Commitment to a Cleaner Environment

WATER AND WASTE WATER TREATMENT PLANTS FOR ASAM-ASAM STEAM POWER PLANT IN KALIMANTAN - INDONESIA

A Case Study

The Government of Indonesia awarded a contract of a 2 x 65 MW coal fired power plant for the city of Banjarmasin, located in the island of Kalimantan. The $ 300 million project was awarded to an International Consortium including Sumitomo Corporation and Toshiba Plant Kensetsu with financing provided by the World Bank.

The comprehensive water and wastewater treatment systems included in the project were sub-contracted to Metito against international competition.

There are features of this project that make it unique and challenging compared to the normal requirements of water and wastewater treatment systems for power stations. The water source is the Assam river which is close to the sea with resulting salty water during the dry season. The proximity to the sea causes hourly changes in the water quality over an extremely wide range with total dissolved solids varying from 30 to 27,000 mg/l during the rainy season and the suspended solids vary from 5 to 690 mg/l.

This presented Metito with a challenging task to be innovational in the design of the plants, together with implementing optimal procedures for successful operation.

Metito has completed the project to the satisfaction of the end user and consultants.

General Information:

The complete package comprises of the following treatment plants :

- River water treatment plant.
- Sea water reverse osmosis plant.
- Brackish water reverse osmosis plant.
- Demineralization plant.
- Ash and coal runoff waste water treatment plant.
- Metal cleaning waste water treatment plant.
- Sewage treatment plant.
- Skid mounted cooling water chemical dosing package.
- Supply of chemicals for operation of the water and waste water systems and cooling tower.

OVERVIEW OF THE POWER PLANT

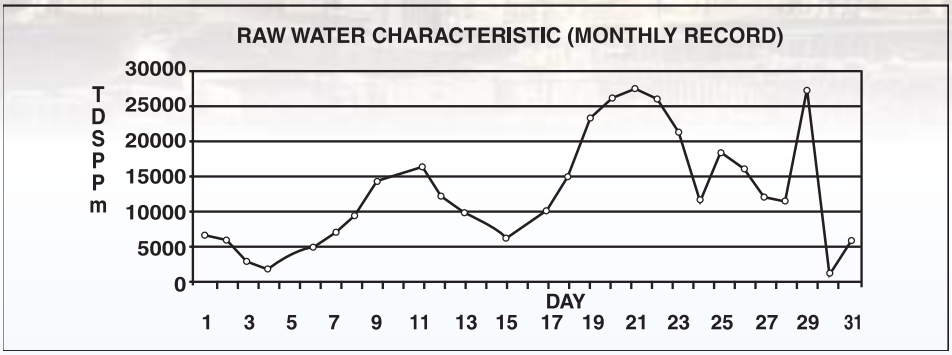
Plant Technical Characteristics:

River water treatment plant of capacity 2 x 480 m^3/h for removal of turbidity, dealkalisation and decarbonisation of the river water. The treated river water is used in the cooling tower and a part of it (100 m^3/h) is utilised by passing through a sea water reverse osmosis plant then through a brackish water reverse osmosis plant and finally through a demineralization plant so as to produce high purity water for boiler feed.

The design influent water characteristics are as follows :

PARAMETER			RAINY SEASON			DRY SEASON		
			MIN	AVG	MAX	MIN	AVG	MAX
Calcium	mg/l	CaCO3	12	19	28	152	490	822
Magnesium	mg/l	CaCO3	14	31	60	654	2438	3904
Sulphates	mg/l	CaCO3	3	11	24	192	1172	3072
m-Alkalinity	mg/l	CaCO3	24	44	55	85	106	119
Total Silica		SiO2	12	20	27	0	2.4	15
Total iron		Fe	1	4.4	16	0.28	0.9	1.84
Total Mn		Mn	0.03	0.12	0.45	0.1	0.19	0.9
Conductivity	µs/cm		66	106	123	6080	25702	42500
TSS	mg/l		5	101	690	16	51	87
Turbidity	NTU		14	37	126	6.8	14.4	37.2
pH			6	7.1	9	7.2	7.4	7.9
TDS	mg/l		30	85	114	2890	16750	27720
Chlorine demand		Cl2	7	9.5	13	0	0.5	12.6
Temperature		oC	24	27	29	27	28	31

Apart from the wide seasonal changes as shown above, there are severe hourly / daily fluctuations as depicted below :



Guaranteed Water Quality from the River Water Treatment Plant

- Suspended Solids : Less than 10 ppm
- Alkalinit : Less than 50 ppm as CaCO3

Guaranteed Water Quality from the Reverse Osmosis Plant

- Permeate conductivity : Less than 100 micro siemens/cm

Guaranteed Water Quality from the Demineralization Plant

- Conductivity : Less than 0.2 micro siemens/cm
- Silica : Less than 100 ppb

Design Data

The waste water treatment facility provided is capable of operating in an efficient and reliable manner for all expected normal design and turndown flow rates with significant variations in waste water quality.

The quality of treated waste water conforms to the following values:

Suspended Solids : Less than 200 ppm

pH : 6-9

CHEMICAL STORAGE TANKS FOR THE DEMIN PLANT

River Water Treatment Plant

This package consists of :

a) Clarification System
b) Sludge Dewatering System and
c) Chemical handling, preparation and feed system.

- **The clarification system** consists of two 18m diameter solids contact clarifiers
- **The sludge dewatering system** consists of two 12m diameter thickeners, sludge pumping systems, a sludge dewatering filter press and a sludge loading hopper.
- The chemical dosing system consists of a lime handling, lime solution preparation and dosing system, alum handling and dosing system, polymer preparation and dosing system and a chlorine dosing system.

Raw water for treatment from the river is pumped by the intake feed pump into the solids contact clarifiers through intake header. The solids contact clarifier constitutes a recirculator which recirculates the sludge from the bottom of the clarifier and mixes it with the influent. This results in the formation of bigger flocs which help in faster and effective settling of suspended particles. The clear water overflows to the treated water basin.

Chemicals are injected into the feed well of the clarifier to help faster and effective coagulation and flocculation.

Sludge collected at the bottom of the clarifier tanks is periodically drained down into the sludge treatment plant, where it is thickened in a sludge thickener. The thickened sludge is

PROCESS WASTE BUFFER TANK & PUMP

then pumped to the filter press for dewatering.

The filter press dewaters the sludge by forcing the water out of it utilising hydraulic rams that compress the sludge. The filtrate extracted from the sludge is recycled to the used water reservoir for reprocessing.

Reverse Osmosis Plant Process Description

The frequently and widely varying salinity in the incoming water posed a major challenge in the design of the reverse osmosis plant, as treated water has to be continuously delivered to a consistent quality.

The reverse osmosis plant has been designed with an innovative process scheme. The high saline water is passed in series, first through seawater membranes and subsequently through brackish water membranes. The wide fluctuations in the quality of the

A VIEW OF ONE OF THE OLARIFLOCCULATORS

incoming water have been managed in the overall process design by the use of automated bypasses and re-circulation arrangements.

Clarified water is drawn by the filter feed pumps from the treated river reservoir to feed the completely automated pre filtration stage of the R.O. plant. The filtration units consisting of dual media filters and activated carbon filters act as a pre-treatment system to remove suspended solids from the river water.

The filtered water is collected in the filtered water basin, where it is used as feed water supply to the Reverse Osmosis plant.
Chemical dosing systems include sodium bisulphite for dechlorination, Antiscalant to prevent sulphate scaling and Sulfuric acid to prevent calcium carbonate scaling.

The filtered water passes through the cartridge filter that removes the colloidal particles present in the water. The treated water at the outlet of the cartridge filter passes through high pressure pumps where the pressure is boosted to a high of 45 bar g thus generating the required osmotic pressure necessary for reverse osmosis.

The permeated water (product water) is stored in a reverse osmosis buffer tank where it is used for feeding the brackish water reverse osmosis plant. Three streams of brackish water reverse osmosis systems are provided for further treatment of the SWRO treated water to improve its quality and render it suitable for feeding the demineralization plant.

Demineralization Plant (Packed Bed Process)

The demineralizer system treats the permeate water from the BWRO units so as to remove the dissolved solids and is designed to treat incoming water at a design flow rate of 15m^3/h. The treatment employed is demineralization by Packed Bed Ion Exchange Process.

The demineralization unit produces and supplies water to the steam boiler equipment. The two demineralization trains are fed from demineralization plant feed pumps. Each train consists of a cation exchanger, an anion and a mixed bed exchanger .

The cation and the anion exchangers are designed for a flow rate of 360m^3/day and are then regenerated. The treated water output between two service cycles of the mixed bed exchanger is 2520m^3.

The latest techniques adopted for equipment design coupled with rugged component and instrument selection ensures the reliability of operation. The necessary safety provisions for handling hydrochloric acid are provided. These include a fume scrubber to scrub the fumes emanating from hydrochloric acid storage and dosing tanks.

The complete operation of the demineralization plant is controlled automatically through remote located central DCS (Digital Control System). The control system allows completely automatic or manual operation of the plant. The software is designed in a manner that provides the plant operator with complete management of the control interface and control systems.

ACRO Waste Water Treatment Plant

The waste water treatment plant caters to the treatment of waste waters generated from the steam power plant. This consists of waste water collected from ash and coal runoff (ACRO) ponds and the metal cleaning waste waters generated from boiler cleaning and washing of air preheaters.

The ash and coal runoff waste water treatment has a capacity of 12m^3/h and consists of equalization, neutralization, coagulation by means of Ferric Chloride, Flocculation with a polymer dosing system, Clarification, storage of the treated water and finally recycling and reuse of the treated waste water for process plant usage.

The sludge is transferred from the clarifier into a sludge thickener, and is subsequently pumped into a filter press for dewatering. A polymer dosing system is provided to condition the sludge before it enters the filter press.

The filter press package is of the plate and frame type which compacts the sludge to 20% solids consistency. Liquid extracted from the

AUTOMATIC CHEMICAL DOSING SYSTEM FOR COOLING WATER

POWER PLANT COOLING TOWERS

sludge is fed into the ACRO buffer tank for reprocessing. The remaining sludge after compression is taken into the filter cake hopper and unloaded into trucks for disposal.

Metal Cleaning Waste Water System

Waste water generated during boiler cleaning and cleaning of air pre-heaters from the steam power plant is fed through feed transfer pumps into the metal cleaning waste water (MCWW) buffer tank. The waste mixture is collected in the buffer tank and then fed to the batch reactor tank through waste water feed pumps.

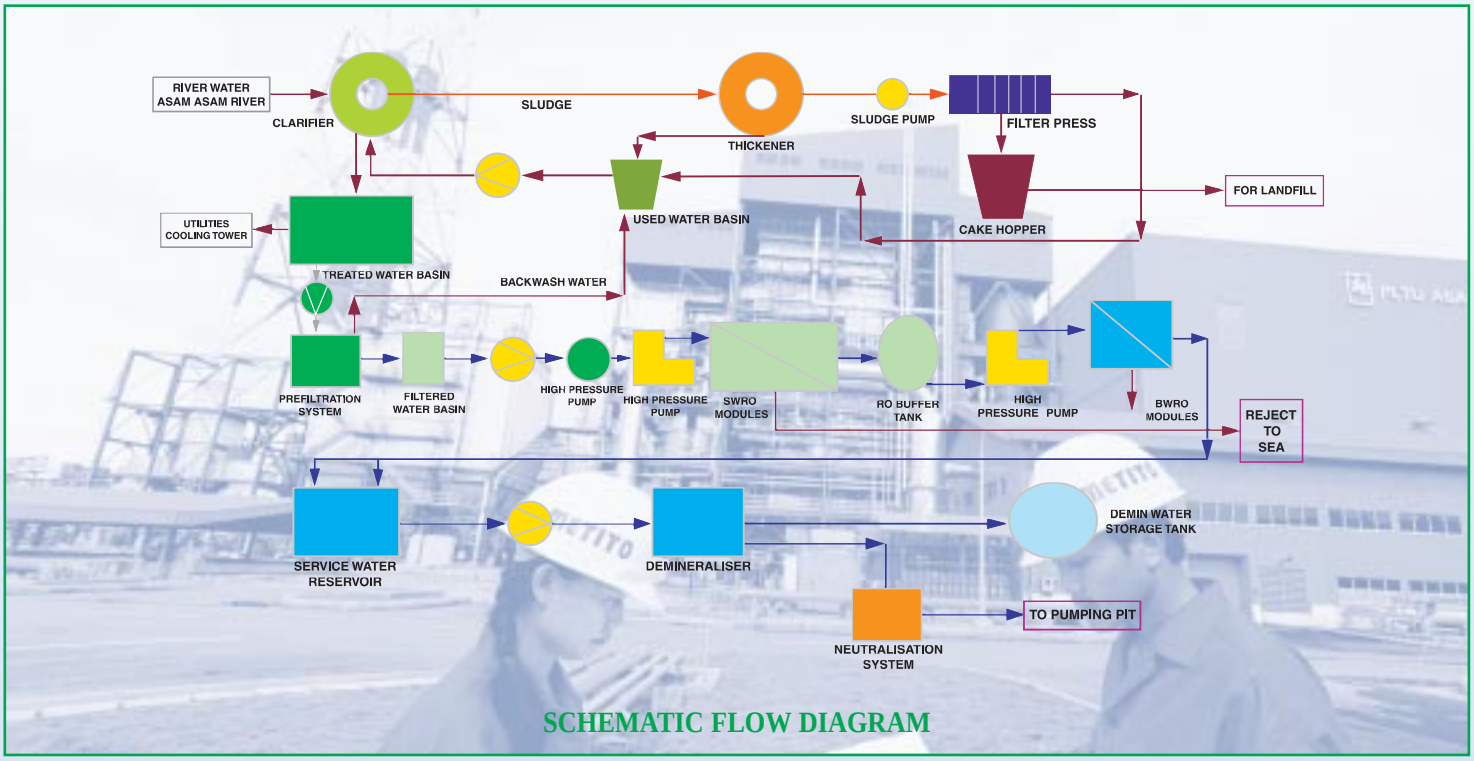
The batch reactor handles all the processing for chemically treating the waste water. The reactor tank mixes, flocculates and clarifies the waste mixture and decants the supernatant for disposal to the sludge thickener equipment.
Chemical solutions are used, such as caustic soda, lime and hydrochloric acid for pH adjustment, polymers for flocculation and ferric chloride for coagulation. After a predetermined period for the reaction to be accomplished, treated waste is discharged for disposal.

Sanitary Drainage and Treatment System

The sanitary treatment system is designed based on extended aeration principle .The treatment system has the capacity to handle a flow of 7 m^3/h, hydraulic load of 168 m^3/day and organic load of 80 kg/day. The main components of the plant comprise sewage lift station, reduction and screening of sewage solids, aeration blowers, diffused aeration supply equipment, final clarification, on-line chlorination, sludge recycle and sludge holding tank. The stored sludge is pumped to the wastewater treatment plant for recovery. The plant is run automatically through a local control panel.

The entire Water And Wastewater Treatment Package has been operating since January 2000.

A CLARIFLOCCULATOR IN OPERATION



SCHEMATIC FLOW DIAGRAM