

China - Canada Co-operation Project in Cleaner Production

Checklist for Cleaner Production Auditing in Pulp and Paper Mills

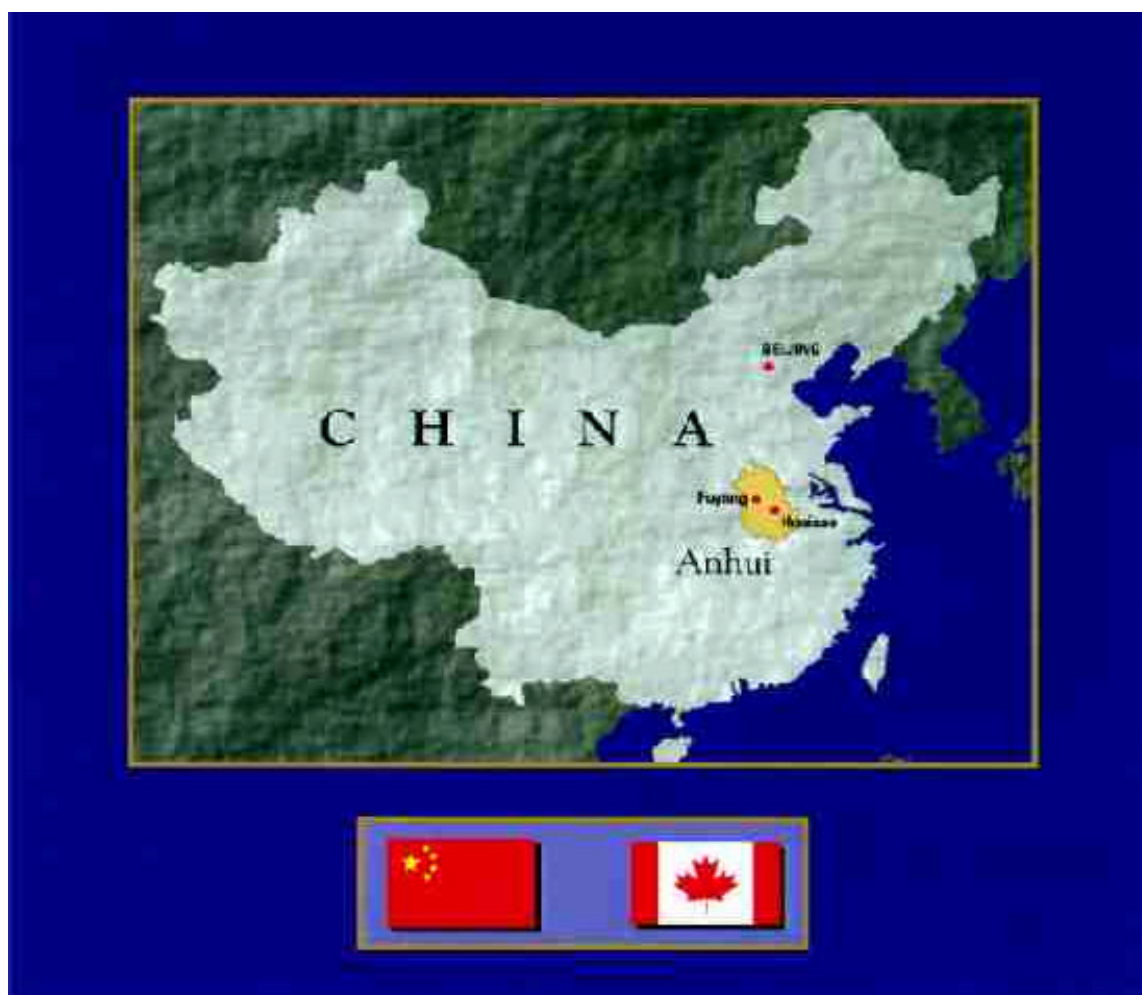


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INTRODUCTION

Pulp and paper mills are very complex facilities composed of many departments which are all interrelated in the production process. Typically, these departments are spread out over a large area and the information needed to identify CP alternatives can be kept in many different offices. Consequently, when initiating a Cleaner Production audit, it may be difficult to determine where to begin and how to compile the required information in such a way as to ensure that all relevant information is collected and none is forgotten.

This checklist is a tool which can be used to help in this process.

The checklist is divided into sixteen chapters covering all departments that can be found in a Chinese pulp and paper mill. The only exclusions are administrative offices, maintenance workshops, landfill sites and raw materials storage (straw yards, etc.). What is covered are all the major departments which can have an impact on achieving Cleaner Production goals. It should be remembered that departments like maintenance workshops can have significant environmental impacts (e.g. production of waste oils, leaking petroleum products storage tanks) and that landfills and other storage sites can produce contaminated leachate which can have an impact on groundwater as well as surface water. Generally, however, these departments have a minor role to play in CP, as compared to the production departments.

By following the checklist, the Cleaner Production team will:

- have a logical framework within which to structure activities;
- make sure that no major activity or equipment is forgotten;
- be able to quickly determine which departments have the information needed for the CP audit and which ones will require special attention.

In addition, the checklist, once completed, will provide at a glance all the information needed for anyone to properly understand the mill's operations.

Some of the information requested in the checklist should be readily available. Other information may require extensive investigations and other work to compile. Consequently, the CP audit team should, in addition to the checklist, create a document which identifies the source of information for each item in the checklist and a due date by which the information requested is to be provided. In this manner, it is possible to develop a coherent plan and timetable for completing the CP audit and persons responsible for all the information are clearly identified.

It is important that the order of the chapters follows roughly the pulp and paper making process. It is not necessary for the CP auditors to complete each chapter of the checklist in chronological order. If the auditors wait until all of the information for one chapter is collected before moving on to the next chapter, the process will take far too long. Instead, it is suggested that the Lead CP auditor assign responsibilities for collecting information to a number of auditors, each responsible for one or more chapters. By working in parallel the process should be much quicker.

This checklist is meant to be a living document. Its authors do not pretend to have identified each and every bit of information which may be required in order to do a thorough CP audit. The checklist may also ask for bits of information which, ultimately, are not required in order to identify possible CP options. As CP auditors use the checklist, they are encouraged to provide feedback to the pulp and paper team on the China-Canada Co-operation Project in Cleaner Production. Every attempt will be made to incorporate this information into new versions of the checklist, which will be posted to the Web site (www.chinacp.com).

Version number 1 of this checklist was produced by the following persons, all from SNC♦LAVALIN in Montreal, Canada.

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Errors, omission and other problems with this checklist are the sole responsibility of the authors.

Environmental Checklist Pertaining to Chinese Pulp and Paper Industries

1. GENERAL INFORMATION

1.1 Name of the pulp and paper mill: _____

1.2 Address: _____

Telephone : _____

Fax : _____

E-mail : _____

Web page (if applicable) : _____

1.3 Information concerning the general manager of the mill:

Name of the general manager : _____

Telephone : _____

Fax : _____

E-mail : _____

1.4 Information concerning the person completing the checklist:

Name and title : _____

Telephone : _____

Fax : _____

E-mail : _____

1.5 Is the mill a state enterprise or a private enterprise? _____

1.6 In what year did the mill first start its operation? _____

1.7 What type and quantity of finished products are produced at the mill?

Product	Quantity (tons/year)	
	1999	1998

1.8 Where are these products sold?

- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____

1.9 Is the mill operating seven (7) days a week, 24 hours per day? _____

If not, indicate the operating schedule:

1.10 Indicate the shut down periods (if any)?

1.11 How many employees are presently working at the mill? _____

2. CONCERNING THE FACILITY

2.1 What is the annual production of the mill for the following years?

	1997	1998	1999
Production (tons/year)			

2.2 What is the main source of energy?

2.3 What is the main source of fresh water?

2.4 What quantity of fresh water is used per day, per year?

Per day:

Per year:

2.5 List all water meters present in the mill (starting at the water intake and moving downstream through the process) and indicate their location:

Water meter	Location
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

(Continue on a separate page if necessary)

2.10 Make a list of the main equipment present at the mill:?

Type of equipment	Year of installation	Type of equipment	Year of installation
Paper machine 1		Wastewater treatment plant	
Paper machine 2			
Paper machine 3			
Paper machine 4			
Paper machine 5			
Paper machine 6			
Paper machine 7			
Paper machine 8			
Paper machine 9			
Paper machine 10			
Digester pulp line 1			
Digester pulp line 2			
Bleaching plant 1			
Bleaching plant 2			
Washing line 1			
Washing line 2			
Washing line 3			
Washing line 4			
Evaporator 1			
Evaporator 2			
Recovery boiler			
Causticizing system			
Lime kiln			
Boiler 1			
Boiler 2			
Boiler 3			
Boiler 4			
Boiler 5			
Turbo generator 1			
Turbo generator 2			
Turbo generator 3			

3. POWER GENERATION

3.1 Is the mill buying power from the grid or is it producing its own?

3.2 How much power is generated on site?

3.3 What type of generator is used?

3.4 What is the amount of steam required to produce the needed power ?

3.5 Is the mill selling excess electricity to the grid?

4. STEAM PRODUCTION

4.1 Is the steam required in the process bought or is it produced on site?

4.2 What type of fuels are used (coal, oil, gas, biomass)?

Type of fuel	Quantity

4.2 Cont'd

If coal is used, give the following information:

Sulphur content (%)	
Ash content (%)	
Calorific value	

If oil is used, give its calorific value: _____

4.3 Is there a scrubber on the gas after burning?

4.4 What is the type of furnace used?

4.5 What is the amount of fresh water required for steam generation?

4.6 Is steam condensate recovered? _____

If yes, in which quantity? _____

4.7 What is the amount of steam produced by the boilers? _____

4.8 Are steam meters available for each department using steam? _____

5. RAW MATERIAL

5.1 Give the following information concerning raw materials used at the mill?

Type of raw material	Quantity used per year (tons/yr)	Quantity used per day (tons/day)	Moisture content (%)	Silica content (%)

5.2 Does the moisture content of the raw materials remain constant all year around?

5.3 Where are the raw materials stored?

5.4 What is the typical storage period (number of days)?

5.5 Is the raw material screened before being used in the process?

5.6 Is fresh water used in the raw material screening and washing process? _____

If yes, what is the amount? _____

6.4 Is the flow of the cooking liquor entering the digester monitored? _____

If yes, at which frequency ? _____

6.5 Are the temperature and pressure inside the digester monitored? _____

If yes, what are their maximum values ? _____

6.6 How long does it take to complete the cooking process for one digester?

6.7 What is the yield of the cooking process?

6.8 Is the cooked pulp blown or is it emptied on the floor?

If the pulp is blown, is there a heat recovery system coming after this step? _____

6.9 Are the flow and temperature of the pulp coming out of the digester monitored? _____

If yes, at which frequency? _____

6.10 Is the black liquor recycled in the cooking process?

7. PULP WASHING, SCREENING AND CLEANING

7.1 How many pulp washers are there at the mill?

7.2 What is the tonnage of pulp washed? _____

7.3 What is the quantity of fresh water used for pulp washing?

7.4 What is the consistency of the pulp entering the first washer?

7.5 What is the consistency of the pulp leaving the last washer?

7.6 What is the yield of the process after washing?

7.7 What is the Baume (% solids) of the washed pulp filtrate?

7.8 Following the pulp washers, how many screens are there?

7.9 What is the quantity of fresh water used for pulp screening?

7.10 What is the yield of the process after screening?

7.11 Are the flowrate and the pH of the black liquor monitored? _____
If yes, what are their average values? Flowrate = _____ pH = _____

7.12 What is the fibre content of the weak black liquor after the washing operation?

7.13 What is the Baume (% solids) of the black liquor after the washing operation?

7.14 How much of the production is rejected during this process and where?

7.15 Is there any additive used in this department such as defoamer, talc or any pitch control agent?

8. BLACK LIQUOR EVAPORATION

8.1 Is the black liquor recovered? _____

If the black liquor is recovered, what is the recovery rate and how is it calculated?

How is it recovered (collected and sold, collected and reuse, sent to the sewer or sent to an evaporator)?

8.2 Assuming the black liquor is evaporated, is there a multiple effect evaporator in operation at the mill? _____

8.3 What is the average flow of the weak black liquor to be evaporated?

8.4 What is the weak black liquor silica content?

8.5 What is the Baume (% solids) of the weak black liquor to be evaporated?

8.6 What is the Baume (% solids) of the strong black liquor after evaporation?

8.7 At which frequency does the evaporator have to be water washed?

8.8 What quantity of steam is used per ton of evaporated water?

9. RECOVERY BOILER

9.1 What is the type of recovery boiler in operation (cascade, low odor, other)?

9.2 What is the capacity of the recovery boiler in tons of solids burnt?

9.3 What is the normal flow of strong black liquor going to the recovery boiler?

9.4 Which product is used to light the recovery boiler (oil, propane, natural gas, other)?

9.5 Is there a scrubber or a precipitator that intercepts the gas coming out of the recovery boiler?

9.6 What is used to dissolve the smelt in the dissolving tank (weak cooking liquor or fresh water)?

9.7 What is the concentration of the green liquor in the dissolving tank

10. **CAUSTICIZING**

10.1 Are dregs removed from the green liquor? _____

If yes, how are they removed?

10.2 What is the temperature of the green liquor before adding lime?

10.3 What is the average flow of the green liquor going to the slaker?

10.4 What is the temperature in the last causticizing tank?

10.5 What is the retention time in the causticizers?

10.6 How is the lime mud separated from the cooking liquor , by filtration or by sedimentation?

10.7 Is the lime mud sent to a lime kiln to be converted to quicklime?

If not, where is the lime mud disposed?

11. LIME KILN

Assuming lime mud is sent to a lime kiln

11.1 What is the average flow of lime mud going to the mud washer?

11.2 What is the average consistency of the lime mud going to the mud washer?

11.3 Is gas or oil used to heat the kiln?

11.4 What is the temperature in the calcining zone of the kiln?

11.5 What is the temperature of the gas leaving the kiln?

11.6 Is there a scrubber or a precipitator intercepting the gas coming from the kiln?

11.7 How much lime is produced per day?

11.8 Is the mill using lime rock or quick lime as raw material and what is the amount?

12. BLEACHING AGENTS

12.1 Does the mill purchase any bleaching agents? _____

If yes, indicate which ones, their quantity and how they are delivered to the mill (by train or by truck) :

Bleaching agents purchased by the mill	Quantity purchased (tons)	Delivery mode (train or truck)
Chlorine		
Caustic soda		
Sodium hypochlorite		
Calcium hypochlorite		

12.2 Does the mill produce (on-site) any bleaching agents? _____

If yes, indicate which ones and the produced quantities?

Bleaching agent	Quantity produced (tons)

12.3 Indicate the concentrations of the following bleaching agents:

Bleaching agents	Concentration (mg/L)
Caustic soda	
Sodium hypochlorite	
Calcium hypochlorite	

12.4 Are the residues resulting from the preparation of hypochlorite landfilled or it is reused in the process?

If the residues are reused explain how and where:

12.5 Fill in the following table concerning bleaching agents storage

Bleaching Agents	Storage type (tank, reservoir, other)	Capacity (L)

13. PULP BLEACHING

13.1 How many bleaching stages are there?

13.2 What are the chemicals used in the bleaching process (chlorine , chlorine dioxide, hydrogen peroxide, oxygen, ozone, etc.)?

13.3 Describe the bleaching sequence for each bleaching stages?

13.6 How are the chemicals controlled (automatically or by manual valves)?

13.7 Where is fresh water used in this process?

13.8 What is the quantity of fresh water used per ton of bleached pulp at each stage?

	Quantity of fresh water (liters)
Stage 1	
Stage 2	
Stage 3	
Stage 4	

14. PAPERMAKING PROCESS (REFINERS AND PAPER MACHINES)

14.1 How many paper machine are there? _____

14.2 Give the following information concerning each paper machine (PM):

	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8	PM-9	PM-10
Are refiners used on the approach system of the paper machines?										
How many refiners are there?										
What is the freeness or SR degress after refining?										
Width (m)										
Max. Speed (m/min)										
Type of product										

14.2 Cont'd

	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8	PM-9	PM-10
Temperature in the wire pit (°C)										
Foudrinier (F) or cylinder (C) in the forming section										
Number of presses										
Is the sheet dried with heated cylinders										
What is the steam pressure in the cylinders										
Quantity of fresh water used per ton of paper produced (liters)										
Is there any control system on the paper machine for basis weight, humidity, etc.										
What quantity of the excess water is recovered (liters)										
How many days per month is the paper machine in operation										

14.3 At the end of the refining process, is the pulp centrifuged in order to remove any remaining impurities? _____

If yes, are the residues directed to a disposal site? _____

14.4 Give the loading pressures for each press of each paper machine:

	Press #1	Press #2	Press #3	Press #4
Loading pressure-PM-1				
Loading pressure-PM-2				
Loading pressure-PM-3				
Loading pressure-PM-4				
Loading pressure-PM-5				
Loading pressure-PM-6				
Loading pressure-PM-7				
Loading pressure-PM-8				
Loading pressure-PM-9				
Loading pressure-PM-10				

14.5 What is the pulp furnish for each paper machine:

	Amount of pulp used (%)	Type of filler used	Amount of filler used	Raw material PM-2	Amount of pulp used (%)	Type of filler used	Amount of filler used
Softwood				Softwood			
Hardwood				Hardwood			
Reed				Reed			
Straw				Straw			
Recycled pulp				Recycled pulp			
De-inked pulp				De-inked pulp			
Raw material PM-3	Amount of pulp used (%)	Type of filler used	Amount of filler used	Raw material PM-4	Amount of pulp used (%)	Type of filler used	Amount of filler used
Softwood				Softwood			
Hardwood				Hardwood			
Reed				Reed			
Straw				Straw			
Recycled pulp				Recycled pulp			
De-inked pulp				De-inked pulp			

14.5 Cont'd

Raw material PM-5	Amount of pulp used (%)	Type of filler used	Amount of filler used	Raw material PM-6	Amount of pulp used (%)	Type of filler used	Amount of filler used
Softwood				Softwood			
Hardwood				Hardwood			
Reed				Reed			
Straw				Straw			
Recycled pulp				Recycled pulp			
De-inked pulp				De-inked pulp			
Raw material PM-7	Amount of pulp used (%)	Type of filler used	Amount of filler used	Raw material PM-8	Amount of pulp used (%)	Type of filler used	Amount of filler used
Softwood				Softwood			
Hardwood				Hardwood			
Reed				Reed			
Straw				Straw			
Recycled pulp				Recycled pulp			
De-inked pulp				De-inked pulp			

14.5 Cont'd

Raw material PM-9	Amount of pulp used (%)	Type of filler used	Amount of filler used	Raw material PM-10	Amount of pulp used (%)	Type of filler used	Amount of filler used
Softwood				Softwood			
Hardwood				Hardwood			
Reed				Reed			
Straw				Straw			
Recycled pulp				Recycled pulp			
De-inked pulp				De-inked pulp			

14.6 List the chemicals, such as pH adjuster, wet strength agents, starch, sizing agents, etc., that are added to the pulp?

- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____

14.7 What is the consistency of the pulp at the following sections of each paper machine:

PM-1	Pulp Consistency	PM-2	Pulp Consistency	PM-3	Pulp Consistency
Head box		Head box		Head box	
Couch press		Couch press		Couch press	
After press #1		After press #1		After press #1	
After press #2		After press #2		After press #2	
After press #3, if any		After press #3, if any		After press #3, if any	
After press #4, if any		After press #4, if any		After press #4, if any	
After dryer		After dryer		After dryer	
PM-4	Pulp Consistency	PM-5	Pulp Consistency	PM-6	Pulp Consistency
Head box		Head box		Head box	
Couch press		Couch press		Couch press	
After press #1		After press #1		After press #1	
After press #2		After press #2		After press #2	
After press #3, if any		After press #3, if any		After press #3, if any	
After press #4, if any		After press #4, if any		After press #4, if any	
After dryer		After dryer		After dryer	

14.7 Cont'd

PM-7	Pulp Consistency	PM-8	Pulp Consistency	PM-9	Pulp Consistency
Head box		Head box		Head box	
Couch press		Couch press		Couch press	
After press #1		After press #1		After press #1	
After press #2		After press #2		After press #2	
After press #3, if any		After press #3, if any		After press #3, if any	
After press #4, if any		After press #4, if any		After press #4, if any	
After dryer		After dryer		After dryer	
PM-10	Pulp Consistency				
Head box					
Couch press					
After press #1					
After press #2					
After press #3, if any					
After press #4, if any					
After dryer					

14.8 Is the paper rejected during papermaking repulped and circulated back into the system?

15. WASTEWATER TREATMENT PLANT

15.1 Is the mill equipped with an operational wastewater treatment plant? _____

If yes, fill in the following table:

Type of treatment	Description	Capacity (m ³ /hr)
Primary		
Secondary (biological)		

15.2 What is the average quantity of wastewater generated by the entire mill, per month or per year?

Per day:

Per year:

15.3 Are there any chemical analysis performed on the raw effluent arriving to the wastewater treatment plant? _____

If yes, which parameters are analyzed:

♦

♦

♦

♦

15.4 What percentage of all the mill's effluent is treated by the wastewater treatment plant?

If the percentage is less than 100%, specify which effluents are not treated:

♦

♦

♦

15.5 Does the mill receive wastewater from other sources (factories, apartment buildings, etc.)?

If yes, quantify:

Wastewater source	Quantity (m ³ /day)

15.6 Are the effluents coming from the mill collected into separate sewers before arriving to the wastewater treatment plant?

15.7 What are the chemicals, if any, used to treat the wastewater?

♦

♦

♦

15.8 Where are the removed solids disposed?

15.9 What is the total flowrate of the treated effluent?

15.10 Is part of the treated effluent recycled back into the process? _____

If yes, in which quantity? _____

15.11 Where is the remaining portion of the treated effluent discharged?

16. TREATED EFFLUENT MONITORING

16.1 Is the treated effluent sampled manually or automatically?

16.2 At which frequency does the mill sample its effluent before discharging?

16.3 What are the tests performed on the effluent samples and at which frequency:

Parameters	Is the test performed?	Daily	Weekly	Monthly	Other
pH					
Temperature					
TSS					
BOD					
COD					
AOX					
Toxicity					

16.4 Does the mill measure the quantity of water used per ton of paper produced?

16.5 Does the mill correlate COD and TSS per ton of paper produced?

16.6 Are the analysis results compared to compliance levels on a daily basis?

16.7 What type of equipment is used to measure effluent flowrate?

16.8 Is the discharge point equipped with a Parshal flume?

16.9 Who, at the mill, receive the monitoring results?

Name	Title

16.10 Submit a table or tables of all the monitoring results for the last three months: