

NORTHERN PULP NOVA SCOTIA CORPORATION
ABERCROMBIE, NOVA SCOTIA

MEMORANDUM: POSSIBILITY TO MEET
COD LIMIT OF 11,890 KG/DAY

April 6, 2015

The proposed daily average COD limit of 11,890 kg/day corresponds to about:

$$\frac{11,890 \text{ kg/day}}{900 \text{ ADt/day}} = 13.2 \text{ kg/ADt}$$

A daily limit for COD is very unusual. Typically COD limits are given as kg/d as monthly and annual average within the European Union, for example. Examples of COD limits in Finnish bleached kraft market pulp mills are:

Mill 1.	Production	450,000 ADt/year hardwood bleached kraft pulp 200,000 ADt/year softwood bleached kraft pulp
	COD limit:	40,000 kg/d as monthly average (or 21.5 kg/ADt) 32,000 kg/d as annual average (or 17.2 kg/ADt)
Mill 2:	Production:	380,000 Adt/year softwood bleached kraft pulp
	COD limit:	30,000 kg/d as monthly average (or 27.6 kg/ADt) 20,000 kg/d as annual average (or 18.4 kg/ADt)

Table 1 gives examples for the interrelation between wood-type, techniques and degree of delignification before the bleach plant, and the COD generated during bleaching. The calculation for the discharge of residual lignin in kg COD/ADt assumes a discharge of approximately 2 – 2.2 kg COD per kappa unit and a pulp to be bleached to full brightness/1/.

Table 1 Examples for the Interrelation Between Wood-Type, Techniques, and Degree of Delignification Before the Bleach Plant and COD Generated During Bleaching

Cooking Method	O ₂ Delignification/ Ozone Bleaching	Hardwood Pulp		Softwood Pulp	
		Kappa Into Bleach Plant	COD (kg/ADt)	Kappa Into Bleach Plant	COD (kg/ADt)
Conventional cooking 1)	--	18	38	30	63
Conventional cooking	O ₂ delignification	13	27	15	32
Modified cooking	--	16	34	20	42
Modified cooking	O ₂ delignification	10	15	12	25
Further modified cooking	--	13	26	15	30
Further modified cooking	O ₂ delignification	10	15	10	15

1) Cooking method at Northern Pulp Nova Scotia

/1/ PARCOM, BAT and BEP for the Sulphite and Kraft Pulp Industry, 1994.

Northern Pulp produces softwood pulp with a maximum kappa of the pulp to the bleach plant at 28. According to Table 1, the COD from the bleach plant would thus be approximately 59 kg/ADt.

The annual average final effluent COD discharge at Northern Pulp is 55.6 kg/ADt and the effluent treatment plant COD removal efficiency is 38%. The total inlet COD with 38% COD removal efficiency would be about 146 kg/ADt, and the COD from other sources than the bleach plant would thus be about 87 kg/ADt, or about 60%.

It is obvious that the Northern Pulp mill cannot reach the effluent COD limit of 13.2 kg/ADt without a massive investment program that would include:


1. Closed screen room
2. Additional washers
3. O₂ delignification
4. Condensate stripping for methanol removal
5. Spill Collection
6. Enhanced effluent treatment (Activated sludge and/or tertiary treatment).


Figure 1 illustrates the COD discharges from bleached market kraft pulp mills in Europe and in North America. Figure 2 shows the COD discharges from sample North American bleached kraft market pulp mills. It has to be noted that COD is not a regulated effluent parameter in Canada or USA. Therefore the mills don't generally report nor even measure regularly the COD discharges.

In Figure 2, the two lowest COD discharge mills are hardwood mills with O₂ delignification, modified cooking, condensate stripping, etc. All mills that have COD discharges 40 kg/ADt or less are modern or modernized mills with O₂ delignification, condensate stripping, closed screening room and effective spill collection systems. The lowest COD discharge in a Canadian bleached softwood kraft pulp mill in the database is 28 - 30 kg/ADt. The COD discharge in the Northern Pulp mill is thus about two times higher than a comparable modernized softwood bleached kraft mill.

Figure 3 shows the BOD discharges from North American bleached market kraft mills. As shown, more than 40% of the North American bleached market kraft pulp was produced by mills with BOD discharge higher than those at the Northern Pulp mill.

EKONO Inc,


Heikki Mannisto, P.E.
President


Eva Mannisto, P.E.
Vice President

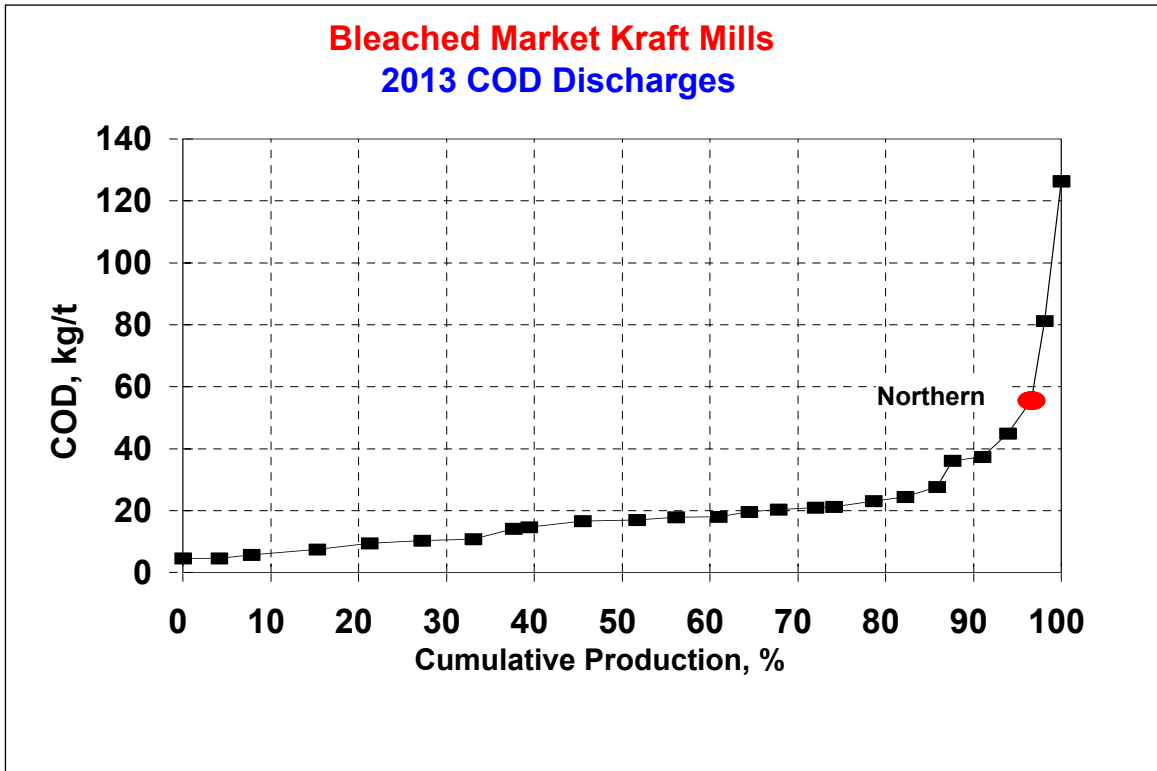


Figure 1 Effluent COD Discharges from Bleached Market Kraft Pulp Mills in 2013

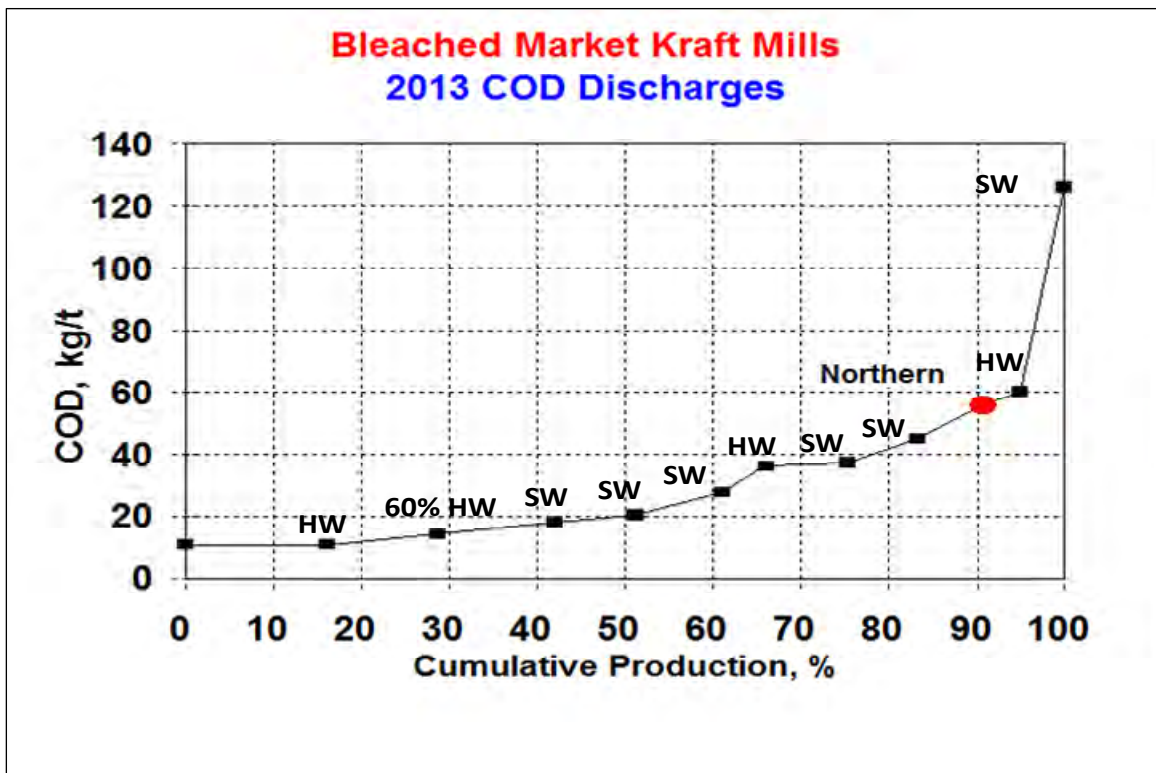


Figure 2 Effluent COD Discharges from N. Am. Bleached Market Kraft Pulp Mills in 2013

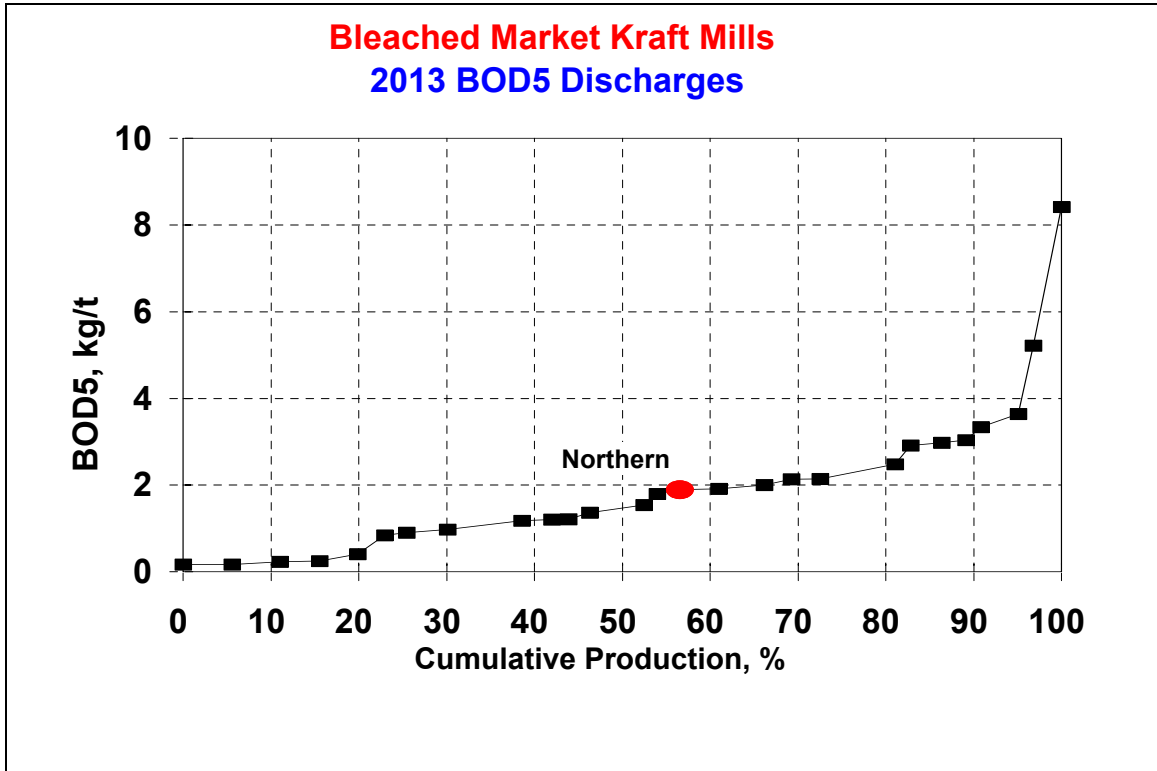


Figure 3 Effluent BOD₅ Discharges from N. Am. Bleached Market Kraft Pulp Mills in 2013

HEIKKI I. MANNISTO

Present Function	EKONO Inc., President
Specialties	Pulp and Paper Process Technology. Environmental and Energy Conservation Technology. Project Management.
Education	University of Oulu, Finland. M.Sc. in Control and Systems Engineering, 1965.
Registration and Licenses	Professional Engineer (Chemical) State of Washington, 1973, State of Florida, 1986.
Professional Career	
1993 -	EKONO Inc., Bellevue, Washington, USA; President
1991 - 1993	DUOPLAN Oy, Helsinki, Finland; President
1989 - 1991	EKONO Consultants, Ltd., Edmonton, AB, Canada; President
1980 - 1989	EKONO Inc., Bellevue, Washington, USA; Vice-President
1978 - 1980	EKONO Oy, Helsinki, Finland; Process Engineering Dept., Manager
1977 - 1978	EKONO Oy, Helsinki, Finland; Process Engineering Department Assistant Manager
1974 - 1976	EKONO Oy, Helsinki, Finland; Senior Project Engineer
1971 - 1974	EKONO Inc., Bellevue; Project Engineer
1969 - 1971	EKONO Oy, Billerud Project Group, Sweden; Project Engineer
1968 - 1969	EKONO Inc. Bellevue; Project Engineer
1966 - 1968	EKONO Oy, Helsinki, Finland; Process Engineering Dept., Project Engineer
1963 - 1966	Oulu Osakeyhtio, Pulp Mill, Oulu, Finland; Process Engineer.
Major Project Experience	<p>Buckeye Cellulose, Perry, FL: Liquor Loop and Environmental Study (2012)</p> <p>Rock Tenn, West Point, VA: Energy Audit (2011)</p> <p>Confidential Client: Due Diligence of two Bleached Kraft Pulp Mills (2010)</p> <p>Several market Pulp Mills In Canada: Black Liquor Audits as part of the Pulp and Paper Green Transformation Program in Canada (2009)</p> <p>Tembec Inc.: Benchmarking of the Sustainability Aspects of High Yield Bleached Pulps (2008 – 2009)</p> <p>Celulosa Arauco: Benchmarking of Environmental performance of the Valdivia and Nueva Aldea Mills(2008)</p> <p>Daishowa-Marubeni, Peace River, Alberta: Calculation of GHG Emissions(2008, 2009, 2010)</p> <p>Confidential Client: Prefeasibility Study of Converting a Paper Grade Pulp Mill to Dissolving Grade Pulp (2008)</p> <p>Weyerhaeuser Company, Federal Way, WA: Environmental Benchmarking of Weyerhaeuser's Mills (2008)</p> <p>Weyerhaeuser, Grande Prairie, Alberta, Canada: Feasibility Study of Green Power Generation (2007)</p>

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Confidential Client: Feasibility Study of Converting a Paper Machine to a Pulp Dryer (2009)

Metafore: Development of Normalization Equations for Environmental Discharge Parameters (2008)

Government of Tasmania: Benchmarking of the Expected Environmental Performance of the Gunn's Ltd Pulp Mill in Tasmania (2007)

ABB Australia: Equipment Life Time Audit of an Australia recycled paperboard mill (2006)

Alberta-Pacific, Peace River, Alberta: Presentation on Lime Kiln alternative Fuels (2006)

Botnia, Finland: Environmental Benchmarking of the proposed bleached kraft mill in Uruguay (2006)

Weyerhaeuser, Grande Prairie: Optimization of black liquor buffer storage

ABB France : Equipment Life time Audit of a European Bleached Kraft Mill (2006)

Celulosa Arauco, Chile, Benchmarking of effluent limits and effluent discharges, including color (2005, 2006)

Tembec Inc: Environmental Permit Benchmarking. (2005)

Tembec Inc: Pre-feasibility Study of PSAQ pulping in three bleached kraft pulp mills. (2005)

Tembec Inc, Tarascon, France: Evaluation of future scenarios for energy conservation, environmental and process improvements at one bleached kraft pulp mill.(2005)

UPM-Kymmene: Environmental Benchmarking. (2005)

ABB Ltd, New Zealand: Energy Audit of the CHH Tasman Mill. (2004)

ABB Ltd, New Zealand: Equipment Life time Audit of the CHH Tasman Mill. (2004)

Norske Canada, Elk Falls, B.C.: Benchmarking of the Kraft Mill Performance. (2004)

Alabama River Pulp, Perdue Hill, AL: Benchmarking of Energy Consumption at the Alabama Pine and Alabama River Pulp Mills. (2004)

Tembec Inc. St Francisville, LA: Preliminary Water Consumption and Conservation Study. (2003)

Bowater Pulp and Paper Canada Inc. Thunder Bay, ON: Review of the pulp mill water and energy savings projects. (2003)

Confidential Client, Scandinavian Kraft Mill: Preliminary engineering of the polysulfide plant. (2003)

Stora Enso North America, Wisconsin Rapids Pulp Mill, WI: Energy conservation study. (2003)

Stora Enso North America, Wisconsin Rapids Paper Mill, WI: Energy conservation study. (2003)

Weyerhaeuser Company Ltd, Grande Prairie, AB, Canada: Implementation of the Energy Monitoring and Reporting System. (2002)

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Marathon Pulp Inc., Marathon, ON: Environmental audit, benchmarking of the performance and determination of measures to reach “Impact Zero” targets in a bleached kraft mill. (2002)

Tembec Inc., Smooth Rock Falls, ON: Environmental audit, benchmarking of the performance and determination of measures to reach “Impact Zero” targets in a bleached kraft mill. (2002)

Stora Enso North America, Stevens Point, WI: Energy audit of the paper mill. (2002)

Confidential Client: Environmental assessment of the current air and water emissions and emission limits, comparing of requirements in different jurisdictions, and establishment of environmental design and performance criteria. (2001-2002)

Confidential Client, USA: Determination of potential market for Bubbling Fluidized Bed (BFB) technology in Canadian pulp and paper industry. (2001)

Tembec Saint-Gaudens, S.A., Saint Gaudens, France: Study on optimum steam and power supply at the mill. (2001)

Norske Skog Tasman Ltd, Tasman, New Zealand: Study on effluent color reduction technologies. (2001)

AllWin Technologies Inc., Nanaimo, B.C.: Equipment lifetime audit of the Norske Skog, Crofton pulp mill. (2001)

AllWin Technologies Inc., Nanaimo, B.C.: Equipment lifetime audit of the Norske Skog, Elk Falls pulp mill. (2001)

Environment B.O.P., Whakatane, New Zealand: Evaluation of the Norske Skog, Tasman mill air consent. (2000)

Canfor Ltd., Prince George, B.C.: Energy audit of the Northwood mill. (2000)

Canfor Ltd., Prince George, B.C.: Energy audit of the Intercon mill. (2000)

Tembec Inc., Smooth Rock Falls, ON: Hog fuel boiler capacity optimization study. (2000)

AllWin Technologies Inc., Nanaimo, B.C.: Development of the start-up procedures for the Norske Skog, Elk Falls pulp mill. (2000)

Tembec Inc., Cestbrook B.C.: Pulp dryer debottlenecking and steam reduction study. (2000)

UPM-Kymmene, Finland: Energy audit of the Blandin Paper Co. mill. (1999-2000)

Tembec Inc., Crestbrook, B.C.: Process control and optimization studies. (1999)

UPM-Kymmene, Finland: Energy audit of the Wisaforest pulp and paper mill. (1999-2000)

The Confederation of Finnish Industry and Employers: Study of energy and CO₂ efficiency in the pulp and paper industry. (1999)

Fine Paper Mill, Eastern USA: Energy conservation study. (1999)

Weyerhaeuser Canada, Prince Albert, SK: Mill capability study. (1998)

Tasman Pulp and Paper Co., Kawerau, New Zealand: Study of colour reduction options. (1998)

UPM-Kymmene, Finland: Energy audit of the Kuusankoski Pulp and Paper Mill. (1998)

HEIKKI I. MANNISTO 4/6

Malette Kraft, Smooth Rock Falls, ON: Process design of the TRS control program. (1998-1999)

Georgia-Pacific, Nekoosa, WI: Evaluation of digester relief, turpentine recovery and NCG systems. (1998)

NCASI, Research Triangle Park, NC: Study on energy and CO₂ reduction opportunities in Forest Products Industry Facilities. (1997 - 1998)

Georgia-Pacific, Palatka, FL: A study to identify and evaluate options for meeting the Cluster Rule. (1998)

UPM-Kymmene, Finland: Energy Audit of the Kaukas pulp and paper mill complex. (1997)

Georgia-Pacific, Ashdown, AR: A study to identify and evaluate options for meeting the Cluster Rule. (1997)

An Integrated Fine Paper Mill, Southern USA: A study to identify and evaluate options for meeting the Cluster Rule. (1997)

Malette Kraft, Smooth Rock Falls, ON: TRS control study. (1997)

Multi-client Study: "Environmental Performance, Regulations and Technologies in Pulp and Paper Industry." (1996, 1997)

Malette Kraft, Smooth Rock Falls, ON: Energy conservation study. (1997)

Tembec Inc., Temiscaming, PQ: Efficiency audit of the sulfite mill and evaluation of future options. (1997)

Environment B.O.P., Whakatane, New Zealand: Review of air and water discharge consent for Tasman Pulp and Paper Company. (1997)

Malette Kraft, Smooth Rock Falls, ON: Study on production and cost optimization. (1997)

Alabama River Pulp Mills, Perdue Hill, AL: Energy and water conservation study. (1996 - 1997)

A United States Pulp Company: An engineering study of a mill conversion in South America. (1996)

A Paper Mill, Midwest, USA: Energy conservation study. (1996)

Multi-client Study: "Environmental Performance, Regulations and Technologies in Pulp and Paper Industry". (1995)

Pulp and Paper Mill, Midwest, U.S.: Energy and water conservation study. (1995)

Multi-client Study: "Optimum washing and metal management concepts in a low effluent bleached kraft mill." (1995)

Weyerhaeuser Paper Company, Longview, WA: An energy opportunity assessment study in order to identify and assess feasible energy cost-reduction measures. (1995)

Multi-client Study: "Environmental performance, regulations and technologies in the pulp and paper industry." (1994)

Pulp and Paper Mill, Eastern USA: Energy and water conservation study. (1994)

Tembec, Inc., Temiscaming, PQ: Study and preliminary engineering of available measures for reduction of effluent discharges. (1994)

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Market Pulp Mill, Southern USA: Review of the mill optimization program and assessment of the impacts on effluent discharges. (1994)

Environment B.O.P., New Zealand: Review of the process technologies associated with a kraft mill's air discharge permit. (1994)

Pulp and Paper Mill, Midwest, USA: Evaluation of low effluent options for implementation in connection with the mill expansion program. (1994)

American Forest Products Association, Washington, D.C.: Review of the current and expected environmental regulations and industry performance in Canada, Finland, France, Germany and Sweden. (1993-1994)

Multi-client Study: "Chemicals, Dry Solids and Solid Waste in a Low Effluent Bleached Kraft Mill." (1994)

Multi-client Study: "Low Effluent Bleached Kraft Mill" Concepts." (1992 - 1993)

Pulp and Paper Mill, Finland: Evaluation of water conservation measures and possible concepts for complete elimination of liquid effluent. (1993)

Finnish Forest Products Association: Development of demonstration and R&D program for new environmental technologies in the pulp and paper industry. (1993)

Procter & Gamble, Grande Prairie, AB: Dynamic modeling of effluent treatment systems for identification of toxicity sources. Assistance in water license renewal. (1992)

Pulp and Paper Mill, Finland: Evaluation of water pollution control measures, both in-plant and treatment options. (1992)

Weyerhaeuser Canada, Prince Albert, SK: Engineering study of the air pollution control methods necessary to meet the clean air act requirements. (1991)

Confidential Client, Canada: Market study for uncoated groundwood papers. (1991)

Weyerhaeuser Canada Ltd, Prince Albert, SK: Preliminary engineering study of chlorine free pulping. (1990)

Procter & Gamble Cellulose, Grande Prairie, AB: Feasibility study of condensate stripping and noncondensable gas collection and incineration options. (1990)

Confidential Client, Canada: Feasibility study of a second fiberline. (1990)

Tembec Inc., Temiscaming, PQ: Development of a five year environmental plan for a multi-product forest products plant. (1989-1990)

Confidential Client, Canada: Preliminary Engineering of a new bleached kraft pulp mill. (1989 -1990)

Confidential Client, Canada: A detailed environmental assessment (EIA) study for a proposed large scale bleached kraft pulp mill. (1989)

Confidential Client, B.C., Canada: A brown stock improvement study to identify and evaluate washing options to facilitate a substantial reduction in washing losses. (1989)

Confidential Client, Southern USA: A study on the evaluation of the mill modernization options in a kraft mill. (1989)

Confidential Client, Southern USA: Development and evaluation of fiberline modernization options with emphasis on environmental improvements. (1989)

Confidential Client, Southern USA: Kraft mill liquor loop optimization study. (1988)

HEIKKI I. MANNISTO 6/6

Confidential Client, Canada: Preliminary engineering of plant optimization program. (1988)

Confidential Client, Canada: Pulp mill optimization study. (1988)

Confidential Client, Canada: Plant optimization study. (1987-1988)

Confidential Client, Southern USA: Pulp mill expansion study. (1987)

Tembec Inc., Temiscaming, PQ, Canada: Feasibility study of bleached board manufacturing. (1986-1987)

Georgia-Pacific Corp., Crossett, AR: Pulp mill expansion study. (1986-1987)

Container Corporation of America, Fernandina Beach, FL: Study and pre-engineering including cost estimate of modifications needed to meet new TRS-emissions limits. (1985-1986)

Procter & Gamble Cellulose Ltd., Grande Prairie, AB, Canada: Engineering study and preliminary engineering of brown stock wash plant optimization program. (1985)

Prince Albert Pulp Co., Prince Albert, SK, Canada: Development of re-instrumentation program for entire mill. (1985)

The Buckeye Cellulose Corporation, Foley, FL: Development of a pulp mill modernization concept. (1984-1985)

Domtar Inc.: Evaluation of design concept for optimum energy, cost and production efficiency for a new fine paper mill. (1984)

Container Corporation of America, Fernandina Beach, FL: Preliminary engineering of energy management systems. (1984)

International Paper Company, Gardiner, OR: Preliminary engineering of capacity increase and TRS control project for two recovery boilers, lime kiln and causticizing plant. (1984)

International Paper Company, Gardiner, OR: Preliminary engineering of energy monitoring and power house control systems. (1983)

Leaf River Forest Products: Evaluation of design concept for optimum energy, cost and production efficiency for a new market pulp mill. (1981)

Various North American and European pulp and paper mills (about 40 mills): Energy conservation studies. (1973-1989)

Publications

More than 70 articles and presentations in professional trade journals and conferences about system engineering, process optimization, process control, energy conservation and environmental care

Professional Affiliations

The Finnish Paper Engineers' Association (SPY)

Technical Association of the Pulp and Paper Industry (TAPPI)

Pulp and Paper Technical Association of Canada (PAPTAC)

Languages

Finnish, English, Swedish, German

EVA H. MANNISTO

Present Function	EKONO Inc., Bellevue, Washington, USA Vice President
Specialties	Pollution Control in Pulp and Paper Industry. Pulping and Chemicals Recovery Processes. Energy and Water Conservation.
Education	University of Åbo, Turku, Finland. M.Sc. in Chemical Engineering, 1970.
Registration and Licenses	Professional Engineer (Chemical) State of Washington, 1982.
Professional Career	
1993 -	Present function
1991 - 1993	DUOPLAN Oy, Helsinki, Finland; Senior Process Engineer
1989 - 1991	EKONO Consultants, Ltd. Edmonton, AB, Canada; Senior Process Engineer
1980 - 1989	EKONO Inc., Bellevue, Washington, USA; Senior Process Engineer, Process Technology and Environmental Control.
1970 - 1979	EKONO Oy, Helsinki, Finland; Process Engineering Dept. Process and Environment Section, Manager (1978-1979), Project Engineer (1970-1977).
Major Project Experience	
	Confidential Client: Development of Nordic Ecolabel (Swan) Qualification Data and Application for BK pulp (2012)
	Weyerhaeuser, Grande Prairie, Alberta: Green House Gas Reporting Assistance (2011)
	Weyerhaeuser, Longview, WA: Liquor Loop Chloride Study (2011)
	Weyerhaeuser, Grande Prairie, Alberta: Process Engineering of New TG and Evaporation Plant Upgrade (2011, 2010, 2009)
	UPM-Kymmene: Benchmarking of Paper Profiles and environmental Benchmarking of Paper Products (2010)
	Weyerhaeuser, Longview, WA: Liquor Loop Balances, Sulfur/Sodium Balances (2010)
	Weyerhaeuser, Grande Prairie, Alberta: Black Liquor Audits as part of the Pulp and Paper Green Transformation Program in Canada (2009)
	Stora-Enso: Environmental Reference Data for Kraft Pulp Mills (2008)
	NCASI, USA. Report on Low Water Use in Pulp and Paper Mills (2008)
	Weyerhaeuser Company Ltd., Grande Prairie, AB: Calculation of a Sulfur/Sodium Balance (2008).
	Daishowa-Marubeni International, Peace River, AB: Calculation of CO ₂ Emissions for the Alberta Green House Gas Reporting; Feasibility Study of Condensing Turbine Options and Costs. (2007)
	Confidential Client: Development of a detailed EXCEL based Sulfur Balance for a Sulfite Mill (2007).
	Stora-Enso: Benchmarking of CO ₂ -emissions in all Stora-Enso mills (2007). UPM-Kymmene: Environmental Benchmarking of five Mills, A.T. Clayton: Environmental Benchmarking of five Mills (2007).

EVA H. MANNISTO 2/6

Weyerhaeuser Company, Longview, WA. Lime Kiln Energy Audit (2006).

Weyerhaeuser Company Ltd., Grande Prairie, AB: Process Simulation of the Eop filtrate Recycle as an Option to Reduce Effluent Colour (2005). Conceptual design of liquor fiber filter and liquor storage tank (2006).

Tembec, Tarascon, France: Operating Cost and Energy Savings Opportunity Study. (2005).

Weyerhaeuser Company, Grande Prairie, AB, Canada Pollution prevention study. Requested by the Alberta Environment. The study included a detailed literature review of available pollution prevention technologies and pre-feasibility study of implementing selected technologies. (1999, 2002, 2005). Project Manager

Multi-Client Study *Environmental Performance, Legislation and Technology in Pulp and Paper Industry*. This annual multi-client study compares the emissions to air and water, solid waste discharges and CO₂ emissions in different process categories and geographical areas. Environmental standards and limits are documented and technologies are reviewed. (1999 - 2008, updated annually). Project Manager

Daishowa-Marubeni International, Peace River, AB: Evaluation of Condensing Turbine Energy Impact. (2005)

Weyerhaeuser Company: Calculation of Air Emissions for New Recovery Boiler Permit Application. (2004)

Weyerhaeuser Company: Non Process Element Balances for New Recovery Boiler Installation. (2005)

Daishowa-Marubeni International, Peace River, AB: Energy Conservation and PINCH study of the pulp mill, including PINCH Technology workshop in cooperation with Paprican, identification and evaluation of energy opportunities and energy projects. (2004)

Confidential Client: Pre-feasibility Study of PSAQ pulping and polysulfide liquor preparation processes. (2004)

Weyerhaeuser Company Ltd., Grande Prairie, AB Energy Conservation and PINCH study of the pulp mill, including determination of PINCH process flow data, PINCH Technology workshop, identification and evaluation of energy opportunities and energy projects. (2003)

Confidential Client, Scandinavian Kraft Mill: Preliminary engineering of the polysulfide plant. (2003)

Weyerhaeuser Company Ltd., Grande Prairie, AB: GOPP (Grande Prairie Optimization Project). Process design and process performance verification of the installation of oxygen delignification, polysulfide process and various debottlenecking projects. (1998 - 2003)

Confidential Client: Environmental assessment of a new bleached kraft mill project to replace an existing older bleached kraft mill. The task included assessment of the current air and water emissions and emission limits, documentation of the environmental performance and requirements in other jurisdictions and establishment of the environmental design and performance criteria for the new mill. (2001-2002)

Tembec Inc., Spruce Falls, ON: Environmental audit of the Spruce Falls mill, benchmarking of the performance, determination of measures needed to reach the Impact Zero targets. (2001)

EVA H. MANNISTO 3/6

Confidential Client: Air permit requirements for a power generation plant using diesel internal combustion engines. (2001)

Prince George Specialty Pulp and Paper Mill, Prince George, BC: Energy conservation study, including preparation of preliminary P&I diagrams for improving the warm and hot water systems to reduce steam for water heating, establishment of mill steam and secondary heat balances, benchmarking of energy usage, feasibility of specific energy conservation measures. (2000-2001)

Tembec Inc., Temiscaming PQ: Review of hog fuel and waste sludge drying technologies. (2000)

Multi-client Study: “Environmental Performance, Regulations and Technologies in the Pulp and Paper Industry”, annual issue. (1993 - 2002)

Weyerhaeuser Canada, Grande Prairie, AB: Oxygen delignification process installation, fiberline engineer. Tasks included reviews of P&I diagrams, process operability, process Hazop, documentation of water and secondary heat balances, documentation of pulp washing trials and evaluation of pulp washing efficiencies, “red oil” problems etc. (1998-2001)

Weyerhaeuser Canada, Grande Prairie, AB: Evaluation of options for reducing effluent manganese, planning and documentation of laboratory trials and mill trials using acid and chelants to reduce Mn carry over to bleaching. (1999 - 2000)

Weyerhaeuser Canada, Grande Prairie, AB: Sewer characterization study. (1998 – 1999)

Georgia-Pacific, Crossett, AR: Condensate treatment study for Cluster Rule Compliance. Project manager for feasibility study. (1997 - 1998)

Georgia-Pacific, Port Hudson, LA: Condensate treatment study for Cluster Rule Compliance. Project manager for feasibility study. (1997 - 1998)

Weyerhaeuser Canada, Grande Prairie, AB: Mill optimization project, process engineer for oxygen delignification, water balances, manganese balances and environmental issues. (1998)

NCASI, Research Triangle Park, NC: Study on energy and CO₂ reduction opportunities in Forest Products Industry Facilities. (1997 - 1998)

American Forest and Paper Association: Extensive literature review comparing ECF and TCF pulp production processes with respect to raw material, energy, and water usage. Responsible for environmental impact comparison. (1997)

Confidential client: Feasibility study for the start-up of an idle bleached kraft pulp mill. Project manager. (1997)

Weyerhaeuser Canada, Grande Prairie, AB: Pre-planning of oxygen stage installation. Responsible for fiberline developments. (1997)

Alabama River Pulp Mills, Perdue Hill, AL: Energy and Water Conservation Study. (1996 - 1997)

Multiclient Study: Environmental Performance, Regulations and Technologies in Pulp and Paper Industry, 1995 issue. (1996)

Multi-client Study: Optimization of Washing Processes and Metal Management in a Low Effluent Bleached Kraft Mill. (1995-1996)

EVA H. MANNISTO 4/6

Ketchikan Pulp Company, Ketchikan, AK : Development of a facility wide sulfur balance. (1995-1996)

Weyerhaeuser Paper Company, Longview, WA: An Energy Opportunity Assessment Study to identify and assess feasible energy cost-reduction measures. (1995)

Weyerhaeuser Paper Company, Longview, WA: Troubleshooting the NCG system. (1994)

Weyerhaeuser Canada, Grande Prairie, AB, Canada: Detail design of the cooling tower and mill water conservation measures. (1994-1995)

Multiclient Study: "Environmental Performance, Legislation and Technologies in the Pulp and Paper Industry, 1994 issue. (1995)

Multiclient Study: Chemicals, Dry Solids and Solid Waste in a Low Effluent Bleached Kraft Mill. (1994)

Weyerhaeuser Canada, Grande Prairie, AB, Canada: "Long Loop" and "Short Loop" closed cycle mill evaluations. Water conservation. (1994)

Confidential Client, Finland: Development of a step-wise, long-term implementation concept for bleach plant effluent recovery, water and energy conservation in a TCF mill, including Computer Simulation of mass and energy balances. (1994)

Confidential Client, USA: Evaluation of six scenarios for bleach plant effluent recovery in ECF or TCF production. (1994)

Weyerhaeuser Canada, Grande Prairie, AB: Research Program on Reduction Technologies for Selected Surface Water Quality Criteria. (1993-1994)

Multiclient Study on "Low Effluent Bleached Kraft Mill" concepts. (1992-1993)

Sodium Chlorate Sector Group of CEFIC: Study on "Chlorine dioxide and the environment." (1993)

ABB Stromberg Park, Vaasa, Finland: Environmental Audit of an Industrial Park, including special investigation of PCB, TCDD/TCDF contamination of soil and building structures. (1992)

Finnish Ministry of Trade and Industry: Impact of environmental control measures in the energy situation in the pulp and paper processes. (1992)

Pulp and Paper Mill, Finland: Computerized modeling of the aerated stabilization basin and evaluation of efficiency improvement measures. (1992)

Procter & Gamble, Grande Prairie, AB: Computerized modeling of the aerated stabilization basin and evaluation of efficiency improvement measures. Assistance in effluent discharge license renewal. Evaluation of effluent toxicity. (1991-1992)

Pulp Mill, USA: Evaluation of end of pipe treatment options to achieve receiving water "surface water quality" criteria. (1991)

Simpson Paper Company, Humboldt, California: Feasibility study of comprehensive mill-wide modernization and environmental compliance program. (1991)

Weyerhaeuser Canada Ltd, Prince Albert, SK: Feasibility study of Clean Air Act compliance project. (1991)

Weyerhaeuser Canada Ltd, Prince Albert, SK: Preliminary engineering study of chlorine free pulping. (1990)

EVA H. MANNISTO 5/6

Procter & Gamble, Grande Prairie, AB: Optimization of the existing aerated stabilization basin, including modeling of the basin using the NCASI computerized model, assistance in dredging of the lagoon, continuing monitoring of mill process effluent and ASB-performance, training of effluent treatment plant operators. (1989-1992)

Procter & Gamble, Grande Prairie, AB: Review of design practices and performance of activated sludge plants in North American and Finnish bleached kraft pulp mills, Conceptual and preliminary design of an extended aeration AST-plant for the mill, Review of the environmental regulations in the bleached kraft pulp industry. (1989-1990)

Procter & Gamble, Grande Prairie, AB: Turpentine recovery, condensate stripping and NCG system - conceptual and preliminary design. (1989-1990)

Tembec, Inc., Temiscaming, PQ: Development of a five-year environmental plan for a multiproduct forest products plant. (1989-1990)

Confidential Client, Canada: A detailed environmental impact assessment (EIA) study for a proposed large scale bleached kraft pulp mill. (1989)

Confidential Client, Canada: Preliminary engineering of a new bleached kraft pulp mill. (1989-1990)

Weyerhaeuser Paper Company, Longview, WA: Several projects including the evaluation of internal measures to reduce the BOD, effluent flows, TSS, AOX and dioxins from the process areas. (1988). Design and engineering of a condensate cooling system for effluent temperature reduction. (1989) Feasibility study on TMP effluent evaporation. (1977)

Westvaco Corporation, Wickliffe, KY: A study on the possibilities of decreasing acid sewer neutralization costs at the mill. (1988)

Weyerhaeuser Paper Co., Longview, WA: Water conservation study in the fine paper mill. (1987-1988)

Georgia-Pacific Corp., Crossett, AK: Expansion of pulping and recovery areas. Study and conceptual design (1986-1988). Energy conservation study. (1987)

Weyerhaeuser Canada, Ltd., Prince Albert, Saskatchewan: Evaluation of white water system for the new fine paper mill. (1987)

Container Corporation of America, Fernandina Beach, FL: Study and preliminary engineering of the modifications needed in the pulping and recovery areas to meet new Florida TRS emission limits. (1985-1986)

Interstate Paper Co., Riceboro, GA: Evaluation of cold blow system feasibility. Concept design and savings estimates of energy conservation projects in the kraft pulp mill. (1985)

Container Corporation of America, Fernandina Beach, FL: Evaluation of energy conservation projects. Conceptual design of the energy systems for mill expansion and modernization. (1983 - 1984)

ATCO/Noranda Company, AB, Canada: Utilization of the Brazeau Forest. Study, concept design and cost estimate of the environmental control systems for a new mill (bleached kraft pulp, CTMP) to meet the very stringent water quality requirements. (1982)

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Eurocan Pulp & Paper Co. Ltd., Kitimat, BC. Canada: Study to reduce mill water use and BOD-load (1980). Preliminary engineering and cost estimates for blow heat evaporator and paper mill water systems modifications. (1981). Evaluation of measures needed for capacity increase in evaporation, recovery boiler and causticizing areas. (1982)

Weyerhaeuser Co., Tacoma, WA: Columbus Project: Assistance in design of the new kraft pulp mill, (1980-1981)

Evaluation of design concept for optimum energy and water use and cost efficiency for new kraft mills, including:

- Leaf River Forest Products, Leaf River, MS. (1981)
- Buckeye Cellulose Corporation, Oglethorpe, GA. (1978)
- Domtar Inc., Windsor, PQ. (1984)

Various North American and European pulp and paper mills (about 25): Energy Conservation Studies. (1973-1989)

Publications

About 30 articles and presentations in professional magazines and conferences on pulp and paper mill process, environmental care and energy conservation.

Professional Affiliations

The Finnish Paper Engineers' Association (SPY)

Technical Association of the Pulp and Paper Industry (TAPPI)

Pulp and Paper Technical Association of Canada (PAPTAC)

Languages

Swedish, Finnish, English, German