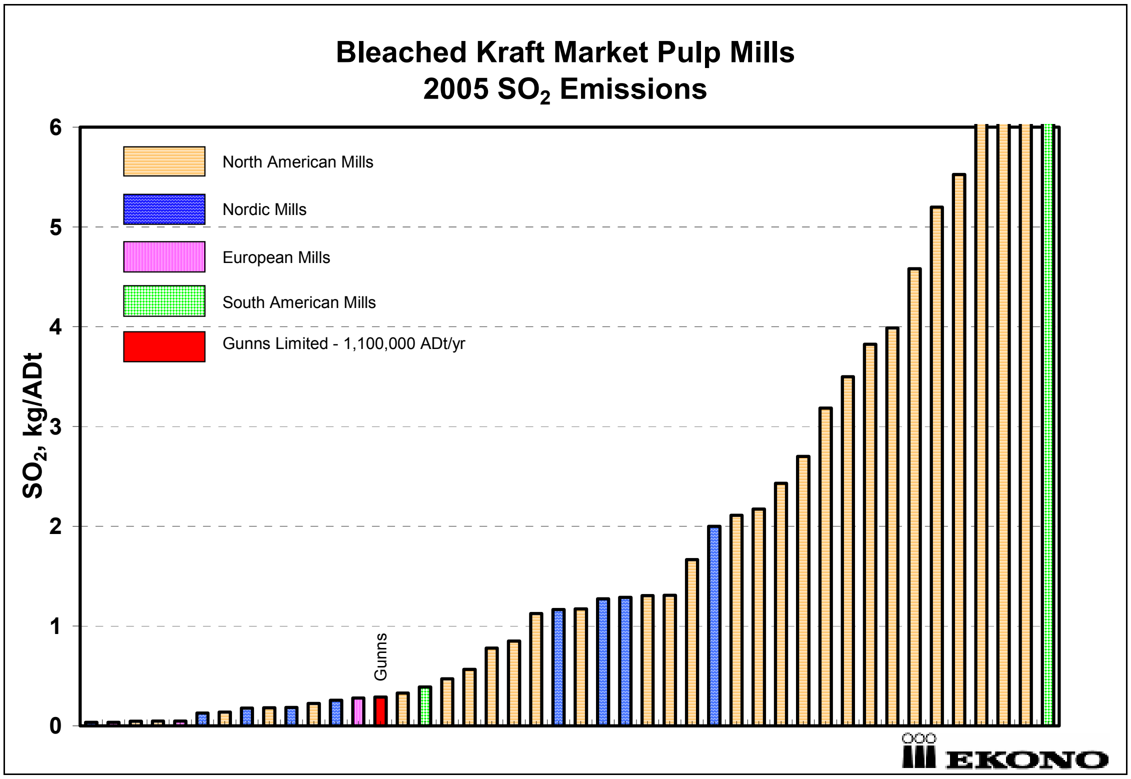

Figure 9 SO_2 Emissions from Bleached Kraft Market Pulp Mills in 2005

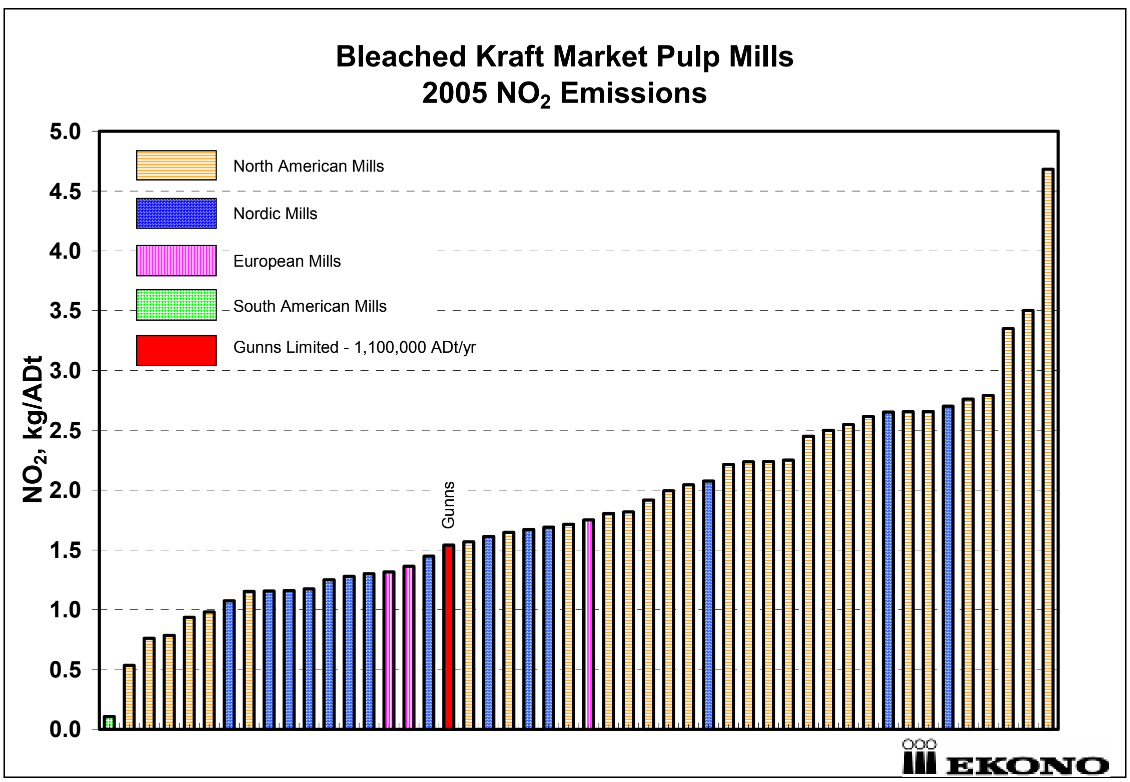

Figure 10 NO_2 Emissions from Bleached Kraft Market Pulp Mills in 2005

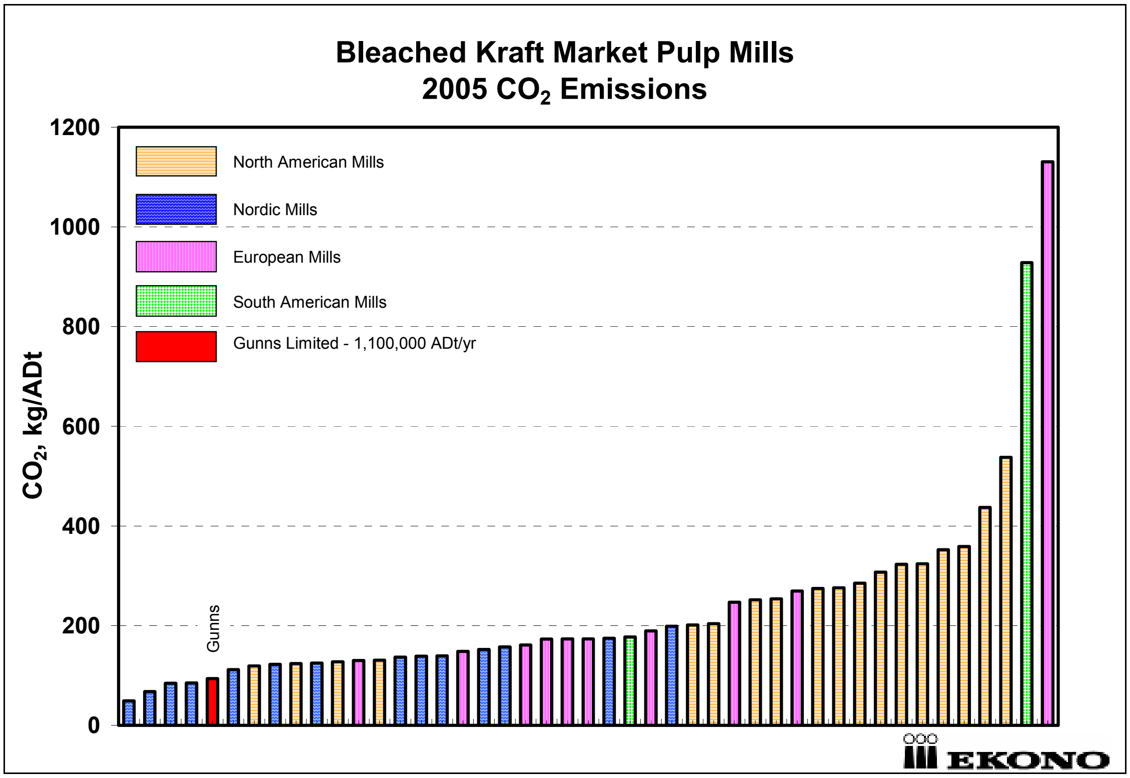

Figure 11 CO_2 Emissions from Bleached Kraft Market Pulp Mills in 2005

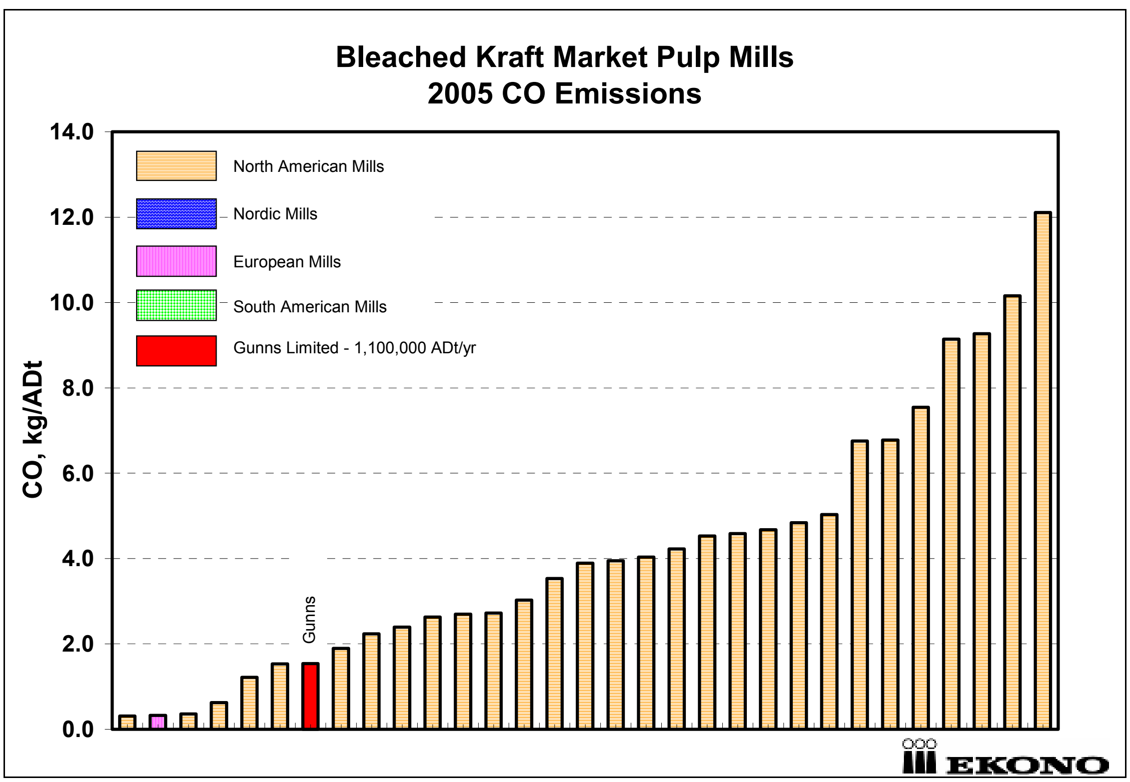

Figure 12 CO Emissions from Bleached Kraft Market Pulp Mills in 2005

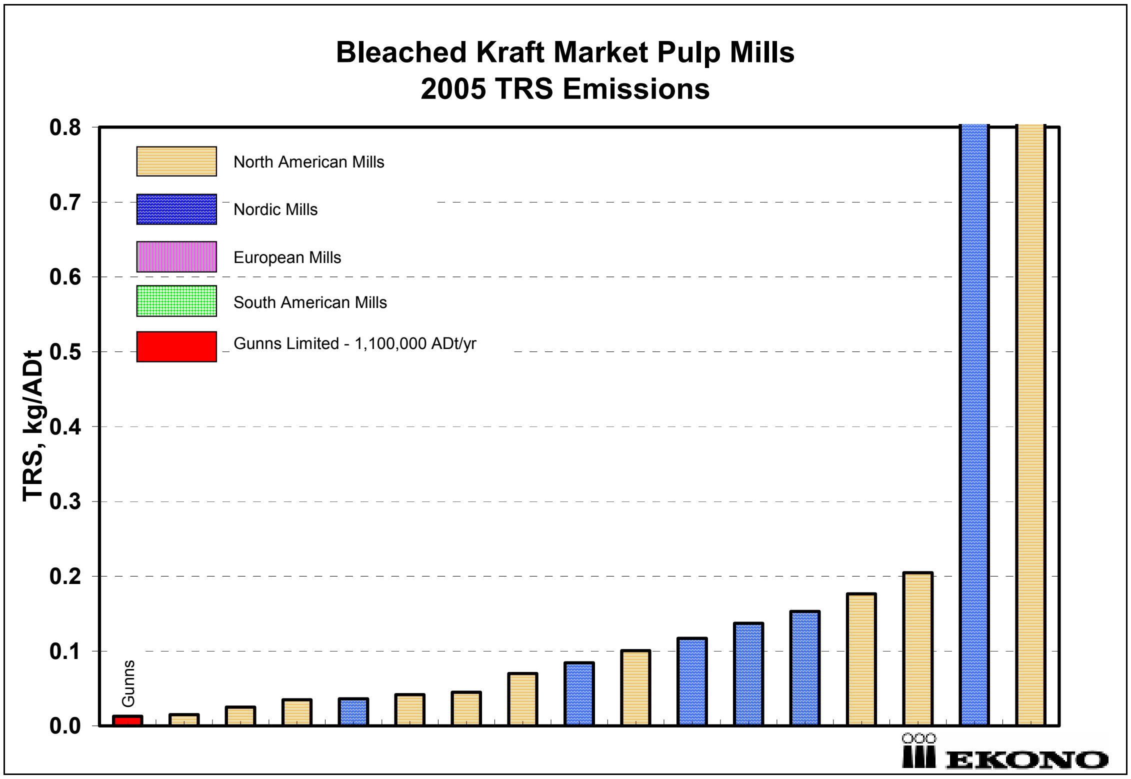

Figure 13 TRS Emissions from Bleached Kraft Marked Pulp Mills in 2005

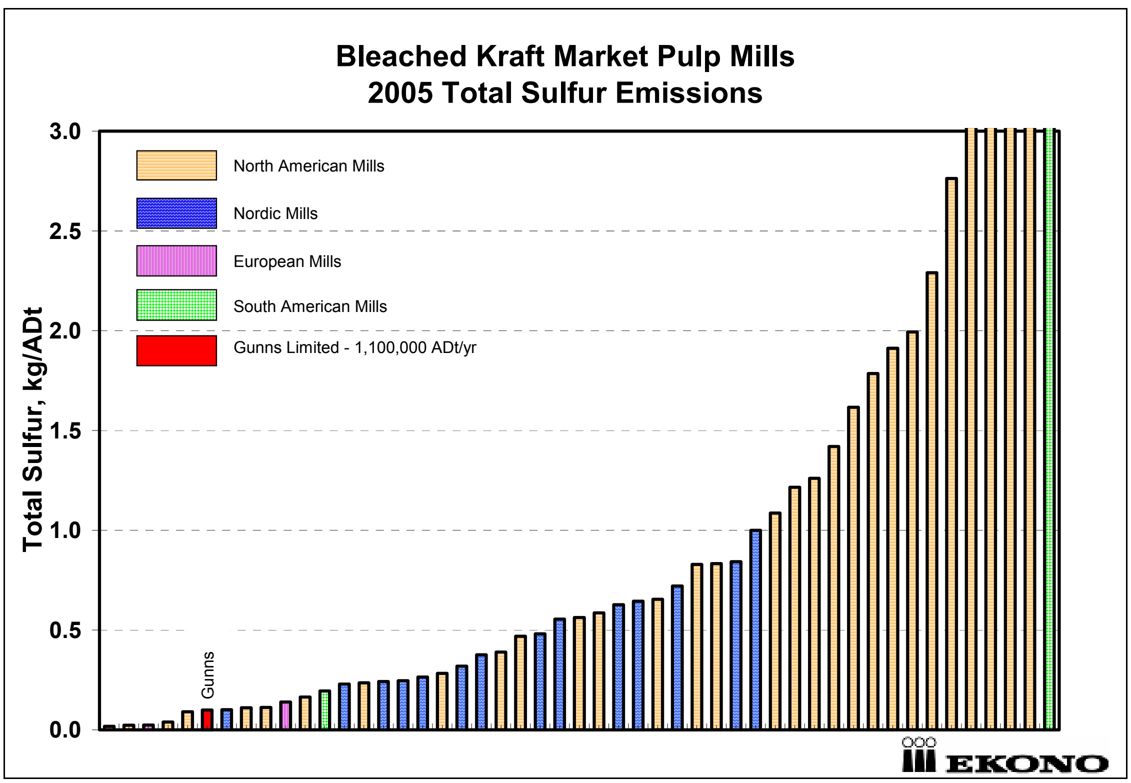

Figure 14 Total Sulfur Emissions from Bleached Kraft Market Pulp Mills in 2005

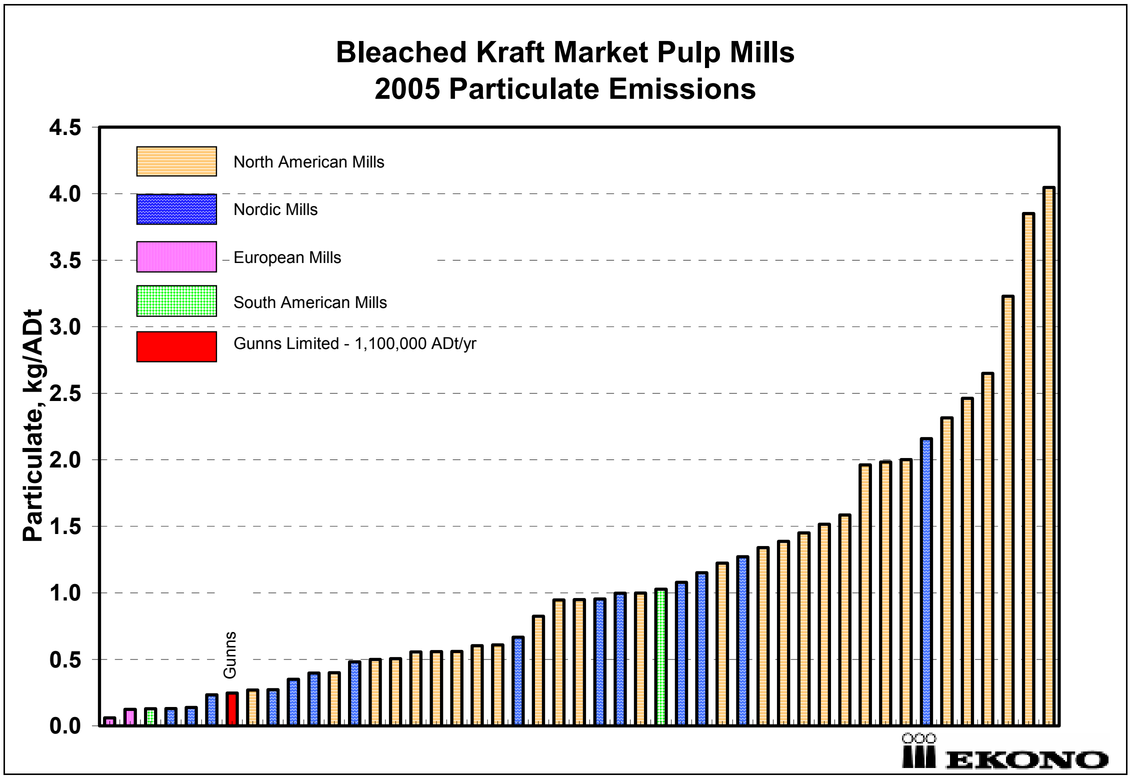

Figure 15 Particulate Emissions from Bleached Kraft Market Pulp Mills in 2005

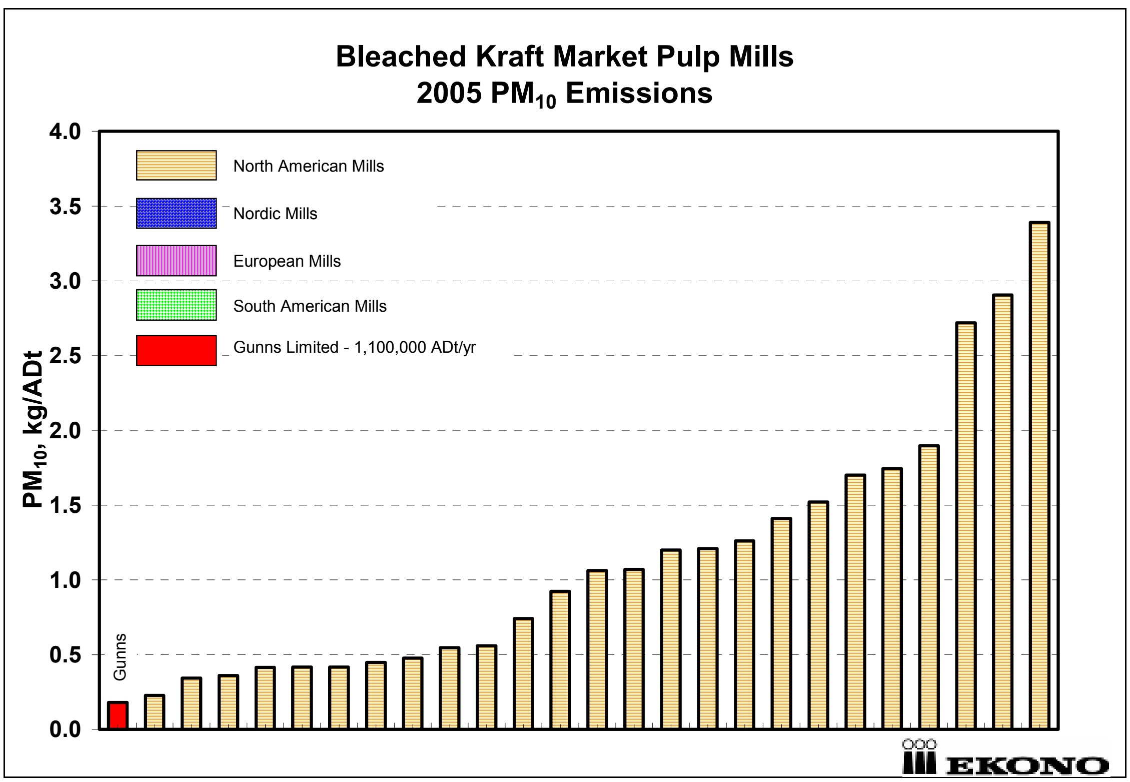

Figure 16 PM_{10} Emissions from Bleached Kraft Market Pulp Mills in 2005

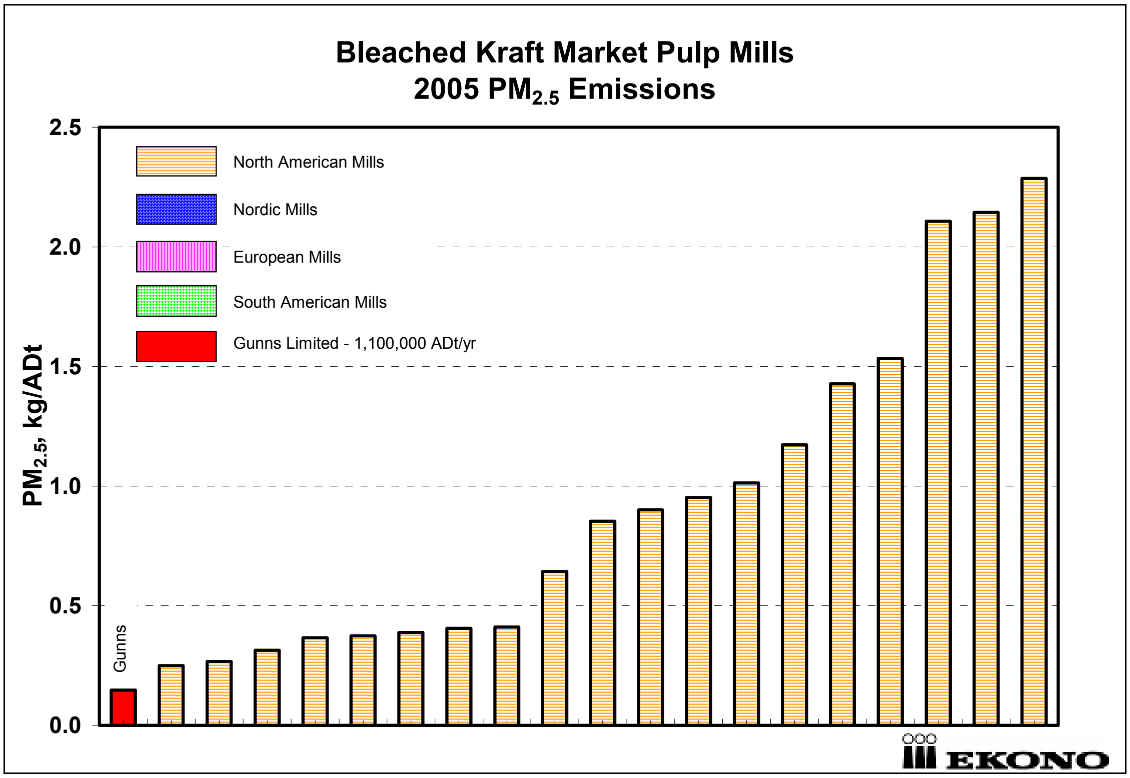

Figure 17 $PM_{2.5}$ Emissions from Bleached Kraft Market Pulp Mills in 2005

3. BENCHMARKING OF SPECIFIC ISSUES

3.1 Lime Kiln Fuel Source and its Impact on Green-House Gas Emissions

The most common lime kiln fuels are oil and natural gas. Especially Swedish mills also fire different types of biofuels, such as sawdust, biogas, talloil and pitch from the tall oil refineries. Biofuels are CO_2 neutral by definition. Several US kraft mills have recently started to burn petroleum coke in the lime kiln.

Figure 3.1 illustrates the lime kiln CO_2 emission for different fuels. The fuel specific emissions are:

Natural Gas	55.9 kg CO_2/GJ (LHV)
Fuel oil	75.0 kg CO_2/GJ (LHV)
Pet Coke	97.0 kg CO_2/GJ (LHV)

Note that the above specific CO_2 emission data are given for the low heating value, LHV, that normally is used as the basis e.g. in Europe.

Figure 18 illustrates the CO_2 emission from the lime kiln as the function of the specific fuel consumption.

The case "Pet Coke" assumes that 80% of the fuel is pet coke and 20% is natural gas.

As shown in Figure 18 the CO_2 emission from the Gunn's lime kiln is very low as compared to the kilns that use oil or pet coke as fuel.

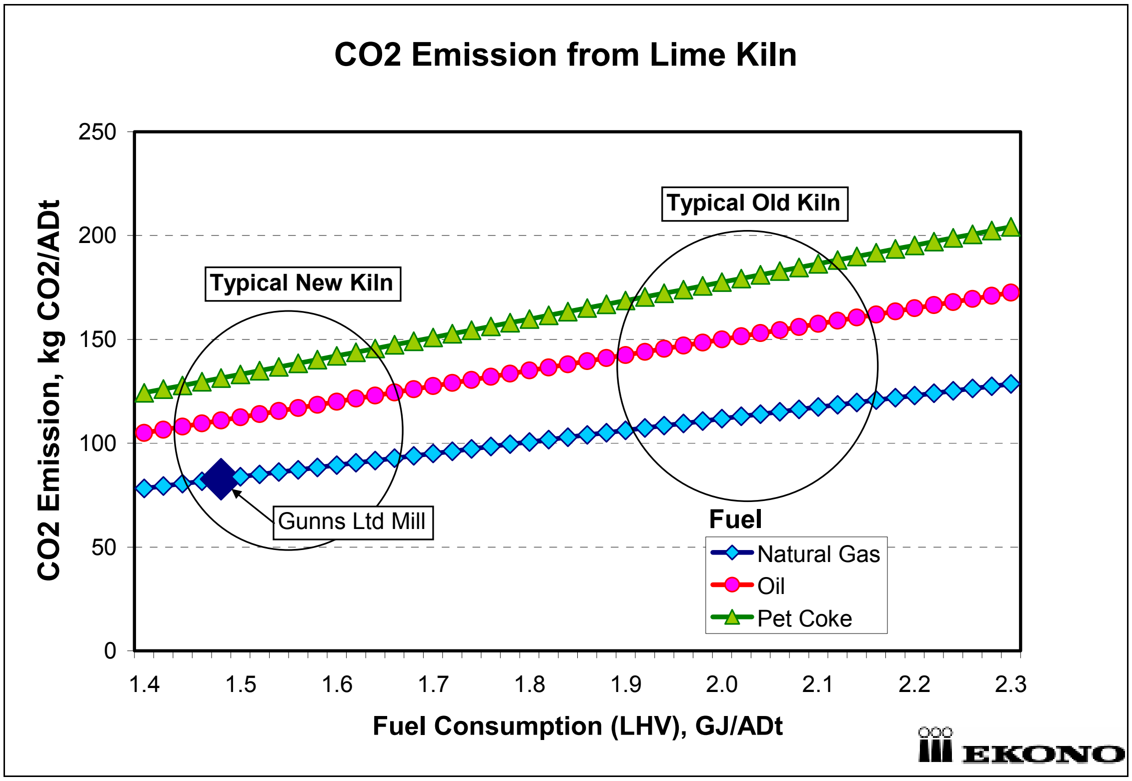

Figure 18 **CO_2 Emission From Lime Kilns With Different Fuels**

3.2 Recovery Boiler Stack Height

Figure 19 shows the height for 114 recovery boilers. As shown, the stack height varies from about 40 meters to 147 meters. The capacities of the boilers vary from 400 t d.s./day to 5000 t d.s./d. Figure 20 shows the stack height as a function of the capacity of the boiler. As shown, the stack height is clearly dependent on the capacity of the boiler. However, the variability around the trend lines is due to local circumstances that normally have to be taken into account in determining the stack height.

The data in Figure 20 includes a large number of boilers, new and old. Figure 21 illustrates the stack height for a sample of boilers built within the last ten years.

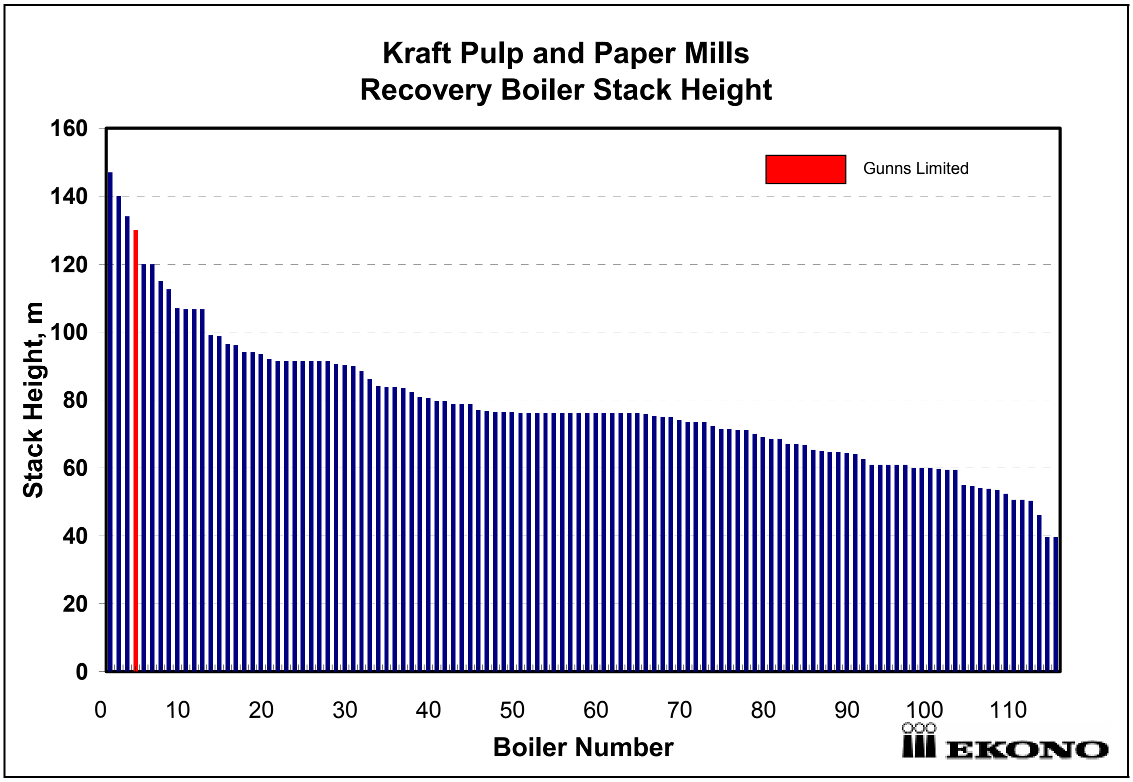

Figure 19 **Recovery Boiler Stack Height**

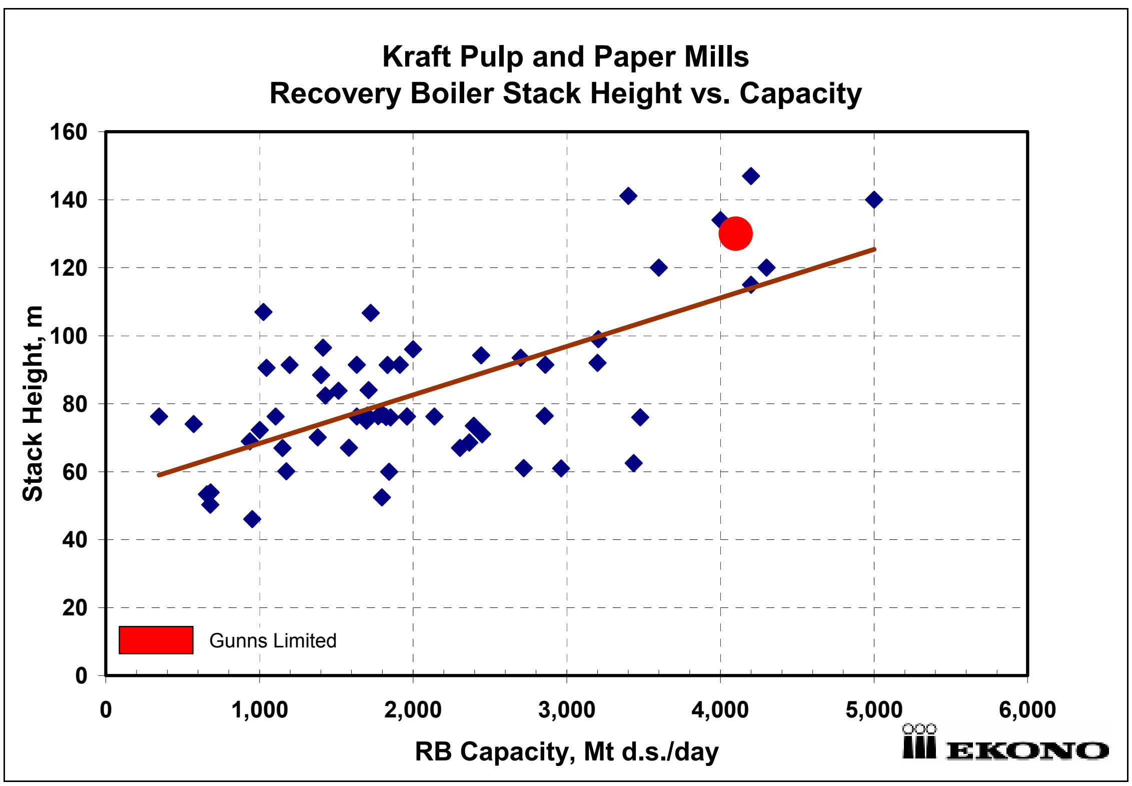

Figure 20 **Recovery Boiler Stack Height vs. Capacity**

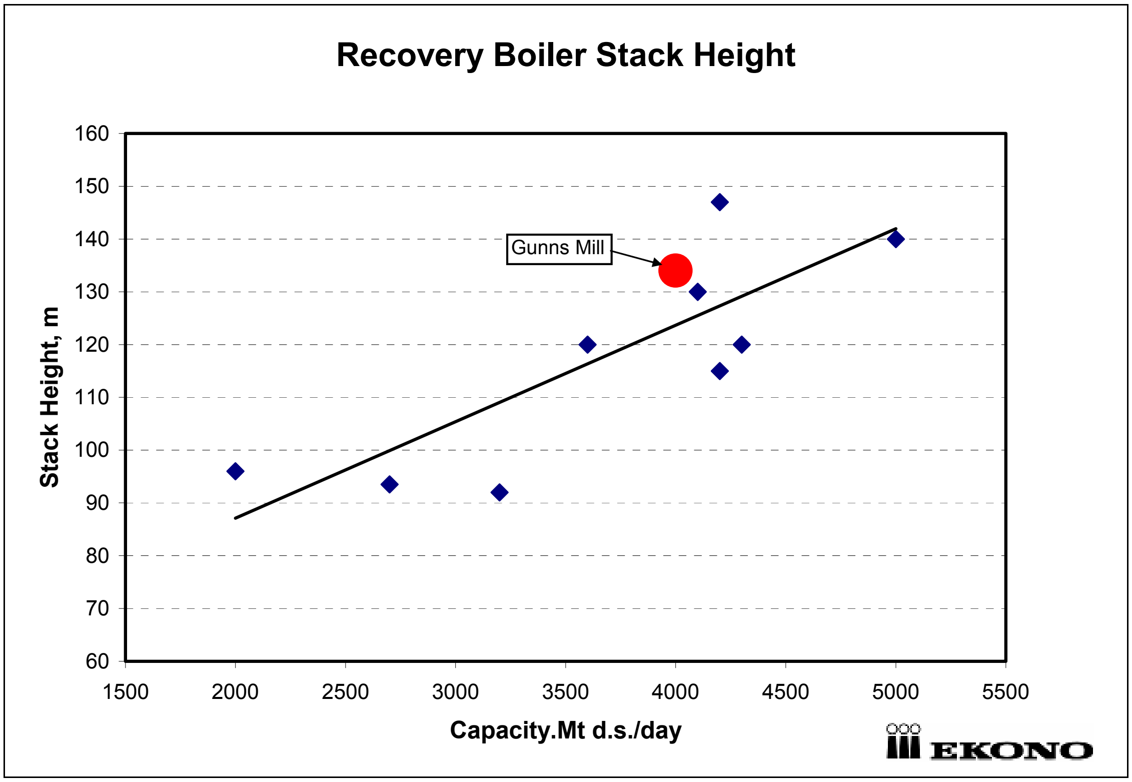

Figure 21 Recovery Boiler Stack Height vs. Capacity – New Mills

3.3 Use of Integrated Chemical Plants in Bleached Kraft Mills

Integrated chemical plants are typically used in the regions where either local economics or site remoteness justifies the on-site manufacturing of the bleaching and make-up chemicals.

The integrated chlorine dioxide process is a high consumer of electricity compared to the non-integrated process (which uses a raw material with higher energy content). Availability of low cost electricity has a major impact on the economics of using the integrated process.

High residual chlorine content of the ClO_2 – solution used to be a typical feature of the integrated process. This would increase the AOX of the bleach plant effluent. Because of the environmental concerns the suppliers have developed their systems to produce ClO_2 with very low residual chlorine. Thus the main environmental difference between the integrated and un-integrated process is related to electricity.

The Gunn's mill will generate an excess of electricity. The fuels for the electrical power generation are planned to be wood based and are therefore CO_2 neutral by definition. According to the preliminary engineering documents, the electrical power balance at 1,100,000 ADt/year production level is:

- Power generation, MW 169
- Pulp mill consumption, MW 81
- Chemical plant consumption, MW 26
- Total consumption, MW 107
- Power sold, MW 62

It is estimated that the power sales would be roughly 25 MW higher without the integrated chemical plant. Pacific Air & Environment have estimated that the green house gas emissions in Tasmania would potentially be displaced by 416,970 t/a due to the surplus electricity generated by the Gunn's mill.

The surplus electricity would be about 25 MW higher, if a non-integrated chemical plant were used. This would mean that about 167,000 t/a additional CO_2 would be displaced. This, however, would be strictly a theoretical displacement, because another company would need to use power for manufacturing of the $NaClO_3$ used as raw material in the non-integrated process.

3.4 Use of Tertiary Treatment

Three mills in EKONO's database use tertiary treatment. Chemical flocculation and clarification is used as for tertiary treatment.

The principle with tertiary treatment is to coagulate the organic material and remove it as a separated sludge. Depending on the sludge and the mill process the sludge can be incinerated or landfilled.

The chemical treatment affects mainly effluent COD, colour and phosphorus. Some reduction in AOX and other parameters can also occur, depending on the chemical usage.

Figure 22 illustrates the colour of the final effluent from sample mills. The expected colour of the effluent from the Gunns mill is very slightly higher than the colour from one of the eucalyptus mills with tertiary treatment. The expected colour discharges are less than a third of the colour from softwood mill with tertiary treatment.

Figure 23 shows the COD discharges from the bleached kraft market pulp mills that report the COD discharges. As shown, the COD discharges are very low for the eucalyptus kraft mills that use tertiary treatment. The softwood kraft mill with tertiary treatment does not report COD discharges.

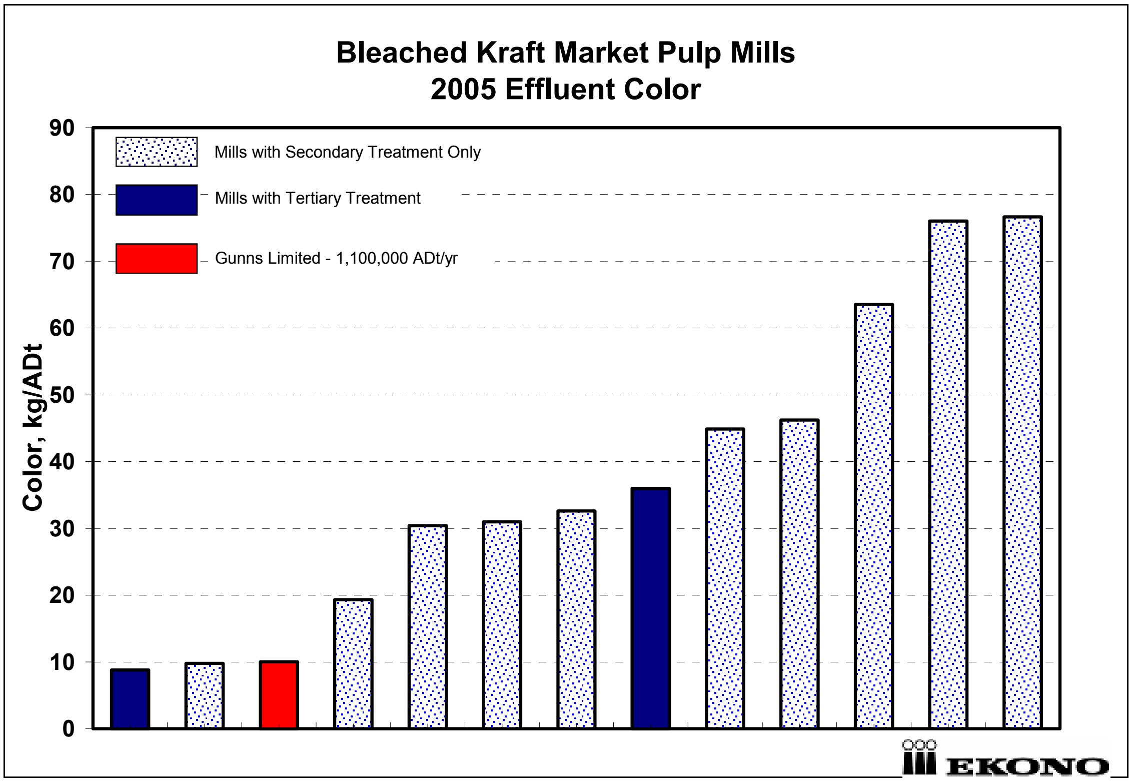

Figure 22 **Bleached Kraft Mills Effluent Colour in 2005**

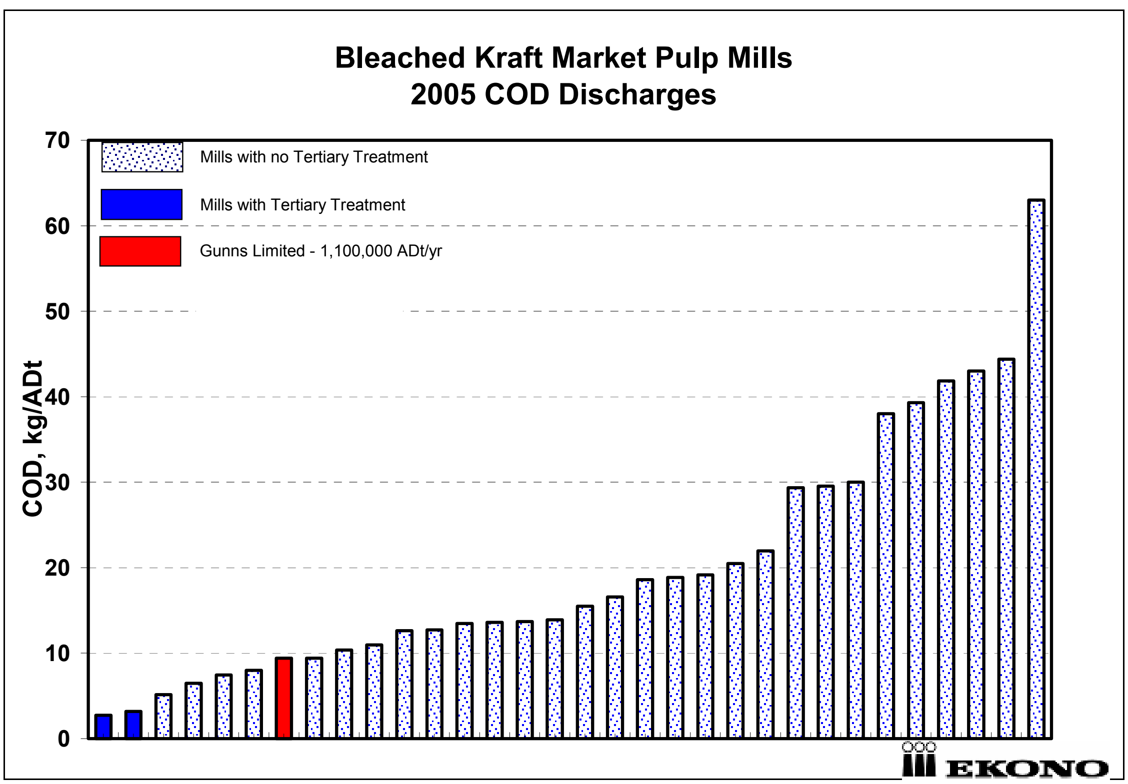

Figure 23 **Bleached Kraft Mills Effluent COD in 2005**

3.5 Development of TCF and ECF Production in Bleached Kraft Industry

"Elemental Chlorine Free" (ECF) pulp bleaching process is a dominant process for bleached kraft pulp production today. In the early 1990'ies a new process, called "Total Chlorine Free" (TCF) bleaching process was introduced.

Figure 24 illustrates the development of the pulp produced using different bleaching processes. Total bleached pulp production increased from about 67 million tons in 1990 to about 85 million tons in 2002. Figure 25 shows the worldwide production of TCF pulp. As shown, the TCF pulp production increased rapidly from 0 tons in 1990 to 5 million ADt/a in 1995. Thereafter the TCF bleached pulp production has remained unchanged or even decreased.

The Nordic Countries produce about 50% of the world TCF production. Figure 26 shows the trend in the Nordic Countries. TCF bleached pulp production reached the 3 million tons/a level in five years. Since the year 2000, the TCF bleached pulp production has decreased to a level of 2.5 million tons/a.

The TCF production in the Nordic Countries is expected to decrease by another 0.5 million tons per year in 2008. The biggest TCF pulp producer in Finland, the Botnia mill in Rauma, Finland started up a ClO_2 plant in the summer of 2007. The conversion from TCF to ECF is said to be market based. Appendix 3.1 includes an article "Market Driven Bleaching Change" related to the conversion from the magazine "Botnia Echo" by Botnia.

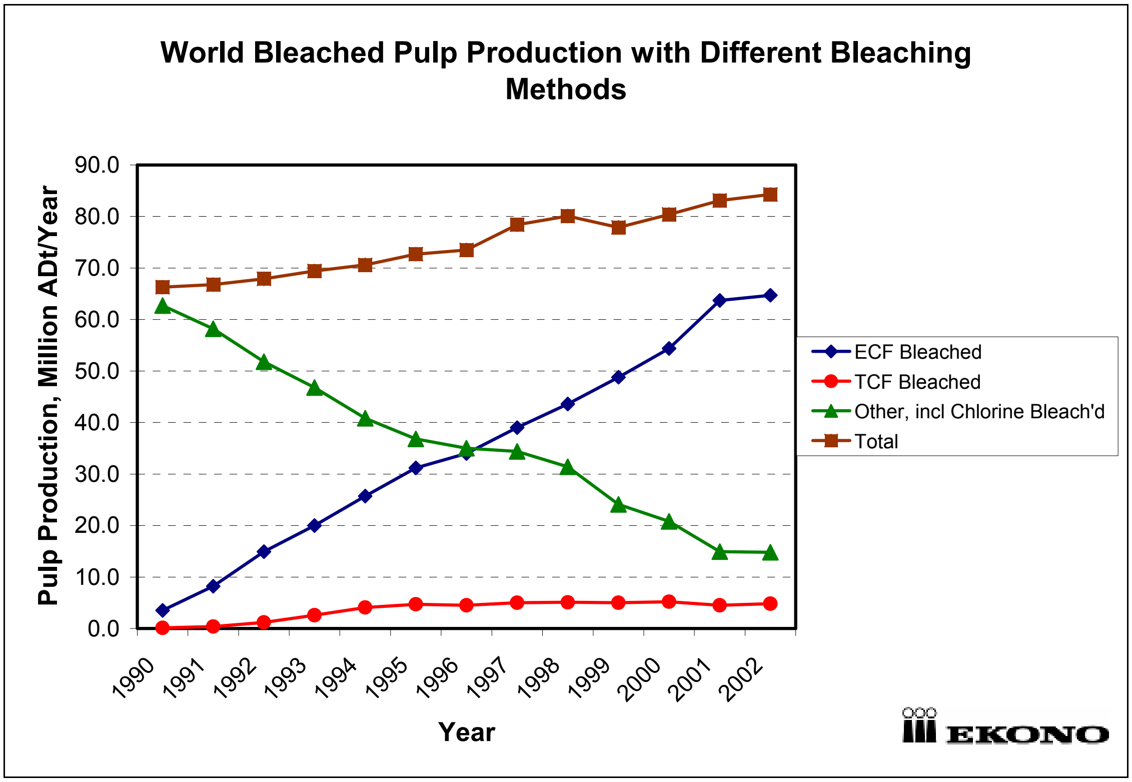

Figure 24 **World Bleached Production with Different Bleaching Methods**

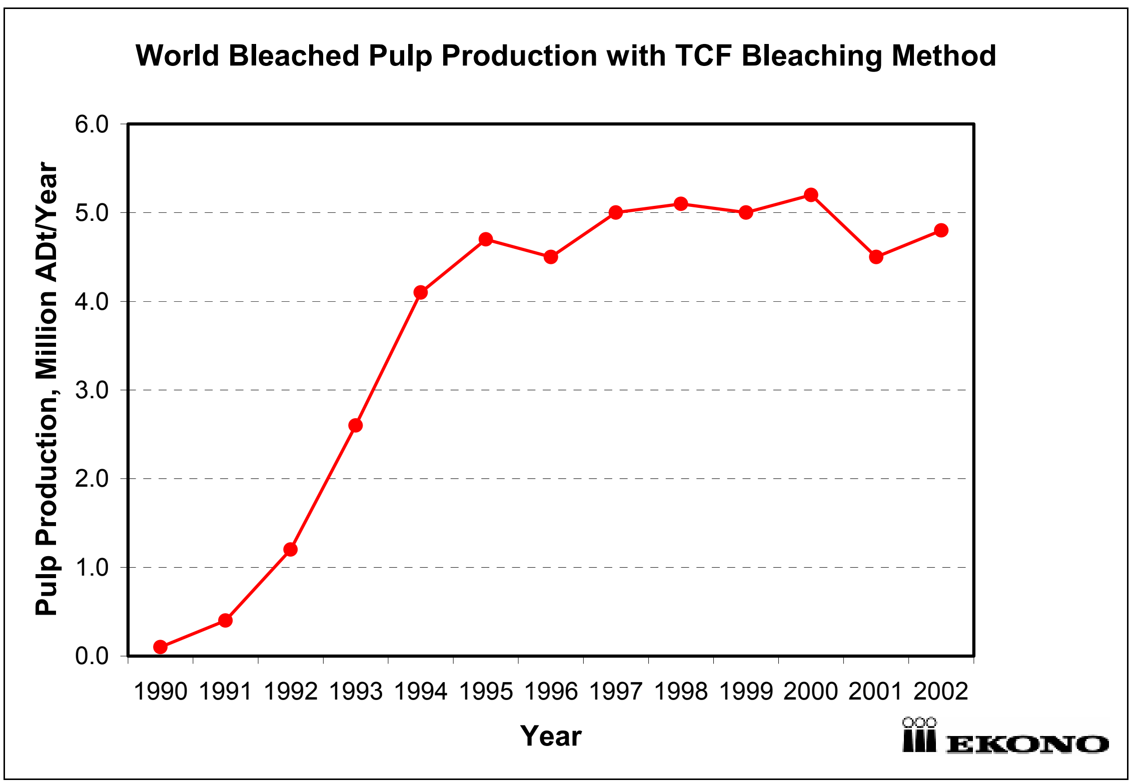

Figure 25 **World Bleached Production with TCF Bleaching Methods**

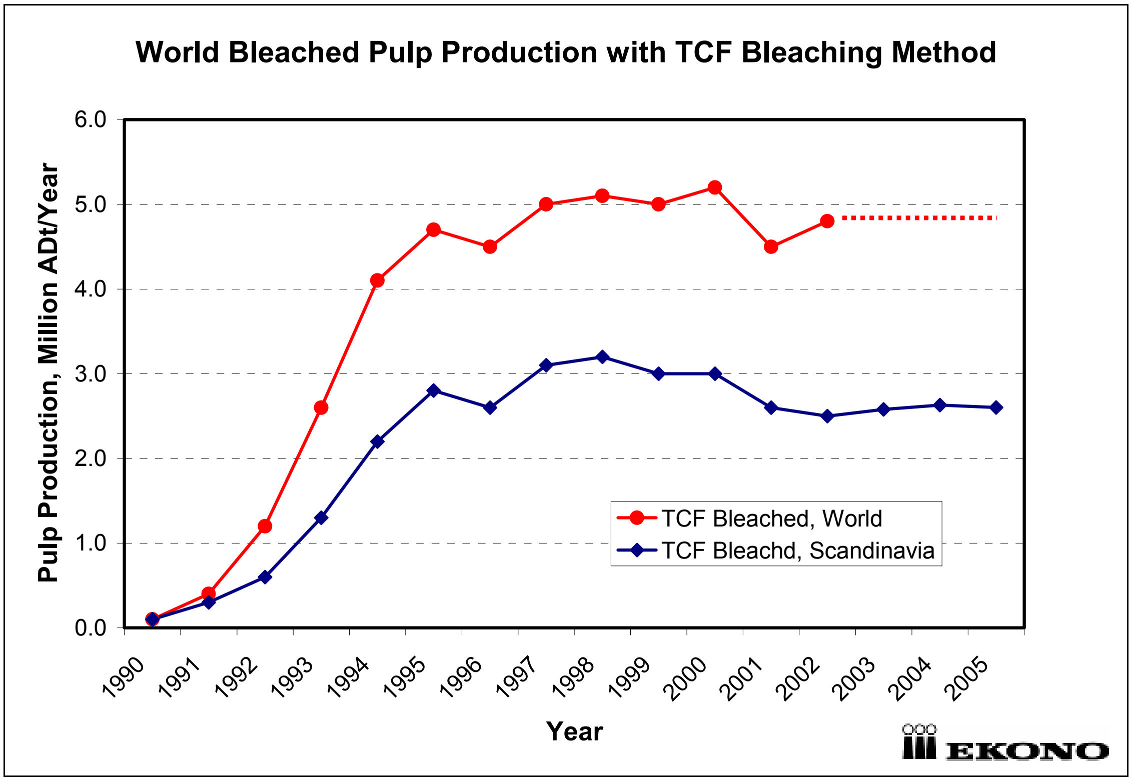

Figure 26 Bleached Production with TCF Bleaching Methods

3.6 Use of Closed Loop Technology

Recycling of the bleach plant effluent in bleached kraft industry is often referred to as "Closed Loop Pulping Technology".

Over thirty years ago, Dr. Howard Rapson presented a method for bleach plant effluent recovery. In the mid seventies, a closed cycle bleach plant was started up and operated for some years until the owners decided to give up the closed loop operation and open up the water systems at the mill.

Because of the bad experience of the first closed mill implementation the concept was not developed further for about ten years. Tightened effluent regulations, e.g., for the releases of chlorinated organic compounds initiated a new interest for the closed loop technology. Especially the Swedish mills were interested in the concept because they saw the recovery of the bleach plant effluent as an opportunity to minimize the size of secondary effluent treatment or possibly eliminate the need for secondary treatment completely.

The main problems with the bleach plant effluent recovery are equipment corrosion and the accumulation of chloride and non-process elements in mill liquor systems. Accumulation of chlorides and potassium is especially corrosive for the recovery boiler.

Different techniques have been developed for chloride removal and the removal of non-process elements. However, in spite of decades of research and pilot and mill scale trials the bleached market pulp mills are far from the target of closed water systems. Figure 27 illustrates the impact of partial bleach plant effluent recovery on the effluent flow. EKONO's database contains effluent flow information from 47 bleached market Kraft mills. Six of the mills have partial bleach plant effluent recovery. The effluent flow is below 40 m3/t in all these mills. The expected effluent flow from the Gunns mill is the second lowest of 47 bleached market Kraft mills.

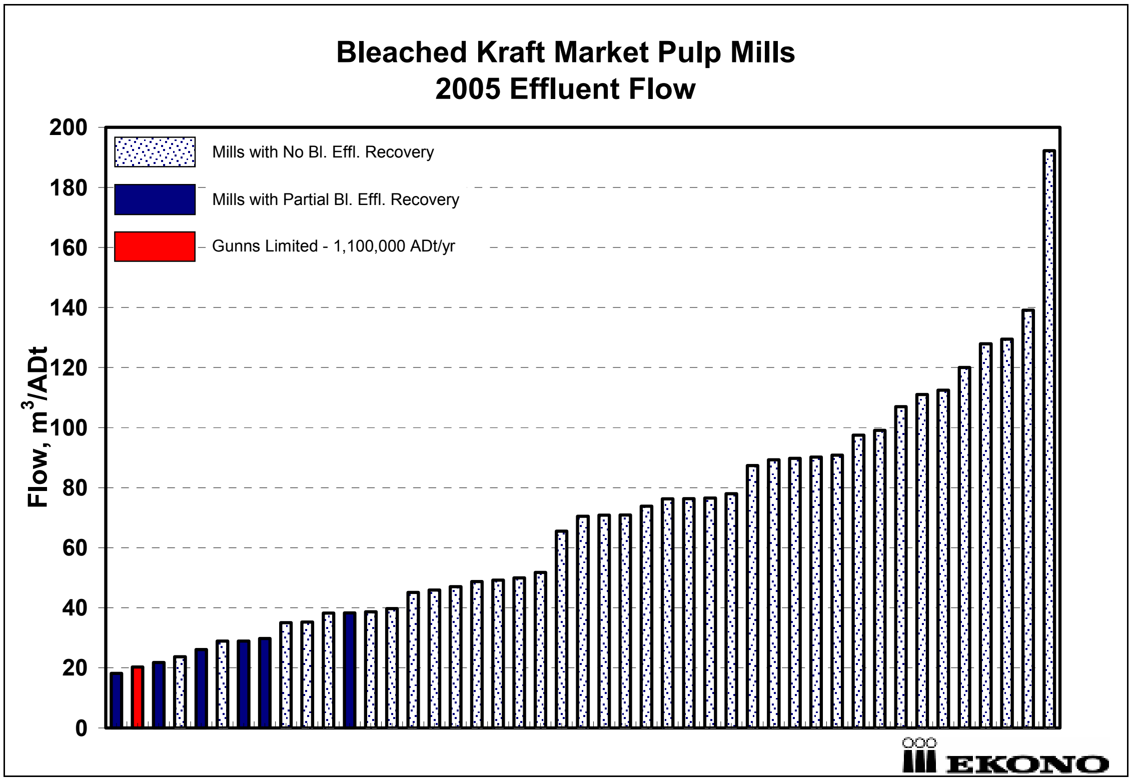

Figure 27 **Effluent Flow in Bleached Kraft Market Pulp Mills**

4. CONCLUSIONS

EKONO has benchmarked the expected environmental performance of the Gunns mill, against the performance of 53 bleached kraft market pulp mills in North America, Europe and South America. The annual average discharge data from 2005 were used for the 53 comparison mills.

Table 4.1 summarizes the benchmarking results for the parameters for which data were available for from the Gunn's mill, and the number of the other mills with data in EKONO's files is at least ten.

Table 4.1 List of Parameters Included in the Benchmarking and the Position of the Gunns mill.

Figure No.	Parameter	No. of Mills	Position of the Gunns Mill
1	Flow	47	2
2	BOD_5	44	9
3	Suspended Solids	47	5
4	COD	32	8
5	AOX	48	23
6	Colour	13	3
7	Phosphorous	37	8
8	Nitrogen	20	3
9	SO_2	44	14
10	NO_2	48	18
11	CO_2	45	5
12	CO	31	7
13	TRS	17	1
14	Total sulfur	49	6
15	Particulate	47	7
16	PM_{10}	26	1
17	$PM_{2.5}$	20	1

Within the 17 parameters listed in Table 4.1, the expected performance of the Gunns mill is within the five best mills for eight of the parameters.

It is not expected that a single mill would be best in all categories. It is also not possible to single out one mill as the best performing mill, because different parameters are emphasized in different regions depending on mill location and the local environmental restrictions.

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Botnia's Rauma pulp mill shares much of production infrastructure with the neighbouring UPM paper mill (in the backgroud).

BY RISTO PITKÄNEN **PHOTOS BY** MIIKA KAINU AND BOTNIA

MARKET-DRIVEN BLEACHING CHANGE

A new ECF bleaching process will start up at Botnia's Rauma mill around the beginning of June. As a result, the proportion of reinforcement pulp will increase, product brightness will improve and more pulp will be obtained from the same amount of feedstock. In its environmental impact, the new process is the equal of the original TCF process.

Matti Lahtinen (left), Kaija Pehu-Lehtonen and Harri Saisaari emphasize that customer needs dictated the change in Rauma mill's bleaching process.

Mill manager **Kaija Pehu-Lehtonen** explains that the original choice of bleaching method was market-driven. When Rauma started up in 1996, customers needed TCF bleached pulp for their products and there was reason to believe that an ever-greater proportion of the pulp industry would eventually switch to bleaching pulp entirely without chlorine chemicals. This did not happen. The market launch of TCF trigged a rapid development phase of ECF bleaching, aimed at reducing the environmental loading. Now Rauma is responding to the needs of its market and customers by switching to the ECF process.

"ECF bleached pulp is more suitable for our customers' processes. Another reason why the situation has changed radically is that development of pulping technology and the ECF process have made it the equal of TCF bleaching in terms of its effects on the environment."

The new bleaching process will raise Rauma's production capacity by about 45 000 tonnes. The product palette in turn will become simpler when three grades are replaced by two – reinforcement pulp and standard softwood pulp. Reinforcement pulp is needed by customers who make wood-containing printing papers, while standard pulp is a suitable feedstock for, among others, fine papers and tissue.

BRIGHTER PULP

Thanks to the change in bleaching method, pulp brightness can be increased.

"Customers for reinforcement pulp want a brighter product that works better as a feedstock for new thin papers. In TCF bleaching, brightness had to be sacrificed in order to achieve the other characteristics expected from a reinforcement pulp," Pehu-Lehtonen says.

In future pulps from Rauma and Joutseno will be better able to serve as back-ups for each other.

A SIMPLER PROCESS

Project engineer **Matti Lahtinen**, responsible for the Rauma fibre line, says that the new four-stage bleaching process is simpler than the old process. Brown stock is bleached with oxygen, chlorine dioxide and hydrogen peroxide. There is no intermediate storage between stages and the stock simply flows through the process as if through a pipeline. A significant part of the investment was building a chlorine dioxide plant.

The pulp's strength properties are improved when delignification in the digester can be terminated at a higher kappa number than before. At the same time a higher fibre yield is produced from cooking. The mill's production capacity is further boosted by changes in stock washing and screening.

As Matti Lahtinen sums it up, "the

THE NEW PROCESS MAKES PULP THAT IS STRONG, BRIGHT AND PURE.

new process makes pulp that is strong, bright and pure."

A straight-through process means that process control is very important. Thorough preparations were made for the changeover in a team spirit that is typical of Rauma. A process operator with electrical automation training from each of the mill's five shifts, the project engineer, the electrical automation manager, one of the automation programmers and representatives of the equipment suppliers went through the system together three days a week last October-November.

Having received an induction into how the process is controlled, the process operators will pass on the knowledge within their own shifts. **Harri Saisaari** was the representative of his shift on the initiation course. His basic training was as an electrical automation technician so controlling the new process is exactly his field. He believes that the new process at Rauma will get off to a smoother start than eleven years ago.

"At that time we were starting a unique process from scratch. ECF bleaching is an established process and the technology is tried and tested. Of course we're going to take it forward and become the best in the field," he adds in typical Rauma fashion.

Lahtinen points out that from the viewpoint of running a process, the new products are much closer to each other than the old ones were. When run settings and final brightness vary less, only small process adjustments are needed when changing the product, which serves to make quality more uniform.

GOOD ENVIRONMENTAL BALANCE SHEET

The new process reduces the environmental load in several ways. More pulp will be obtained from the same amount of wood. The product can be piped to the neighbouring UPM paper mill, which will save energy in drying and transport. There will be an additional saving of electricity because a simple process uses fewer electric motors.

Water consumption will rise, which is why Botnia and UPM have expanded their joint facilities for process water purification and wastewater treatment of their integrated pulp and paper mills.

GREAT SUM OF KNOWLEDGE

Kaija Pehu-Lehtonen points out that a great amount of development work has been done at Rauma over the eleven TCF years. It has provided a fund of knowledge about pulping that would not have been obtained from a different process. The mill has also gained much new understanding about how pulp behaves on a paper machine.

"When we measured pulp from Rauma and other mills, they may seem to have the same strength values but TCF pulp still behaved differently in the customer's process. In order to explain this, we had to probe the phenomena more deeply than before."

It was found that the differences are not the result of feedstock differences but stem from the process. By varying the process it is therefore possible to tune the characteristics of the pulp without altering the feedstock. For the products in Rauma's new palette, long-fibre spruce pulpwood and sawmill chips are the feedstock for reinforcement pulp while pine pulpwood is used for standard pulp.

More than 5 million tonnes of TCF pulp have been produced over the years at Rauma.

"A lot of work has been done to raise its quality incrementally," Matti Lahtinen says. "Ultimately you reach the point where a quantum change is needed."