*Environmental Assessment Executive Summary*

*for*

# Dioxins Reduction from the Pulp and Paper Industry Project



**Foreign Economic Cooperation Office, Ministry of Environmental Protection**

## Table of Content

# 1. Introduction

## Background

This document summarizes the environmental impact assessment of the GEF China Dioxins Reduction from Pulp and Paper Industry Project, highlighting the mains issues and conclusions of the Environmental Impact (EIA) reports and Environmental Management Plan (EMP) reports of the project. According to both Chinese Environmental Assessment laws and regulations, and the World Bank's Operational Policy and Bank Procedures OP/BP4.01 Environmental Assessment, the proposed project is Category A for environmental assessment purposes, due to the scale and significance of potential environmental issues. Therefore, a full environmental assessment is required.

The National Implementation Plan (NIP) of the People's Republic of China for the Stockholm Convention on Persistent Organic Pollutants (POPs) has listed the pulping and papermaking industry as one of the country's six priority industries for POPs reduction. Non-wood fiber pulping enterprises make up a considerable proportion for virgin pulp production in this sector in China. In order to help China implement its responsibility under the Convention, achieve reduction of UPOPs and other pollutants, and eventually facilitate the sustainable development of the sector, the Ministry of Environmental Protection (MEP) and the World Bank (WB) are working together to implement UPOPs reduction from the non-wood pulping and papermaking sector through promoting Best Available Technology and Best Environmental Practices (BAT/BEP). In this context, four Chinese pulp and paper making mills were selected to implement elementary chlorine free (ECF) based BAT/BEP, financed by the Global Environmental Facility (GEF).

The four paper mills retained accredited EIA Institutes for EIA preparation. An EIA and an EMP for each mill were prepared following relevant provisions specified in Chinese EIA laws, regulations and technical guidelines as well as World Bank safeguard policies. The EA Executive Summary is based on these reports, as well as feasibility studies, design and relevant surveys carried out for the project.

The EIA and EMP reports cover regulatory framework analysis; review of mill operations and environmental, health and safety management, analysis of ECF bleaching based BAT/BEP implementation; operational impacts, risk assessment and construction related impacts including decommission of old facilities. The EIA and EPM reports were submitted to the World Bank for review and they conform fully to Bank policies regarding environmental, health, safety and social issues. All above reports have been made available locally and in the Public Information Center (INFOSHOP) of the World Bank.

As designed, the project (i) incorporated international acknowledged BAT/BEP and engineering measures to reduce dioxins and other conventional pollutants; (ii) included review and enhancement for the mills' environmental, health and safety management system; and (iii) included a management plan for addressing environmental and social issues during construction and operations of the project.

## Project Development Objective

The project development objectives are to (a) demonstrate the result of BAT/BEP adoption in four selected non-wood pulp mills, and (b) support China in developing and adopting a long-term action plan to guide the promotion of a sector-wide BAT/BEP adoption.

## Project Description

This project will support the four selected non-wood pulp mills to adopt BAT/BEP practices following Stockholm Convention guidelines, including investments in process substitution and process optimization and replacing the elemental chlorine-based bleach process by the elemental chlorine-free (ECF) process to minimize dioxins releases. Investments in other aspects of pulp production will aim at reducing pollutant loads in water discharge, water use, and energy use.

The four demonstration mills typify the production line for the most common non-wood fibers (reed, straw, bagasse and bamboo) and are located in different provinces (Hunan, Ningxia, Guangxi and Sichuan, respectively). Investments in each mill will include:

- The Sichuan Leshan Jinfu Paper Mill (hereafter Leshan) will build a 52,000 ton/a **bamboo** pulp ECF bleaching line and associated material preparation, cooking, bamboo joint removal, screening, oxygen delignification, and a 4 ton/day chlorine dioxide generation facility.
- The Nanning Sugar Company Pumiao Paper Mill(hereafter Pumiao) has built a 98,000 ton/a **bagasse** pulp ECF bleaching line and an associated 8 ton/day chlorine dioxide generation facility, and an 11,000 m3/d anaerobic wastewater treatment system for bagasse material preparation. Currently the above mentioned facilities are being commissioned. The project will support its pilot operation and building a 40,000t/d tertiary wastewater treatment facility.
- The Ningxia Zhongye Meili Paper Mill (hereafter Meili) will build a 68,000 ton/a **straw** pulp ECF bleaching and associated 4 ton/day chlorine dioxide generation facility, and a 260 ton/day alkaline recovery facility. The wastewater treatment plant will also be renovated.
- The Hunan Yueyang Paper Mill (hereafter Yueyang) will builda180t/d (61,200t/a) **reed** pulp oxygen delignification and ECF bleaching system, and associated chlorine dioxide generation facility.

Besides investment in the 4 participating mills, the project will also support technical assistance activities including national action plan for sector-wide replication, monitoring and evaluation, and project management.

# 2. Environmental Regulatory Framework

For each mill, a full Environmental Assessment (EA) was carried out following the Chinese EIA regulations as well as the World Bank safeguards policies. Bank operational policies OP/BP 4.01 Environmental Assessment and requirements regarding information disclosure and public consultation also apply to the project. In addition, the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines hereafter) were thoroughly taken into account in the EA process.

The project will not involve land take or household resettlement. In Pumiao Mill, a piece of barren and hilly land (about 80 mu, equivalent to 5.3 hectares) was taken in 2010 before the project identification. As the land is now being used for its BAT/BEP investment activities, the World Bank's OP 4.12 is triggered. A due diligence review for this piece of land was conducted and a due diligence review report was prepared.

## National Laws and Regulations

The purpose of the project is to ensure the four paper mills comply with Chinese national and sectoral policies and regulations, environmental quality and pollutants discharge/emission standards, technical guidelines, cleaner production directives, which are summarized in Tables 1, 2 and 3.

Of particular importance is the wastewater discharge standards for pulp and paper sector (GB3544-2008) promulgated in 2008. Table 2 of the standards, effective on July 1st, 2011, specifies more stringent effluent discharge limits for conventional pollutant parameters, and introduces AOX and dioxins indicators, as presented in Table 4.

**Table 1 Relevant Chinese Environmental Laws and Regulations**

| Title | Relevant article |
|---|---|
| *Environmental Protection Law of the People's Republic of China* | Pollutants discharger must meet certain national or local standards. EIA must be prepared for new development project and submitted for review and approval by responsible environmental authority. No commencement of construction before the approval. Environmental protection work must be planned for enterprises that produce pollution. New industrial development or technical renovation must adopt new equipment or technologies that use resource more efficiently and discharge less pollutants. Pollutants. Pollution control facilities shall be designed, built and put into use simultaneously with the production facilities (“Three Simultaneous”) and shall be inspected before being issued with completion acceptance. |
| *Circular Economy Promotion Law of the People’s Republic of China* | The country closely monitors and supervises the water and energy consumption of paper making industry. The state council, in together with national environmental authority and others, regularly issue list of technologies, equipments, materials and products that will be encouraged, limited or eliminated. |
| *Law of the People’s Republic of China on the Promotion of Cleaner Production* | The country enforces phase-out of obsolete production technologies, equipment and products. New, renovation or expansion project shall carry out EIA that must evaluate resource consumption and use, recycling and waste treatment. Resource efficient and pollution reduction processes shall be given priority. Enterprises shall monitoring resource consumption and pollution producing and take cleaner production audit as needed. |
| *Law of the People's Republic of China on Environmental Impact Assessment* | Environmental impact assessment refers to analysis, prediction and evaluation of the environmental impacts as result of implementation of plans and constructions projects. In addition, prevention or mitigation plans or measures shall be developed, and follow-up and monitoring shall be conducted. |

**Table 2 Relevant Paper Sector Policies**

| Title | Relevant policies and rules |
|---|---|
| *Policy on Wastewater Pollution Control Technology in Straw Pulp Papermaking Industry* | II. Control target<br>6. According to the principle of integrating development with environmental protection and given the properties of NWPM wastewater treatment, pollution treatment of NWPM enterprises need to be above certain size: 34,000t pulp/a for newly constructed wheat straw pulping enterprises, 50,000t pulp/a for other NWPM enterprises; while 17,000t/a is the minimum size required for the construction of alkali recovery facilities for alkaline chemical pulping mills.<br>III. Technical measures<br>8. For technical transformation and pollution treatment, papermaking enterprises shall use clean production technologies that consume less energy and has a lower pollution load; the technology threshold shall be raised, for instance, straw pulp raw materials that contain less silicon and more fiber are preferable.<br>9. For technical transformation and pollution treatment, papermaking enterprises shall use clean production technologies that consume less energy and has a lower pollution load. Straw pulp raw materials having a lower silicon content and a higher fiber content shall be used; automatic baling technique, lean-chlorine or chlorine-free bleaching technology shall be employed. |
| *National Implementation Plan of the People's Republic of China for Stockholm Convention on Persistent Organic Pollutants* | China has been performing unintentional POPs monitoring in chlorophene derivatives, tetrachlorobenzoquinone, chlorobenzene, wastewater treatment, cement, iron & steel, papermaking, medical waste incineration, etc., and papermaking (chlorine bleaching) has been included in key industries to be firstly put under control. This plan proposes the action targets of reducing and eliminating unintentional POPs release and analyzes the gap with POPs Convention and necessary measures to be taken. Meanwhile, the stress is laid on the implementation of BAT/BEP management system. |
| *Development Policy of Papermaking Industry* | **Article 21** The emphases of pulping and papermaking equipment R&D are: research and development of new processes, new technologies, and new equipment that use non-wood raw materials for pulping and papermaking, particularly the development of straw pulp alkali recovery technologies and equipment; water-saving and energy-saving technologies and equipment.<br>**Article 22** Technologies of papermaking industry shall develop toward high level, low energy consumption, and less pollution. It should be encouraged to develop high yield pulping technologies, biotechnologies, low-pollution pulping technologies, moderate enriching technologies, elemental chlorine free (ECF) or totally chorine free (TCF) bleaching technologies, low energy-consumption mechanical pulping technologies, |

| | |
|---|---|
| | high-efficiency waste paper deinking technologies, and associated equipment.<br><br>**Article 23** Pulping technologies and equipment such as chemical straw pulp production facilities and rotary spherical digester with an annual output of 34,000t or less shall be deselected; narrow width and low-speed papermaking machines known to be high energy-consuming and of low-level shall also be deselected. Lime process pulping shall be prohibited and new projects are not allowed to use elemental chlorine bleaching technique (existing enterprises shall phase out this technique). It is forbidden to import deselected and outdated second-hand pulping equipment. |

**Table 3 Relevant domestic environmental standards**

| Standard title | Enforceable as of | Main contents |
|---|---|---|
| *Environmental Quality Standard for Surface Water*<br><br>(GB 3838-2002) | June 1, 2002 | This standard, on the basis of environmental function category and protection target of surface water, specifies the items and limit values to be controlled for water environment quality; it also defines the analysis method of water quality assessment and water quality items and stipulates the implementation and supervision of this standard. It is applicable to surface water bodies serving certain purposes like river, lake, canal, channel, and water reservoir within the borders of the P. R. China. |
| *Ambient Air Quality Standard*<br><br>(GB 3095-1996) | October 1, 1996 | This standard defines the classification of ambient air quality function area, standard class, pollutants, measuring time & concentration limits, sampling & analysis method, and validity of statistics. It is applicable to ambient air quality assessment in China. |
| *Environmental Quality Standard for Soils*<br><br>(GB 15618-1995) | March 1, 1996 | This standard specifies the allowable maximum pollutant concentration indices in soil and the monitoring and measuring methods according to the function, the protection targets, and the main properties of the soil. This standard applies to soils of cultivated field, vegetable field, tea plantation, orchard, pasture, forest, and natural reserve. |
| *Discharge Standard of Water Pollutants for Pulp and Paper Industry*<br><br>(GB 3544-2008) | August 1, 2008 | This standard sets pollutant discharge limit values for pulping and papermaking enterprises or their production facilities. In addition to water pollutant discharge limit values for existing and newly constructed enterprises; this standard has also specified special water pollutant discharge limit values for places where special precautions are needed in order to avoid serious water environment pollution. Water pollutants dealt with in this standard include pH-value, chromaticity, suspended substance, BOD, COD, ammonia nitrogen, total nitrogen, total phosphorus, absorbable organic halogens (AOX), and dioxin. |

| | | |
|---|---|---|
| | | This standard also includes the criteria for water pollutant concentration measurement methods. |

**Table 4: National discharge standards (Table 2, GB3544-2008）applicable to the project**

| Parameters | Units | Pumiao Mill (pulp only) | Jinfu, Meili and Yueyang (pulp and paper) |
|---|---|---|---|
| Water discharge | t/ t product (absolutely dry pulp) | ≤50-60 | ≤50-60 |
| pH | / | 6~9 | 6~9 |
| Chroma | Times | ≤50 | ≤50 |
| SS | mg/L | *≤50* | *≤30* |
| BOD5 | mg/L | ≤20 | ≤20 |
| CODcr | mg/L | *≤100* | *≤90* |
| NH3-N | mg/L | *≤12* | *≤8* |
| TN | mg/L | *≤15* | *≤12* |
| TP | mg/L | ≤0.8 | ≤0.8 |
| AOX-workshop | mg/L | ≤12 | ≤12 |
| Dioxins-workshop | pgTEq/L | ≤30 | ≤30 |

## World Bank Environment, Health and Safety (EHS) Guidelines

The World Bank EHS Guidelines on pulp and paper sector provide comprehensive design, operation and waste management measures and performance levels that are generally considered to be achievable in **new** facilities by existing technology at reasonable costs. Application of the EHS guidelines to **existing** facilities may involve the establishment of site-specific measures, with appropriate timetable for achieving them.

A comparison key measures that will be adopted by the project and the EHS Guidelines is presented in Chapter 3. Of particular importance, the EHS Guidelines explicitly indicate that when Elemental Chlorine Free (ECF) or Total Chlorine Free (TCF) bleaching technologies are used, the concentrations of dioxins and furans in the effluents are below the detection limits. The proposed project is in line with this principle.

A comparison of the EHS effluent guidelines and Chinese standards on wastewater discharge from pulp and paper mill (Table 2 of GB3544-2008) was made during EA process. It is noted that for most wastewater discharge parameters, the Chinese standards are expressed as pollutant concentrations (mg/L) and the EHS Guidelines are expressed as pollutant mass flow rates (kg/ton of air dry pulp[1]). As each of the mill has a different "wastewater-to-pulp production" rate, mill specific comparison was made and presented in Chapter 5 Impact assessment and mitigation measures. However, an initial comparison can be made using the maximum allowed wastewater discharge per dry pulp produced as indicated in the Chinese standards, as is shown in Table 5a.

[1] air dry pulp refers to dry pulp that is 90% dry

**Table 5a Comparison between EHS effluent guidelines and GB3544-2008, Table 2**

| Parameters | Units | GB3544-2008, Table 2 Non-wood | World Bank EHS Guidelines [Non-wood, Annex B-Table 1(I)] |
|---|---|---|---|
| pH | | 6~9 | 6~9 |
| color | Times | 50 | / |
| TSS | kg/Adt | 1.62 | 2 |
| BOD5 | kg/Adt | 1.08 | 2 |
| CODcr | kg/Adt | 4.86 | 30 |
| $NH_3$-N | kg/Adt | 0.43 | / |
| T-N | kg/Adt | *0.65* | *0.5* |
| T-P | kg/Adt | 0.04 | 0.05 |
| *AOX-Workshop* | *kg/Adt* | *0.65* | / |
| *Dioxin-Workshop* | *TEQ ng/Adt* | *1.62* | / |
| Wastewater discharge* | t/Adt | 54 | 50 |
| * The EHS Effluent Guidelines does not include in the wastewater discharge the cooling water and other clean water while the national standards do. Since cooling water and other clean water are recycled in the mills to the extent possible, resulting very small amount of final discharge (1-2 m3/Adt) into the wastewater system. Therefore the comparison is the considered made on the same basis. | | | |

It is noted from the comparison study that the applicable non-wood EHS effluent guidelines does not have requirements on dioxins or AOX. The results show that generally the Chinese GB3544-2008 standards are more stringent than the EHS effluent guidelines, except that the Total Nitrogen (TN) and wastewater discharge slightly surpass the EHS effluent guidelines. Mill specific comparison of the discharge compliance is presented in the impact assessment chapter.

Further, a study on international dioxins standards for pulp production is conducted. Table 5b shows that the Chinese dioxin standard is comparable with internal standards for the pulp sector in general.

**Table 5b Comparison of Chinese and International Dioxin Standards for Pulp Production**

| Country | Dioxin Effluent Standard |
|---|---|
| Canada* | 15 pg/L; |
| USA** | TCDD 10 pg/L; TCDF 31.9 pg/L |
| EU *** | no specific limit values; ECF “eliminates 2,3, 7, 8 TCDD/F to non detectable limits |
| World Bank Group**** | No specific limit values. ECF processes are acceptable and will bring TCDD/TCDF below detection limits. |
| * Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations (SOR/92-267); Reference Method for the Determination of Polychlorinated Dibenzoparadioxins (PCDD) and Polychlorinated Dibenzofurans (PCDF) in Pulp and Paper Mill Effluents (Report EPS 1/RM/19, 1991)<br>** USEPA, 40 CFR Parts 63, 261, and 430 (Effluent Guidelines - Pulp and Paper Rulemaking Actions - Final | |

Pulp and Paper Cluster Rule)

*** EU, 2001, Integrated Pollution Prevention and Control (IPCC Directive).

**** World Bank Group, *Environmental, Health, and Safety Guidelines* for Pulp and Paper Sector

For air emissions, three mills will not include air emission related activities in the project, except the Meili Mill which will renovate part of its alkali recovery system that will reduce air emissions upon completion. Thus the project is unlikely to cause significant changes of air emissions. Air emissions assessment mainly addresses a review of actual monitoring data of the malodorous gases, Particulate Matters (PM), SO2 and NOx in the process gases (recovery boiler) and flue gases (steam/power generation boilers). Several relevant EHS emissions guidelines are used for the comparison, including the Pulp and Paper Guidelines for process gases emitted from recovery boilers, EHS General Guidelines for boilers whose total rated heat input capacity is less than 50MWt; and EHS Thermal Power Plants Guidelines for boilers whose total rated heat input capacity is more than 50MWt.

For noises, Noises from mechanical equipment such as vacuum pump, transport and other physical activities have been effectively mitigated through engineering and other reduction measures. Noise monitoring results show the noise level at mill boundary and sensitive receptors meet national and EHS Guidelines as well.

# 3. Review of Paper Mills Operation, EHS Management and Technical Upgrading

A comprehensive and systematic review of the current production process of each mill has been conducted during EA process. The waste streams along with the production process, their treatment, compliance with applicable regulations and standards, and mill EHS management are thoroughly addressed in the EIAs.

## Non-wood Pulping Process and Current Mills Operation

The non-wood pulping process varies slightly depending on the type of raw materials. Figures 1to 4 show the flowchart of pulping process of bamboo (Jinfu), bagasse (Pumiao), straw (Meili), and reed (Yueyang).

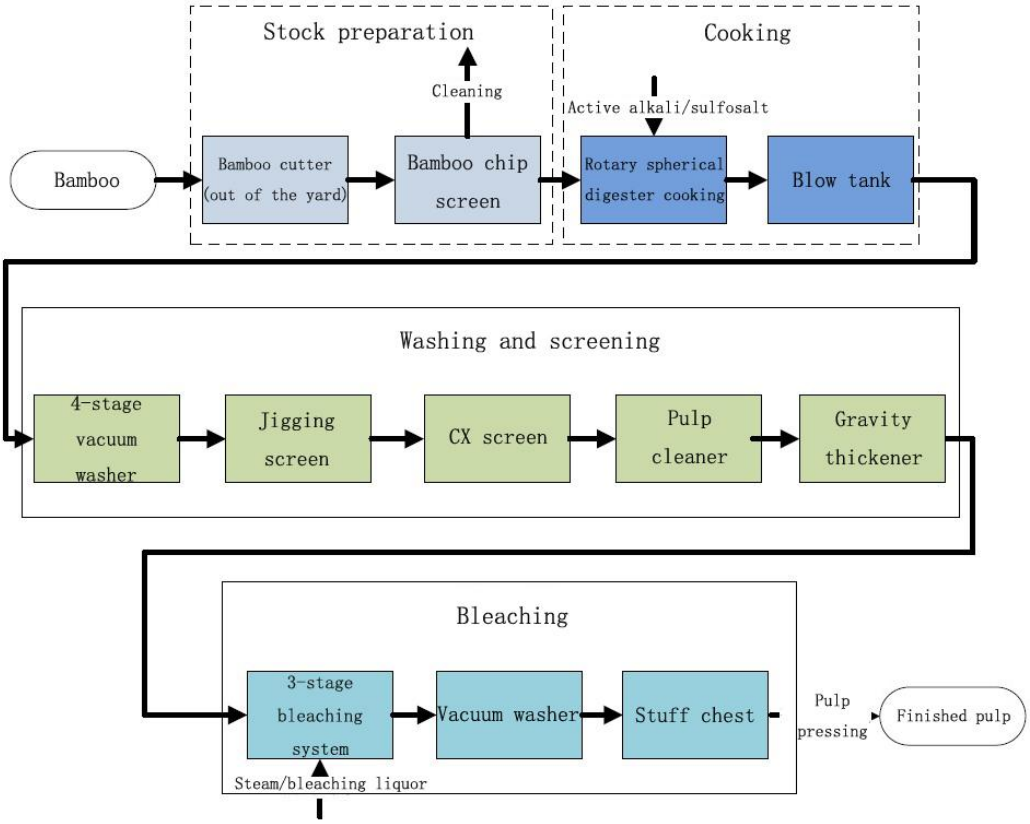


**Figure 1 Typical Process Flowchart of Bamboo Pulping Process (Jinfu)**

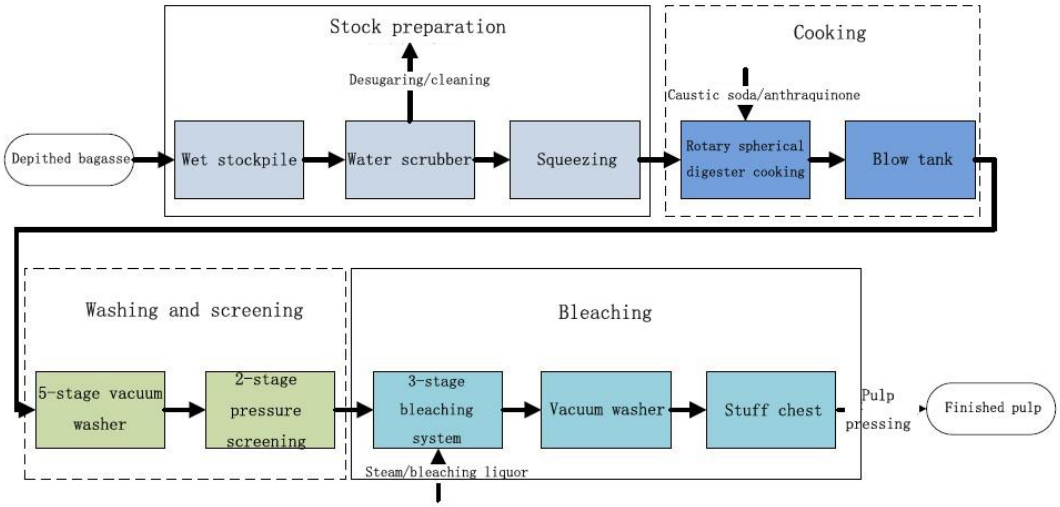


**Figure 2 Typical Process Flowchart of Bagasse Pulping Process (Pumiao)**

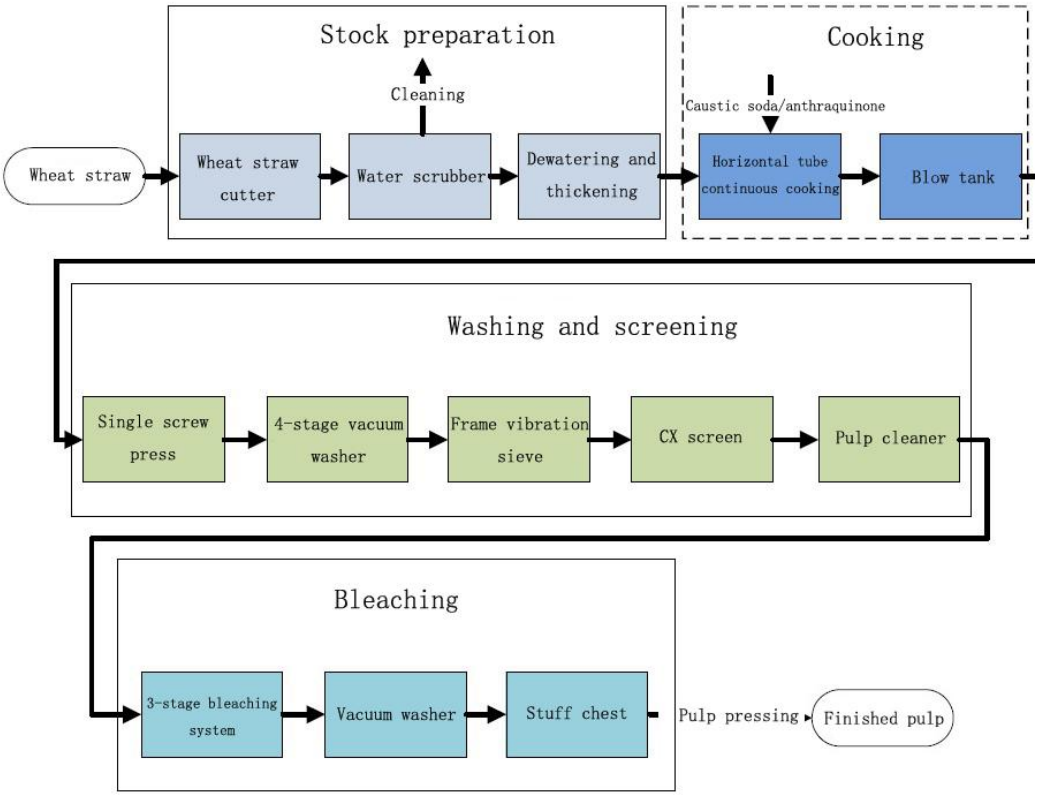


**Figure 3 Typical Process Flowchart of Straw Pulping Process (Meili)**

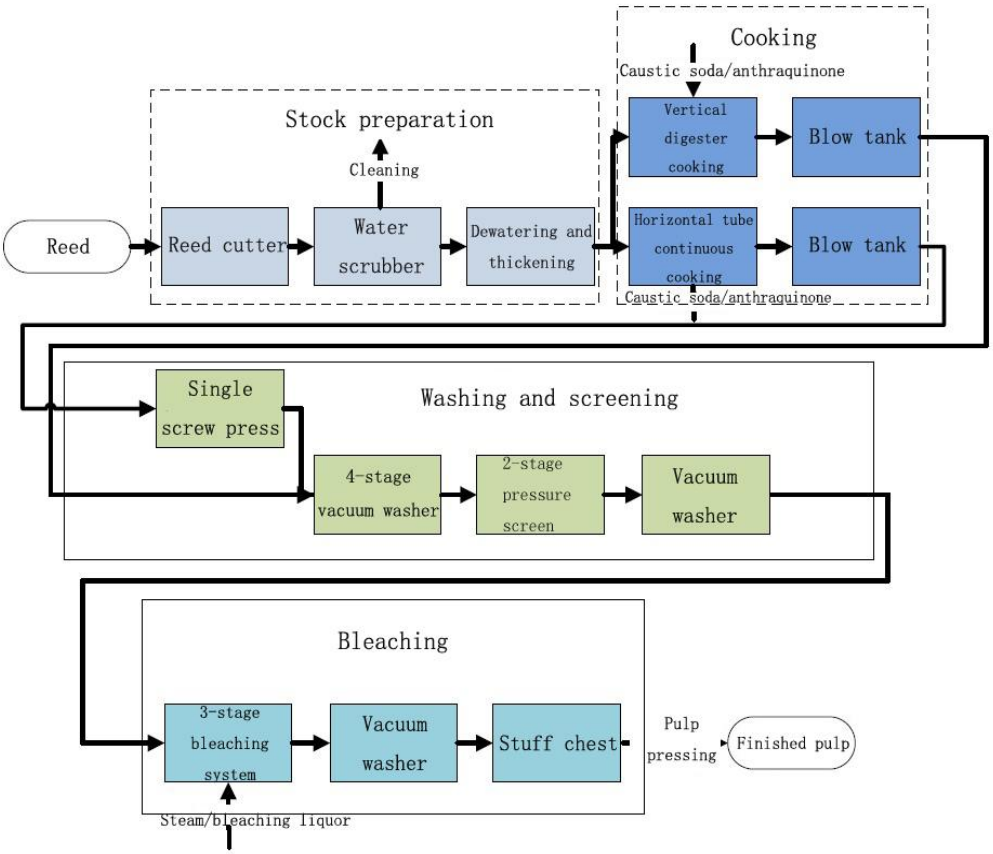


**Figure 4 Typical Process Flowchart of Reed Pulping Process (Yueyang)**

## Current Operation

Table 6 shows a summary of the production in each mill.

**Table 6 Overview of production in each mill before the project**

| Description | Jingfu (Bamboo) | Yueyan (Reed) | Pumiao(Bagasse) | Meili (Straw) |
|---|---|---|---|---|
| Pulp production capacity | 52000t/y | *61,200t/y* | 98,000t/y | 68,000t/y |
| cooking technology | Batch cooking, rotary spherical digester (soda + promoter) | *Two lines: one batch cooking, the other continuous cooking* | Batch cooking, rotary spherical digester | Continuous cooking, horizontal tube continuous cooking |
| pulp washing technology | Back flush, 4-stage vacuum drum washer | Back flush, 5-stage vacuum drum washer | Back flush, 5-stage vacuum drum washer | Back flush, 4-stage vacuum drum washer |
| screening technology | Non-closed screening | Closed screening, 2-stage pressure screening | Closed screening, 2-stage pressure screening | Non-closed screening |
| bleaching technology | CEHP 4-stage bleaching, bleaching in bleaching tower | *CEHP 4-stage bleaching* | CEpH 3-stage bleaching (normally without introducing $H_2O_2$), bleaching in bleaching tower | CEH 3-stage bleaching, integrating moving and static bleaching |
| Alkali recovery | Solid treatment capacity 100t/d, alkali recovery rate 88% | 2 sets of alkali recovery equipment, solid treatment capacity 270t, 530t/d, alkali recovery rate 83~85% | 3 sets of alkali recovery equipment, solid treatment capacity 100t, 160t, 160t/d, alkali recovery rate 85% | 3 sets of alkali recovery equipment, solid treatment capacity 130t, 100t, 110t/d, alkali recovery rate 65~70% |
| Wastewater treatment system | Secondary treatment + tertiary treatment (ABR + contact oxidation + air floatation), total capacity 20,000t/d | Total capacity; 10,0000m3/d, including anaerobic, aearobic and tertiary surface floatation wastewater treatment | Anaerobic/aerobic treatment, anaerobic treatment capacity 11,000t/d<br>Aerobic 4 series: 50,000t/d | Secondary treatment capacity: 50,000t/d |

## Current Waste Management

Waste streams from the paper mills include wastewater, air emissions and solid wastes mainly. Each mill has established environmental protection system to deal with wastewater management and treatment, air emissions and solid wastes. As noted, the primary driver for the mill to implement the project is to ensure compliance with the more stringent national wastewater discharge standards for pulp and paper sector (Table 2, GB3544-2008) that come into effective on July 1st, 2011. Air emissions monitoring show the air emissions from these mills generally meet applicable national standards. The solid wastes are also handled in accordance with relevant regulations and standards.

### Jinfu

Wastewater. Jinfu has a secondary biological wastewater treatment system. A tertiary treatment facilities including chemical oxidation and air floatation were built and put into operation in May 201.1Monitoring results show that conventional pollutants (COD, BOD, TSS, etc) in the effluent have met the new standards (Table 2 ,GB3544-2008). However, simply relying on the advanced wastewater treatment is not economical in the long run; and the removal of dioxins from the effluent is not verified due to lack of monitoring data. Therefore, the mill has decided to implement ECF based bleaching techniques to secure long term compliance with the new standards.

Air emission. Typical air emissions from Jinfu mill consist of malodorous gases, Particulate Matters (PM), $SO_2$ and $NO_x$ in the process gases (recovery boiler) and flue gases (steam/power generation boilers). Dust removal was achieved through electrostatic dust controller. The mill uses low sulfur coal and in-boiler lime desulfur techniques to deal with $SO_2$ emission. Air emissions are emitted through an 80m high stack. Monitoring data show flue gases, $SO_2$ and non-point air emission met national standards.

Solid Waste. The typical solid wastes produced in the mills include residuals from raw materials preparation process, white sludge (lime mud) produced in the alkali recovery process, wastewater treatment sludge, and other residuals and wastes from production process. White sludge (lime mud) is non-hazardous and disposed of in the mill's dedicated white sludge landfill which had undergone domestic environmental review and approval. Groundwater monitoring conducted in June, 2011 show the groundwater water quality is not contaminated and meets national standards. The mill's wastewater sludge is disposed of at a local sanitary landfill.

### Pumiao

Wastewater. Pumiao has secondary biological wastewater treatment. Before the project, the wastewater discharge can only meet the old standards, i.e. Table 1 of GB3544-2008. Therefore, it has proposed to build a tertiary wastewater treatment facility in addition to ECF bleaching process.

Air emissions. The mill has installed dust removal facilities at each boiler to deal with flue gases. Desulfur was achieved through adding alkali agent. Emissions are emitted through 3 stacks (60, 80, 100m high). Malodours gases are mainly from bagasse stockpile site and bleaching processes. The mill has taken measures to control it.

Solid waste. White sludge (lime mud) and boiler slag produced in the mill is sent to a cement plant. The wastewater sludge are composted and sold to local villagers as sugarcane farmland fertilizer. Other solid wastes are also handled properly either through reuse or recycling.

### Meili

Wastewater. Meili has a secondary biological wastewater treatment plant Unlike the other three mills, the effluent from the mill's wastewater outlet will not be discharged into any receiving water body, but to oxidation ponds for further treatment. The local EPB has made it clear that the new standards (Table 2, GB3544-2008) apply to the mill effluent upon completion of the proposed project.

Air emissions. The mill has installed dust removal facilities at each boiler to deal with flue gases. Desulfur was achieved through adding lime stone. Emissions are emitted through a 120m high stack. Monitoring data show flue gas, SO2 and NOx met relevant national standards.

Solid Waste. White sludge is disposed of in the mills dedicate white sludge landfill. Wastewater sludge is non-hazardous and sent to the company's fast-growing forests and used as soil agent.

### Yueyang

Wastewater. Yueyang basically has two lines, one biological process for paper making "white water" with capacity 40,000 m3/d, and a biological process for bleaching wastewater with capacity 60,000m3/d, followed by tertiary surface flotation. There is also a 14,000m3/d anaerobic wastewater treatment for material-preparation wastewater, which is sent to the bleaching wastewater treatment system. The current wastewater discharge can meet Table 1 of wastewater discharge standards for pulp and paper sector (GB3544-2008), but cannot reach Table 2 discharge limits.

Air emissions. The mill has installed dust removal facilities at each boiler to deal with flue gases. Desulfur was achieved through adding alkali agent.

Solid Waste. Raw material preparation residuals, fiber sludge, and wastewater sludge will be either recycled or incinerated in the mill. White sludge (lime mud) is also reused as paper making additives after refinement. Other solid wastes are also handled properly either through reuse or sanitary landfill.

## Current EHS Management System

Each mill has established environmental, health, safety and emergency response system in accordance with national and local requirements. including an environmental and safety office with dedicated staff, environmental management and occupational safety regulations, operational monitoring and emergency management plan. Each mills' environmental management staff receive regular training and certificates where necessary. Apart from grab sampling and analysis, online monitoring equipment, including wastewater and air emissions are in place to monitor flow rate, COD, pH and flue gas, SO2, etc. These mills are also closely monitored and supervised by local EPBs whose environmental monitoring stations carry out regular supervision monitoring and enforcement. The EPBs also share monitoring

data with and provide technical support to the mills as necessary; particularly on a few parameters that mill (s) lacks capacity to monitor.

## Technical Upgrading

In line with national sector development policies and environmental regulations, the four mills all proposed ECF centered technical upgrading plans. Meanwhile, given different mill situations, each mill has different engineering scope to meet its specific needs. Table 7 summarizes the key technical upgrade scope of each mill.

**Table 7 Summary of the technical upgrading scope at each mill.**

| Mill | Main investment activities |
|---|---|
| Jinfu | • 52,000t/a oxygen delignification and ECF bamboo pulp bleaching system<br>• 52,000t/a material preparation, cooking, bamboo joint removal, and screening facility<br>• 4 ton/day chlorine dioxide production facility.<br>• Bleaching process gas collection and washing facility |
| Pumiao | *Already built, currently under pilot operation. The project will finance the pilot operation and a tertiary wastewater treatment facility（advanced oxidation process）.*<br>• 98,000 t/a ECF bagasse pulp bleaching system<br>• 8t/d chlorine dioxide production system<br>• 11,000 m3/d anaerobic wastewater treatment system for bagasse material preparation Proposed<br>• 40,000m3/d tertiary wastewater treatment system |
| Meili | • 68,000t/a ECF straw pulp bleaching system<br>• 34,000t/a material preparation, cooking and screening system<br>• 4t/d chlorine dioxide production system<br>• 260t/d alkaline recovery system<br>• Wastewater treatment system upgrade |
| Yueyang | • 180t/d (61,200t/a) oxygen delignification and ECF reed pulp bleaching system<br>• Chlorine dioxide production system |

Table 8 presents key EHS guidelines environmental management measures and mill specific measures proposed by the project. In general, the proposed project is in line with the EHS guidelines.

**Table 8 Compliance with EHS guidelines measures**

| EHS Guidelines Environmental Management Measures | Jinfu | Pumiao | Meili | Yueyang |
|---|---|---|---|---|
| **1. Wastewater Management** | | | | |
| • Oxygen delignification ahead of the bleach plant | Yes | No | Yes | Yes |
| • Efficient washing of the pulp ahead of the bleaching | Yes | Yes | Yes | Yes |
| • Replacement of elemental chlorine bleaching with elemental free bleaching (ECF) | Yes | Yes | Yes | Yes |
| • Minimizing precursors such as dibenzo-p-dioxin and dibenzofuran entering the bleach plant by using precursor-free additives and thorough washing; | Yes | Yes | Yes | Yes |
| • Eliminating pulping of furnish contaminated with polychlorinated phenols | Yes | Yes | Yes | Yes |
| • Collection and recycling of spent cooking liquor spills; | Yes | Yes | Yes | Yes |
| • Stripping and reuse of evaporation and digester condensates in order to reduce odor producing total reduced sulfur (TRS) compounds | Yes | Yes | Yes | Yes |
| • Recycling of white water with fiber recovery | Yes | Yes | Yes | Yes |
| **2. Wastewater Treatment** | | | | |
| • Primary mechanical treatment | Yes | Yes | Yes | Yes |
| • Secondary treatment | Yes | Yes | Yes | Yes |
| • Anaerobic biological pretreatment | Yes | Yes | Yes | Yes |
| **3. Air Emissions** | | | | |
| • Process gases: Malodorours gases should be collected and incinerated to completely oxidize all reduced sulfur compounds; | Yes | Yes | Yes | Yes |

| | | | | |
|---|---|---|---|---|
| • Recovery Boilers: Reducing sulfur emission by concentrating black liquor in the evaporator above 75% dry solids before incineration in the recovery boiler; reducing sulfur emission by controlling combustion process parameters in the recovery boiler including temperature, air supply, distribution of black liquor in the furnace, and furnace load | Yes | Yes | Yes | Yes |
| **4. Residues and Waste** | | | | |
| ● Solid waste volumes should be reduced to the extent feasible through in-situ reuse and recycling of materials | Yes | Yes | Yes | Yes |
| ● Lime mud is normally recycled in the mill recovery system but excess materials can be commercially used for liming of acid soils or otherwise landfilled | Yes. Landfilled | Yes. Sent to a cement plant | Yes. Landfilled. | Yes. Recycled in the mill. |
| ● Green liquor slduge can be used as a daily cover in solid waste landfills after improved dewatering, or, less frequently, as forest fertilizer (based on an analysis of nutrient contents and potential impacts from land application). It can also be used as a neutralization agent for acidic wastewater | Yes. Landfilled. | Yes. Landfilled. | Yes. Landfilled. | Yes. |
| ● Fiber sludge can be recycled into production on site, sold to other mills, or sent off-site for use in other products. It can also be incinerated or used as landfill daily cover material; | Yes. | Yes. | Yes. | Yes. |
| ● Biological sludge can be incinerated in the bark boiler together with fiber sludge, or evaporated and incinerated in the kraft mill recovery system. It can also be composted with other organic materials for the preparation of soil products; | Yes. Composted or incinerated. | Yes. Composted. | Yes. Composted | Yes. Composted or incinerated |

# 4. Environmental Baseline

The EIA provides description of the ambient environment of each mill, including natural, ecological and social-economics. The EIA also conducts environmental monitoring and desk review to present ambient environmental quality of each mill, including water quality situation of effluent receiving water bodies, ambient air, and groundwater.

## Natural and Social Economics

The social economics baselines of the four project sites are presented in Table 9. Basically, the four mills are located in regions that present quite different natural and metrological conditions that grow different fiber materials used for non-wood pulping production. In terms of social-economics, the four provinces/autonomous regions are less developed areas in China.

## Current Environmental Quality

Jinfu: The effluent from Jinfu's wastewater treatment plant is discharged into the Dadu River, whose water quality function is classified as Class III according to water body quality function zoning. Monitoring results at four cross sections up and downstream of the outlet show that this function is entirely achieved. There is no evidence that the discharge from Jinfu has not deteriorated the river quality. In terms of groundwater, monitoring shows it meets the standard groundwater quality. Air quality and noise monitoring show that relevant environmental quality standards are met.

Pumiao: The effluent from Nanning Pumiao's wastewater treatment plant is discharged into Yongjiang River, whose water quality function is classified as Class III according to water body quality function zoning. Monitoring results at five cross sections up and downstream of the outlet show that most of the function standards can be met, except total phosphorus concentration downstream of Pumiao Town, which is considered cause by the domestic untreated wastewater from the town. Overall it is concluded the discharge from Jinfu has not deteriorated the river quality. Air quality and noise monitoring show that relevant environmental quality standards are met.

Meili: The effluent from Ningxia Meili's wastewater treatment plant is NOT discharged into any water body. It flows into an oxidation pond, then mixed with water pumped from the Yellow River and used to irrigate fast-growing trees that are used as pulping materials. Monitoring of the Yellow River quality shows it meets applicable standards. In terms of ground water, 3 locations were selected to sample. Monitoring results show that relevant ground water quality standards are met. Air quality monitoring results show the TSP and PM10 surpassed the designated quality standards. This is due to the regional low coverage vegetation, and dry and windy weather in the semi-desert area. On the other hand, $SO_2$ and $H_2S$ concentration at the monitoring location meet the standards. Soils samples were also taken in the mill to test the quality. Results show soil quality standards are met.

Yueyang: The effluent from Yuyang's wastewater treatment plan is discharged into the Yangtze River. Monitoring results show that TP, $NH_3$-N and in some cases DO cannot not meet the relevant water quality zoning standards, while other indicators can meet the standards. Ground water

monitoring show in some locations, nitrite and Total *Eco. Li*, iron and manganese can not meet groundwater quality standards. In terms of air quality, monitoring results show TSP and PM10 cannot meet relevant standards, while SO2 and NO2 can make it. Acoustic monitoring results show relevant environmental quality standards can be met.

**Table 9 Natural and Social Economics Baselines**

| Items | Sichuan Jinfu | Nanning Pumiao | Ningxia Meili | Hunan Yueyang |
|---|---|---|---|---|
| Location | Shawan district, Leshan city, Sichuan Pronvince, Southwest China. | Yongning District , Nanning City, Guangxi Zhuang Autonomous Region, South China | Zhongwei city, Ningixa Hui Autonomous Region, Northwest China | Yueyang City, Hunan Province, Middle-South China |
| Geology and Landform | Mountainous area | Hilly and plain | Alluvial plain, close to desert | Flood plain, hilly |
| Weather | Middle subtropical humid monsoon weather<br>Average temp: 7oC in Jan, 26oC in July<br>Annual precipitation: 1120mm<br>Wind: North-Northwest | Subtropical monsoon weather<br>Average temp: 28 in July, 12.6 in Jan<br>Annual precipitation: 1272.9 mm<br>Wind: Southeast-Northeast | Semi-dry continental weather<br>Annual average temp: 8.8oC<br>Annual average precipitation: 179.6mm<br>Dominant wind: East | Middle subtropical – north subtropical. Humid continental subtropical monsoon weather |
| Hydrology | Receiving water body: Dadu River with annual average flow rate: 1490 m3/s<br>Groundwater : | Receiving water body: Yongjiang River with annual average flow rate: 1550 m3/s<br>Groundwater: | No receiving water body for the effluent from the mill. | Receiving water body: Yangtze River |
| Ecology | Evergreen broad leaf trees and bamboo dominate.<br>No precious or protected flora or fauna found in the project area. | Tropical and subtropical secondary rain vegetation.<br>Few wild species found in the project area | Farmland dominate<br>No precious or protected flora or fauna in the project area | Farmland |
| Sensitive Area | None | None | Shapotou Nature Reserve (protecting steppe ecosystem) about 5 km away | None |
| Administration and Population | Shawan district: area-61,706 km2; population-201,913 (year 2008) | Yongning District: area-1295 km2<br>Population: 316 thousand | Zhongwei: area 16986 km2<br>Population: 1.16 m in 2010 | Yueyang: area 15019 km2<br>Population: 5.28 million |
| Social economics | GDP: 8.49 billion RMB in 2009<br>Industrial output: 262 million | GDP: 4.1 Billion RMB in 2011 | GDP: 13.6 billion RMB in 2009<br>Industrial output: 4.4 billion RMB | Yueyang city: GDP 62.9 Billion RMB in 2005 |
| Transportation | On major highway, raiway and airport | Within Nanning municipality | Near Baotou-Lanzhou Raiway, National Highway 109, Airport | Near major railway, expressway and highway. Waterway transportation very developed. |
| PCR | None | None | None | None |

# 5. Impacts Assessment and Mitigation

The proposed project, through adopting ECF centered bleaching technical upgrading and other environmental management measures, aims to meet the more stringent national environmental standards including GB3544-2008, Table 2. These measures are also in line with the BAT/BEP as recommended by Stockholm Convention and the World Bank EHS Guidelines in general. Therefore, the impact assessment put emphasis on compliance analysis, comparison between before and after the project implementation, residual impacts, risks analysis and construction related impacts including decommission of old facilities.

Based on this analysis, it is expected that the project will result in significant environmental benefits to local environment compared to the 'without project' scenario. The environmental benefits include minimization of UPOPs (dioxins and furans) releases, significant reduction of water consumption and pollutant load in effluents, including COD, BOD and TSS, etc. The project will not involve air emission related activities, except the Meili Mill which will renovate part of its alkali recovery boiler system that will reduce air emissions upon completion. Thus the project is unlikely to cause significant changes of air emissions. Solid waste and noises management will follow current practices that comply with national regulations and the EHS Guidelines in general.

Manageable construction impacts include decommission of eliminated facilities, noise and dust, and disposal of wastes. These impacts will be effectively avoided or minimized through the application of project EMPs.

The proposed BAT/BEP investments will take place within the existing boundary of each mill. No land take is needed.

## Impact Assessment of Jinfu Mill

### Wastewater Management

Jinfu had its wastewater treatment system upgraded to include a tertiary treatment facility in May, 2011. Monitoring conducted in July 2011 by local environmental protection bureau show the effluent from the mill's wastewater treatment plant met the new Chinese standards (GB3544-2008, Table 2) in terms of flow and conventional pollutant parameters. AOX and dioxins were not included in the monitoring as the local EPB has no the needed capacity. To ensure further resource savings and steady long-term compliance with the standards, the mill needs to implement the proposed project. The EIA carried out mill specific analysis of the before (March 2011 before the tertiary wastewater treatment facility put into operation) and after the proposed project, compared with the EHS effluent guidelines and domestic standards, as shown in Table 10 below.

**Table 10 Before and after project effluent quality of Jinfu Mill**

| Parameters | Unit | EHS | GB3544-2008, Table 2 | Before the project (March, 2011) | Prediction |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Flow | $m^3$/t（AD） | 50 | 60 | 72 | 54 |
| pH | / | 6～9 | 6~9 | 6~9 | 6~9 |
| TSS | kg/t（AD） | 2.0 | 1.8 | 1.8 | 1.62 |
| COD | kg/t（AD） | 30 | 5.4 | 10.16 | 4.83 |
| $BOD_5$ | kg/t（AD） | 2.0 | 1.2 | 1.20 | 1.08 |
| Total nitrogen | kg/t（AD） | 0.5 | 0.72 | 0.72 | 0.65 |
| Total phosphor | kg/t（AD） | 0.05 | 0.05 | 0.048 | 0.045 |
| AOX-workshop | kg/t（AD） | / | 0.75 | 0.72 | 0.64 |

According to the Table 10, before the tertiary wastewater treatment facility is installed, most of the parameters meet the new national standards (GB3544-2008, Table 2), except flow and COD. After the project, the national standards can be met. Most of the predicted parameters will meet the EHS effluent guidelines. However, the predicted total nitrogen (TN) surpasses the EHS values. It is noted that receiving water body Dadu River has a fairly large flow rate at dry season is 400m3/s. While, the effluent flow rate is only 0.128m3/s, accounting only 0.032% of the river flow rate. The TN and AOX discharge is not considered to result in significant impact the water quality and human health.

A risk assessment on the wastewater treatment as also conducted to evaluate the impacts on receiving water body Dafu River under the worst scenario, i.e. total wastewater treatment process failure and the lowest flow rate. Under such accidental breakdown circumstance, the discharge effluent is about 0.128 m3/s, with CODcr concentration 1100 mg/L. Water quality modeling shows this will lead to a pollution plume of about 2m wide and 40m long towards the downstream, with highest CODcr concentration of 42 mg/L compared to allowed water quality function objective 20 mg/L. To avoid that, the assessment requested that the WWTP be well maintained. To this effect, an emergency plan has been prepared.

In conclusion, the technical upgrading in Sichuan Jinfu will further reduce water pollutants discharge and ensure it meets new standards in a steady long-term manner. Even under accidental discharge, the impacts on the Dadu River are limited and will not significantly cause any significant impacts to river water quality.

## Air Emissions

In Jinfu, the proposed project activity will only include building a total closed cooking, screening and washing facility that will substantially reduce malodorous emissions. In addition, the proposed project will include collection and treatment system for exhaust and malodorous gases (Total Reduced Sulfur, TRS mainly) from cooking, screening and washing process and the tail gases from chlorine dioxide production utility. Malodorous gases emissions will thus be minimized. The final emissions will meet relevant standards and be emitted through 30m high stacks. Another source of malodorous gases is wastewater treatment sludge, which is properly handled through timely cleanup. Further, the EIA requires the safety distance from these gases sources will be no

less than 100m. Since there are no households located within the distance, there is no need to take actions.

An ongoing technical upgrade includes renovation of alkali recovery or steam/power boilers, which is expected to be done in early 2012. Air emissions from the two boiler systems share an 80m stack. Dust removal and desulfur facilities are in place and will be well operated. Monitored and predicted parameters, including PM, $SO_2$ and $NO_x$, comply with national air emission standards and/or local EPB approved emission limits.

A comparison study of actual/predicted air emissions with relevant EHS guidelines was conducted. It is found that monitored and predicted air emissions (PM, $SO_2$ and $NO_x$) from the steam/power boilers can universally meet the EHS guidelines (EHS General Guidelines). However, for alkali recovery boiler, the emissions do not meet the EHS guidelines (Pulp and Paper), notably $NO_x$. Considering the alkali recovery emissions belong to process gases, it is subject to raw materials, chemical usage, and production scale. The compared EHS Pulp and Paper Guidelines specifically refer to Kraft process that deals with wood pulping process in the context of much larger production capacity in western developed countries, where there is almost no non-wood pulping production. Therefore, the basis for the comparison is not put on the same basis. Further, Ambient air quality monitoring and assessment shows that the air emissions from each mill have not cause significant impacts to the ambient air quality which comply with planned air quality standards.

### Solid Waste

The solid wastes produced in Jinfu include mainly bamboo preparation residuals, white sludge (lime mud), and wastewater sludge. These solid wastes are non-hazardous and will remain current management approach, i.e. bamboo preparation residuals will be reused or incinerated in the mill; white sludge will be disposed of at the mill's dedicated white sludge landfill; and the dewatered sludge will be disposed of at Leshan Shawan district landfill. These measures comply with domestic requirements and the EHS Guidelines recommendations.

### Noise

In Jinfu mill, noises are and will be generated from mechanical equipment such as vacuum pumps, air compressors, and other pumps. Through implementing mechanical noise reduction, sound insulation, and safety distance measures, the noise levels will be minimized. Monitoring results show the noise levels meet national standards and EHS Guidelines.

## Impact Assessment of Pumiao Mill

Pumiao mill finished the technical upgrading in 2011. Currently the new facilities are under pilot operation. The proposed project will support the pilot operation and building a tertiary wastewater treatment facility.

### Wastewater Management

The EIA carried out mill specific analysis of the effluent quality compared with the EHS effluent guidelines and domestic standards, as shown in Table 11 below.

**Table 11 Before and after project effluent quality of Pumiao**

| Parameters | Unit | EHS | GB3544-2008, Table 2 | Before the project | Prediction |
|---|---|---|---|---|---|
| Flow | $m^3/t$（AD） | 50 | 54 | 84.6 | 49.5 |
| pH | / | 6～9 | 6～9 | 6～9 | 6～9 |
| TSS | kg/t（AD） | 2.0 | 2.7 | 4.95 | 1.494 |
| COD | kg/t（AD） | 30 | 5.4 | 12.15 | 3.987 |
| $BOD_5$ | kg/t（AD） | 2.0 | 1.08 | 2.169 | 0.594 |
| Total nitrogen | kg/t（AD） | 0.5 | 0.81 | 0.72 | 0.54 |
| Total phosphor | kg/t（AD） | 0.05 | 0.04 | NA | 0.018 |
| AOX | kg/t（AD） | / | 0.75 | NA | 0.59 |

According to the analysis, before the technical upgrading, most of the parameters do not meet the new national standards (GB3544-2008, Table 2), as well as EHS guidelines. The mill adopts a dual approach in order to ensure the compliance with new standards, i.e. ECF bleaching and a tertiary wastewater treatment facility.

After the project, Pumiao can meet the national standards universally, and most of the EHS effluent guidelines except total nitrogen (TN). This is the same situation as Jinfu. As previously discussed, this surpass is considered acceptable. Another important aspect is the receiving water body Yongjiang River, whose flow rate at dry season is 170m3/s. While, the effluent flow rate is only 0.21m3/s, accounting only 0.012% of the river flow rate. The TN and AOX discharge is not considered to result in significant impact the water quality and human health.

A risk assessment on the wastewater treatment as also conducted to evaluate the impacts on receiving water body under the worst scenario, i.e. total wastewater treatment process failure and the lowest flow rate.. Under such accidental breakdown circumstances the discharge effluent is about 0.012 m3/s, with CODcr concentration 953mg/L and BOD 192 mg/L. Water quality modeling shows this will lead to a 10m wide and 100 long, with highest CODcr concentration compared to allowed water quality function objective CODcr 20mg/L. To avoid that, the assessment requested that the WWTP be well maintained. To this effect, an emergency plan has been prepared.

## Air Emissions

In Pumiao, the proposed project doesn’t involve boilers or cooking system that will produce process gases or flue gas. However, the project will support wastewater treatment facilities that produce malodorous gases from sludge and methane from anaerobic digestion process. Methane will be collected and burned through a dedicated methane boiler, thus will not cause significant impacts to the environment. As to the smells, monitoring shows that 100m downwind it can be smelled. Modeling study suggests keeping a safety distance of 150m. Since the nearest sensitive receptor is about 200m away, there is no need to take special action. Other suggested mitigation measures include properly managing dewatered sludge and carrying out vegetation at several residential areas, high school that are sensitive to smells.

For air emissions from alkali recovery boilers and steam/power generation boilers, dust removal and desulfur facilities are in place and well operated. Final emissions are emitted through 3 stacks (60m, 80m and 100m high each). A comparison study of monitored air emissions data with relevant EHS guidelines was conducted as well. Results show that in general for steam/power boilers, the EHS Guidelines are met. For the alkali boiler, the national standards are met while the EHS guidelines are also meet except $NO_x$ parameter. This is a similar situation to Jinfu and had been analyzed above.

Ambient air quality monitoring results show that at 7 sensitive sites monitored the air quality all meet relevant standards. There is no evidence that the air emissions from the mill has caused significant impacts to the ambient air quality.

### Solid Waste

The wastewater sludge is non-hazardous and will be amount to 3,766t per year. It will be composted in a fertilizer plant belong the Nanning Sugar Company. White sludge (lime mud) produced in the mill is sent to a cement plant. These measures comply with domestic regulation and EHS guidelines recommendations.

### Noise

Noises are and will be generated from mechanical equipment such as vacuum pumps, air compressors, and other pumps. Through implementing noise reduction, sound insulation, and safety distance measures, the noise levels will be minimized. Monitoring results show the noise levels meet national standards and EHS Guidelines.

## Impact Assessment of Meili Mill

### Wastewater Management

Unlike other three mills, Meili's effluent from its wastewater treatment plant does not discharge to any receiving water body. It is pumped to several oxidation ponds for further natural treatment. The Ningxia Environmental Protection Department requires the effluent from the Meili mill to meet the new GB3544-2008(Table 2) standards, the same as other project mills.

The Meili EIA carried out mill specific analysis of before and after project effluent quality compared with the EHS effluent guidelines and domestic standards, as shown in Table 12 below.

**Table 12 Before and after project effluent quality of Meili**

| Parameters | Unit | EHS | Domestic Standard | Before the project | Prediction |
|---|---|---|---|---|---|
| Flow | $m^3$/t（AD） | 50 | 60 | 78.2 | 44.4 |
| pH | / | 6～9 | 6～9 | 6～9 | 6～9 |
| TSS | kg/t（AD） | 2.0 | 1.8 | 4.67 | 1.11 |
| COD | kg/t（AD） | 30 | 4.86 | 27.36 | 3.60 |
| $BOD_5$ | kg/t（AD） | 2.0 | 1.2 | 7.5 | 0.80 |
| Total nitrogen | kg/t（AD） | 0.5 | 0.72 | 0.72 | 0.36 |

| | | | | | |
|---|---|---|---|---|---|
| Total phosphor | kg/t（AD） | 0.05 | 0.048 | 0.048 | 0.01 |
| AOX | kg/t（AD） | / | 0.72 | 0.94 | 0.53 |

According to the analysis, before the technical upgrading, most of the parameters do not meet the new national standards (GB3544-2008, Table 2). The Meili mill therefore proposes to upgrade its bleaching process and wastewater treatment facilities in order to comply with the new standards. The analysis also shows after the project, water consumption and pollutants discharge will be substantially reduced and fully comply with the new Chinese standards and the EHS effluent guidelines as well.

After the oxidation ponds, the effluent from Meili will be mixed with water pumped from the Yellow river and used to irrigate fast-growing woods at a previously semi-desert area. Therefore, ground water impact analysis was conducted to understand whether the irrigation practices will have significant impacts on the groundwater in this area. Groundwater quality monitoring conducted in 2005 and 2009 show that there had been no significant changes since 2005 in the area. The proposed project site locates at the outlet area of groundwater and far from the drinking water protection area. As the mill's water consumption is relatively low at 11306$m^3$/d, the assessment concluded that the potential impact on ground water quality will be not significant, provided mitigation plans properly implemented, including infiltration proof of the oxidation ponds and long-term groundwater monitoring.

## Air Emissions

The proposed project will include renovating part of the existing alkali recovery boiler which will reduce air emissions further. Air emissions for the recovery boiler and steam/power boilers will be treated with dust removal and desulfur facilities and emitted through two stacks, 80m and 120m high each. A comparison study of monitored air emissions data with relevant EHS guidelines was conducted as well. Results show that for steam/power boilers, the EHS Guidelines are met. For the alkali boiler, the national standards are met, while the EHS guidelines are not met. This is a similar situation to Jinfu and Pumiao, and had been analyzed above.

Other air emissions include malodorous gases from cooking process and wastewater treatment facilities. Since the cooking system will be renovated and gas recovery facilities will be added, malodorous gases from the cooking system will be minimized.

Impacts on ambient air quality were conducted. Air quality modeling study was conducted taken into account NOx, SO2 and TSP parameter. The results shows the project will help reduce the air emissions. After the project, relevant air quality standards will still be met. Within the safety distance (100m) from existing malodorous gases source such as the sludge dewatering workshop there are no sensitive receptors, no special actions need to be taken. In conclusion, the project will have no significant impacts on ambient air quality.

## Solid Waste

Straw preparation residuals (9860t/a) and wastewater sludge (39030t/y) will be sent to the fast growing woods for reuse. Fiber sludge (4800t/y) will be recycled into production. The white sludge (lime mud, 14900t/y) and green liquor sludge (680t/y) will be sent to the mill's dedicate

white sludge landfill for final disposal. The mill has a plan to use it as desulfuizing agent for the mill's boilers in the future. These measures comply with national regulations and in line with the EHS Guidelines recommendations.

### Noise

Noises impact assessment shows after the project the noise level at sensitive receptors will not increase and comply with national standards and EHS Guidelines.

## Impact Assessment of Yueyang Mill

### Wastewater Management

The Yueyang mills's effluent is discharged into Yantze River. The EIA carried out mill specific analysis of the effluent quality compared with the EHS effluent guidelines and domestic standards to understand the impacts on the receiving water body. Table 12presents the analysis results.

**Table 13 Before and after project effluent quality of Yueyang**

| Parameters | Unit | EHS | Domestic Standard | Before the project | Prediction |
|---|---|---|---|---|---|
| Flow | $m^3$/t（AD） | 50 | 60 | 85.8 | 48.9 |
| pH | / | 6～9 | 6～9 | 6～9 | 6～9 |
| TSS | kg/t（AD） | 2.0 | 1.8 | 4.67 | 1.35 |
| COD | kg/t（AD） | 30 | 4.86 | 11.67 | 4.68 |
| $BOD_5$ | kg/t（AD） | 2.0 | 1.2 | 1.63 | 0.93 |
| Total nitrogen | kg/t（AD） | 0.5 | 0.72 | 0.69 | *0.67* |
| Total phosphor | kg/t（AD） | 0.05 | 0.048 | 0.053 | 0.045 |
| AOX | kg/t（AD） | / | 0.72 | 0.89 | 0.40 |

According to the analysis, before the technical upgrading, most of the parameters do not meet the new national standards (GB3544-2008, Table 2), as well as EHS guidelines. The mill therefore proposes to implement the ECF bleaching upgrading in order to ensure the compliance with new standards.

After the project, Yueyang mill can meet the national standards universally, and most of the EHS effluent guidelines except total nitrogen (TN). This is the same situation as Jinfu and Pumiao. Another important aspect is the receiving water body Yangtze River, whose flow rate at driest season is 4,495m3/s. While, the effluent flow rate is only 0.10m3/s. The TN discharge is not considered to result in any significant impact to the water quality and human health.

A risk assessment on the wastewater treatment as also conducted to evaluate the impacts on receiving water body under the worst scenario, i.e. total wastewater treatment process failure and the lowest flow rate. Water quality modeling shows this will lead to a 10m wide and 100 long, with highest BOD5 concentration (4.1 mg/L) compared to allowed water quality function objective BOD5 4mg/L. This will not lead to significant impact to the water quality in the Yangtze

River but should be avoided. To avoid that, the assessment requested that the WWTP be well maintained. To this effect, an emergency plan has been prepared.

### Air Emissions

The proposed project will only include bleaching process upgrade. No air emission sources will be involved. Management of malodorous gas from cooking process and wastewater treatment processes, and air emissions from boilers will follow the current practices.

A comparison of monitored air emissions with relevant EHS guidelines was conducted. It is found that monitored air emissions (PM, $SO_2$ and $NO_x$) from the steam/power boilers can universally meet national and EHS guidelines (EHS General Guidelines). For alkali recovery boiler, the emissions also meet national standards universally and EHS guidelines, except $SO_2$.

Monthly Air quality monitoring data of Jan 2009-June 2011 are collected to assess the regional air quality. It is found in general the air quality is good and meets national standards, with only 3 exceptions. Of the monitoring results, $SO_2$, $NO_2$ and PM10 surpassed the standards once each during the 2.5 years. An additional monitoring to sensitive sites near the mill conducted during EA preparation, with $SO_2$, $NO_2$, PM10 and $NH_3$ and TSP parameter included. Results show that $SO_2$, $NO_2$ and $NH^3$ meet relevant ambient air quality standards while TSP and PM slightly surpass, which are analyzed and considered due to the dry weather and transport dust near the monitored sites. In conclusion, there is no evidence that the air emissions from the Yueyang mill has caused significant impacts to the ambient air quality.

### Solid Waste

Raw material preparation residuals, fiber sludge, and wastewater sludge will be either recycled or incinerated in the mill. White sludge (lime mud) is also reused as paper making additive after refinement. The deinking sludge is sent to a certified hazardous waste treatment center for disposal. These measures comply with national regulations and in line with the EHS Guidelines recommendations.

### Noise

Noises monitoring shows the noise sources are located far from the mill boundary. Noise evaluation results show relevant national standards and EHS Guidelines are met.

## Emergency Prevention and Response

Risk assessment was conducted during EA process for all mills. Accordingly, mitigation measures and emergency plans have been developed and incorporated into the EMPs.

Since the bleaching agent has been switched to chlorine dioxide from chlorine gas which is acute poisonous, the major risk source chlorine storage will be eliminated. Risk analysis shows that the main potential environmental risk during operation would be 1)the accidental leakage of black liquid and cooking liquid, 2)chemicals such as methanol, 3)accidental breakdown of waste management system, and 4)fire and explosion.

To avoid the risks, the proposed project will include additonal emergency facilities such as spills collection and storage facilities, automatic detection or alarms equipment, personal safety equipments, water spray system. Risk management plan that covers design, transportation,

operation, and storage of chemicals, management setup, information exchange and disclosure have been prepared.

Each mill has emergency response prepared and incorporated into the EMP. With these risk mitigation measures and management plans in place, the risk levels are considered low and manageable.

## Construction impacts

The construction activities will take place within the boundary of the mills. There will no land take or households relocation. Construction impacts mainly include noise, dust and exhaust, soil erosion, wastewater and solid wastes associated with transportation, demolition, building and installation activities. The scale of these activities is limited. These impacts are manageable and can be effectively mitigated through proper design, construction schedule, and implementation of generic construction specifications.

However, decommission of old facilities shall be given particular attention. According to the mill and field visit during EA stage, there are no asbestos or PCB contained capacitors in the mill. Old facilities and equipments will be collected by certified waste management companies for safe disposal or reuse. Chemicals and wastes will be handled in accordance with national regulations in a environment and health protective way. The mitigation measures procedures have been incorporated into the EMPs.

# 6. Environmental Management Plan

A detailed Environmental Management Plan (EMP) addressing all issues identified in the EIA (i) organizes all measures to mitigate environmental impacts during the operation and construction; and (ii) establishes an organizational structure, procedures, institutional responsibilities for implementation, and a budget and source of financing for each activity. The EMP also includes environmental monitoring and capacity building programs. In summary, the project will implement a four-fold approach to achieve the expected environmental benefits and minimize environmental and social impacts associated with construction and operation.

- BAT/BEP design. The ECF based bleaching technology and other BAT/BEP such as improved cooking, screening and thorough washing processes have been built into the project design for each mill. These measures are fundamental for the mills to ensure compliance with the more stringent national environmental standards and international practices.
- Comprehensive environmental management plans. Site-specific environmental assessments have been conducted by accredited EIA institutes for each participating mills. A stand-alone EMP has been developed for each mill based on the findings of the EIA report. The EMP details the environmental management and supervision organizations and their responsibilities, mitigation measures, a capacity training plan, a monitoring plan, risk management plan and budget estimates for EMP implementation for construction and operation stages as well.
- Performance Based Framework (PBF). The project will support recruiting internationally acknowledged independent dioxin lab to do dioxins sampling and analysis. Upon verification of compliant dioxins discharge performance, the disbursement can be made to the participating mills. The environmental performance of other wastewater discharge parameters are also built into the performance based framework.
- Capacity building. At mill level, environmental management capacity building are built into each mill's environmental management system, including staff training and online water and air emission monitoring. It is planned that during the project implementation for all participating mills, new parameters such as $NH_3$-N and $NO_x$ will be included into the online monitoring arrangement that has included flow rate, pH, COD in the wastewater; and PM, SO2 of air emissions. At regional level, the project will strengthen UPOPs monitoring and enforcement in four participating provinces where the mills are located.

**Management Organization and Responsibilities.** Environmental management responsibilities have been defined for both construction and operational stages. During construction stage, the management involves each paper mill, During construction, environmental supervision shall be carried out by qualified supervision engineer hired by the project owner. Each supervision engineer will be required by contract to assign one environmental supervision engineer. local environmental protection bureau and monitoring station contractors and supervision engineers. During operational stage, the management mainly involves the paper mill and local environmental protection bureaus/monitoring stations.

**Environmental Monitoring.** Comprehensive environmental monitoring programs have been designed for both construction and operational phases. Basically, four types of monitoring will be conducted, 1) regular operational monitoring carried out by mills, 2) regulatory supervision monitoring by local environmental authorities, including periodical grab sampling and online continuous monitoring, 3) ad hoc monitoring such as the project completion acceptance environmental monitoring; and 4) In addition ,the project will support independent dioxin monitoring to detect whether the mill will achieve the proposed dioxin reduction objective, which is the main project development objective.

# 7. Public Consultation and Information Disclosure

During the EA preparation, public consultations were conducted in accordance with the Chinese regulations and Bank's OP4.01, through a combination of opinion surveys and public meetings in project area. Local communities, villagers, mill workers and other affected people were consulted. All the affected villages are informed, investigated and consulted. Public concerns raised during the consultation have been incorporated into the design, the EMP. For example, concerns over construction impacts such as dust and noise have been addressed in the EMP.

The EA has been disclosed in accordance with the Bank's policy and are sent to the InfoShop. Information disclosure of EA preparation has been carried out by internet and through hardcopies. The draft EIA reports were disclosed during project EA preparation, which is accessible to general public. See below table for full document disclosure dates.

**Table14 Disclosure and public consultation**

| Mills | 1st time disclosure | 2nd time disclosure | 3rd time disclosure |
|---|---|---|---|
| Sichuan Jinfu | May 10, 2011<br>Notice on the project, Shawan district public internet | May 28, 2011<br>Simplified draft EIA, Shawan district public internet | Sep 9, 2011<br>Full EIA report<br>Shawan district public internet |
| Nanning Pumiao | Sep 14, 2011<br>notice on the project, Yongning district public internet | Sep 28, 2011 on Yongning district public internet,<br>Full EIA report<br>Yongning district government public information window | / |
| Ningxia Meili | Aug 01, 2011<br>Notice on the project, Zhongwei city government wetsite | Oct 17, 2011 on Zhongwei municipal government website, Full EIA available | / |
| Hunan Yueyang | June, 2011<br>Notice on the project, Yueyang mill website | Oct 8, 2011 notice on EIA disclosure on website of Hunan Academy of Environmental Sciences, Full EIA available. | / |