

WASTEWATER TREATMENT PLANT – KURIEMAT

**WELCOME
TO
WASTE WATER
TREATMENT
PRESENTATION**



WASTEWATER TREATMENT PLANT – KURIEMAT

AIM OF THE PRESENTATION

- To understand Waste Water Treatment Process in general & its application to KURIEMAT Power Plant Station II- 750 MW Combined Cycle Project.

OBJECTIVE OF THE PRESENTATION

To apply the process concepts to treatment plant design & daily plant operation to ensure strict to Treated Water Quality Requirements.



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INTRODUCTION TO WASTE WATER TREATMENT :



DEFINATION

Water which is generated as a by-product from process unit operation having constituents which can cause harmful & hazardous effect to human, animal, plants, aquatic & microbial life / different life forms on the earth.



WHEN DO WE CALL A CONSTITUENT / COMPOUND AS POLLUTANT ?



Presence of which in exceeding conc. can lead to toxic effect. i.e. beyond / above Toxic Threshold Limits (TTL).



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VARIOUS TYPES OF POLLUTANTS PRESENT

- Suspended Solid
- Colloidal Solids
- Inorganic & Organic Salts
- Organic compounds (Solvents, Pesticides, Insecticides, Herbicides, volatile compounds etc.
- Oil & Grease
- Ammonia
- Phosphate
- Heavy Metals
- Cyanide
- Refractory substances resistant to biodegradation. e.g. ABS (Alkyl Benzene Sulfonate)
- Pathogens
- Colour



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PRELIMINARY DATA COLLECTION

- ☐ **Environmental Impact Assessment studies to be carried out.**
- ☐ **Study processes which generate waste water.**
- ☐ **Study the input raw material & compounds .**
- ☐ **Expected in by-product /waste water.**
- ☐ **Assessment of quantity of waste water generated from various sources.**



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PRELIMINARY DATA COLLECTION-Cont.

- ☐ **Measurement / Analysis of various pollutants.**
- ☐ **Production 100% expected date/time from the time of starting of main plant.**
- ☐ **Any future expansion plan.**
- ☐ **Area allocated for waste management.**
- ☐ **Treated waste water & sludge disposal facility or point of discharge.**
- ☐ **Monitoring system.**
- ☐ **Risk Management.**
- ☐ **Occupational Health & Hazards**



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STAGES OF TREATMENT

- STAGE 1** → **Primary Treatment**
- Physico-Chemical Treatment Processes only
- STAGE 2** → **Secondary Treatment**
- Mainly Biological Treatment or in combination with Physico-Chemical Treatment
- STAGE 3** → **Tertiary Treatment**
- Mainly includes disinfection, filtration, chemical oxidation, recovery /recycling systems for reuse
- STAGE 4** → **Sludge Treatment**
- Involving natural or mechanically forced dewatering or drying processes
 - Landfill / composting / Incineration etc.



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DIFFERENT TYPES OF PRIMARY TREATMENT

PROCESS	APPLICATION
Screening	Removal of coarse suspended solids
Grit Removal	Removal of gritty material
Fat Traps	Removal of free oil & grease
Flow Balancing	To check diurnal fluctuation in hydraulic & pollutant loading
Primary Clarification	For removal of suspended solids
Oil Separation	For removal of free & emulsified oil



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DIFFERENT TYPES OF PRIMARY TREATMENT – CONTD.

PROCESS	APPLICATION
pH Correction	Neutralisation or pH adjustment to enhance oxidation / precipitation and or coagulation process
Flash Mixing & Flocculation	To enhance coagulation & flocculation of suspended solids, oil globules
Heating / Cooling	To make water suitable for down stream treatment or discharge
Odour Control	To remove odour producing gases.
Stripping	For VOC, H ₂ S, Ammonia, Cyanide removal



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DIFFERENT TYPES OF SECONDARY TREATMENT

Aerobic Process

- ❖ Generally for BOD conc. below 2500 mg/l.
- ❖ Suspended & attached growth processes.
- ❖ Can handle shock loads.
- ❖ Nutrient removal (N & P).
- ❖ No foul odour.
- ❖ High operating cost.
- ❖ BOD/COD removal efficiencies vary between 50-95% depending upon the process applied.
- ❖ High quantity of sludge production compared to anaerobic process.



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Anoxic Process

- ❖ Generally applied for removal of nitrogen i.e. Denitrification.
- ❖ Suspended & attached growth processes.
- ❖ Requires external source of carbon to carry out denitrification.
- ❖ Low power requirements.
- ❖ Application for domestic sewage or waste waters containing high concentration of nitrogen.



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Anaerobic Process

- ❖ Generally for high BOD conc. > 2500 mg/l or for high flow, low strength waste water /sewage streams.
- ❖ Suspended & attached growth processes.
- ❖ Highly sensitive to shock loads or change in process parameters.
- ❖ Low nutrient removal.



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Anaerobic Process

- ❖ Generates Methane, Hydrogen Sulphide gas which discharged to atmosphere can lead to foul odour.
- ❖ Energy recovery possible offering payback.
- ❖ Low operating cost.
- ❖ BOD/ COD removal efficiencies vary between 40-90% depending upon type of waste & process applied.
- ❖ Low quantity of sludge production with good dewatering characteristics.



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Facultative Growth

- ❖ Generally applied for low BOD/COD conc. waste waters.
- ❖ High foot print area required.
- ❖ Nutrient removal (N& P).
- ❖ Can handle shock load.
- ❖ Can produce foul odour sometimes.
- ❖ Low operating cost.
- ❖ BOD /COD removal efficiencies vary between 40-80% depending upon type of waste & process applied.
- ❖ Sludge digestion in the anaerobic zone of the lagoon / pond.
- ❖ Used generally as maturation ponds.



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COMBINATION OF AEROBIC & PHYSICO CHEMICAL TREATMENT

- ❖ **For removal of refractory organics.**
- ❖ **Adsorption of organics by Activated Carbon using PACT Process.**
- ❖ **For Antifoaming.**
- ❖ **Off gas Treatment.**
- ❖ **High Operating Cost.**



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TERTIARY TREATMENT

Process	Application
Chlorination / Ozonation / UV	For destruction of pathogen & chemical oxidation of organic matter
Filtration (Media, U/F, Micro, Nano)	For removal of suspended solids, oil & organics
Reverse Osmosis	Recovery of water for reuse
Evaporation	To reduce volume / zero discharge
Post Aeration	To increase the dissolved oxygen conc. is treated waste water before discharge to river/ sea.



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SLUDGE TREATMENT

PROCESS	APPLICATION
Thickeners	For concentration of sludge
Dewatering Units	For thickening & dewatering of sludge
Sludge Drying Beds	For dewatering & drying of sludge
Landfill	For energy recovery or dumping of concentrated sludge
Composting	To reduce the sludge quantity & convert into fertilizer / manure value
Incineration	Destruction of sludge / volume reduction or heat generation / recovery



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TYPICAL WASTE WATER TREATMENT EQUIPMENT & ITS APPLICATION

EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Screens	√		
Grit Removal	√		
Grease Traps	√		
Clarifiers	√	√	√
Lamella Separators	√	√	√
Dissolved Air Flotation	√	√	
Induced Air Flotation	√	√	
API Separator	√	√	√



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Aeration Systems	✓	✓	✓
Mixing Systems	✓	✓	✓
Electro Coagulation – ElectroDestruction	✓	✓	✓
Trickling Filters / Biotowers	✓	✓	
Lagoons (Aerobic / Anaerobic / Facultative)	✓	✓	



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Membrane Bioreactors		√	
Anaerobic Filter / Digester		√	
Fixed Bed Biological Reactors		√	
Moving Bed Biological Reactors		√	



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Anoxic Systems		✓	
Strippers	✓	✓	✓
Odour Control Units	✓	✓	
Media Filters			✓



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Ultra Filtration		✓	✓
Micro Filtration			✓
Nano Filtration			✓
Reverse Osmosis			✓



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Electro Deionization			✓
Filter Press	✓	✓	
Belt Press	✓	✓	
Thickeners	✓	✓	



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EQUIPMENT	PRIMARY	SECONDARY	TERTIARY
Centrifuge	√	√	
Evaporators			√
Spray Dryers			√
VOC Incinerators	√		√



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TYPICAL POWER PLANT WASTE WATER GENERATION SOURCES

- ❖ Sanitary Waste Water.
- ❖ Waste Water from Water Treatment Plant.
- ❖ Cooling Tower Blowdown.
- ❖ Cleaning in Process.
- ❖ Boiler Blowdown (Heat Recovery Steam Generator & Auxiliary Boiler).
- ❖ Transformer Area Drain.
- ❖ Fuel Oil Tank Drain.
- ❖ Equipment Drain.
- ❖ Condensate Blowdown.
- ❖ Deaerator .



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APPROACH TO PLANT DESIGN

- ❖ Identification of waste water generating stream.
- ❖ Quantification & qualification (analysis) of waste water.
- ❖ Segregation.
- ❖ Study of flow / waste generation pattern.
- ❖ Provide sufficient hold up time for flow balancing & peak flow handling.
- ❖ Determine the treated water quality requirement.
- ❖ Design a system to treat the waste water & meet the discharge standards.
- ❖ Automation level requirements.
- ❖ Monitoring.



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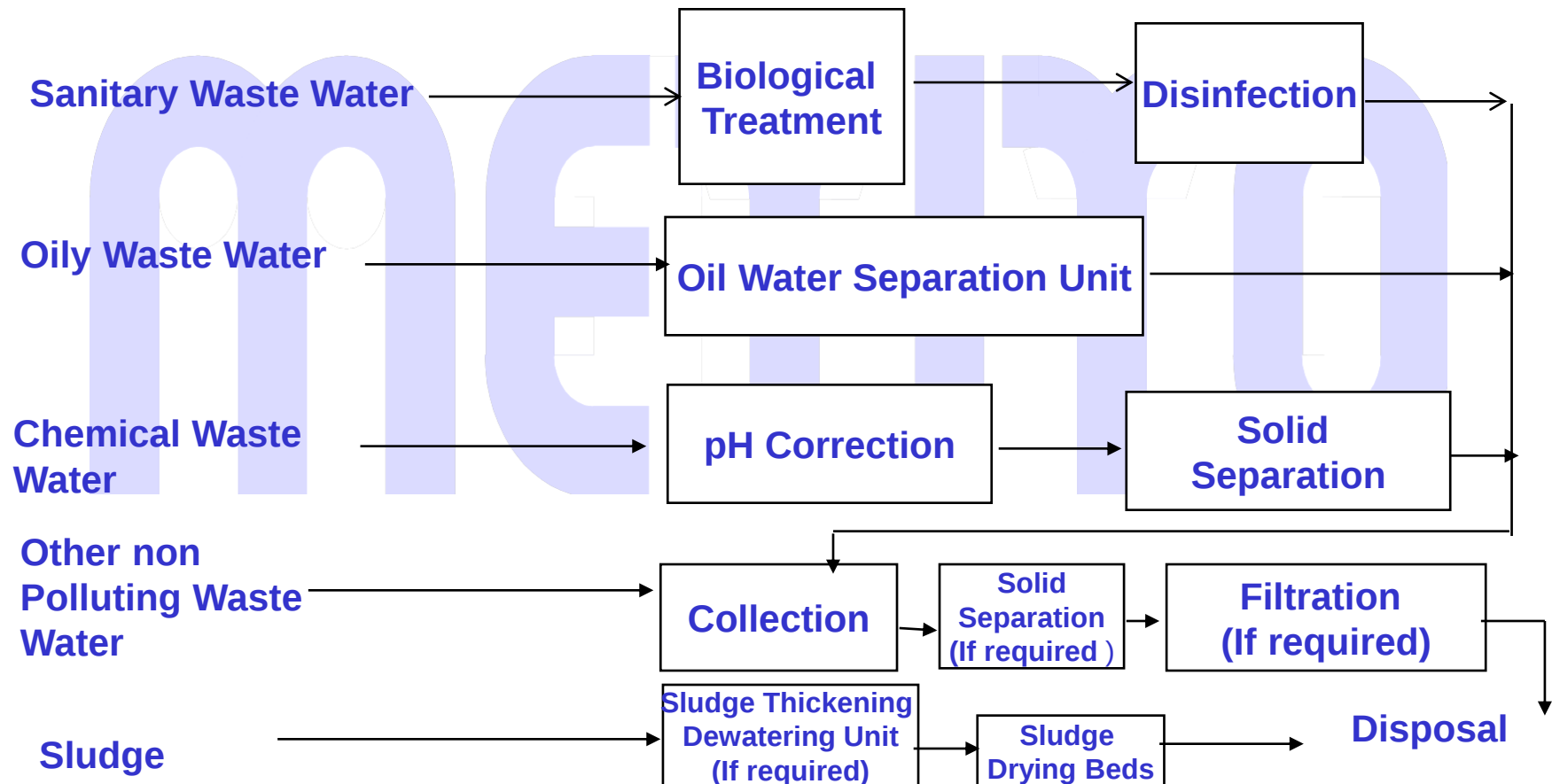
TYPICAL POLLUTANTS IN POWER PLANT WASTE WATER

WASTE STREAM	POLLUTANTS
Sanitary	TSS, Organics, Nitrogen, Oil & Grease, Phosphate
Transformer Area, Fuel Oil, Turbine Drain	Oil & Grease, TSS
CIP	pH, TSS
Water Treatment Plants	pH, TSS
Boiler & Cooling Tower Blow Down	pH



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TYPICAL TREATMENT PROCESSES EMPLOYED FOR POWER PLANT WASTE WATER



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CLARIFIER

Type	:	High Rate Solid Contact Type
Flowrate	:	60 m ³ /hr each
Nos.	:	2 Nos. (1 duty / 1 standby)
Total flow	:	60 m ³ /hr
Inlet TSS	:	200 mg/l
Sludge Qty	:	15 kg/hr (max.) on dry solid basis
Sludge		
Concentration	:	1%
Sludge Production:		1.5 m ³ /hr



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TYPES OF SETTLING PHENOMENA

TYPE	DESCRIPTION
Discrete Particle	Sedimentation of particles in suspension of low solid concentration. Particles settle as individual entities. No significant interaction with neighboring particles.
Flocculant	Dilute suspension of particles that coalesce or flocculate. The particles increase in mass and settle at a faster rate.
Hindered /Zone	Suspensions of intermediate concentration, in which inter particle forces are sufficient to hinder the settling of neighboring particle.
Compression	Particles are of high concentration that a structure is formed & further settling can occur only by compression of the structure.



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SETTLING REGIONS FOR ACTIVATED SLUDGE

- ❖ **CLEAR WATER REGION**
- ❖ **DISCRETE SETTLING REGION**
- ❖ **FLOCCULANT SETTLING REGION**
- ❖ **HINDERED (ZONE) SETTLING REGION**
- ❖ **COMPRESSION REGION**



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FEATURES OF HIGH RATE SOLID CONTACT CLARIFIER

- ❖ Advanced type of clarification unit.
- ❖ Suitable for low inlet solid application.
- ❖ Low TSS at the outlet of clarifier.
- ❖ Internal sludge recirculation.
- ❖ Built in flocculation zone.
- ❖ Low chemical consumption.
- ❖ High surface loading (1.8-2.4 m/hr).
- ❖ Less foot print area.
- ❖ High sludge consistency.



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FILTRATION SYSTEM

Type	:	Gravity Sand Filter
Flowrate	:	60 m ³ /hr each
Nos.	:	2 Nos. (1duty/1standby)
Nos. of cells each filter	:	2 Nos.
Filtration rate	:	5.0 m/hr
Area of each filter	:	12 m ²
Area of each cell	:	6 m ²
Backwash rate	:	30 m/hr (Typical 24-36 m/hr)
Air scour rate	:	50 m/hr (Typical 40-60 m/hr)
Type of media	:	Anthracite / Sand
Media depth	:	300/200



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FILTRATION PHENOMENA

- ❖ Surface Filtration
- ❖ Depth Filtration



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TYPES OF FILTRATION MECHANISM OPERATION PHENOMENA

TYPE	DESCRIPTION
Straining Mechanical	Particles larger than the pore spaces of the filtering medium are strained out mechanically.
Chance Contact	Particles smaller than pore space are trapped within the filter by chance of contact.
Sedimentation	Particles settle on the filtering medium within the filter
Impaction	Heavy particles will not follow the flow stream lines



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TYPES OF FILTRATION MECHANISM OPERATION PHENOMENA

TYPE	DESCRIPTION
Interception	Particles moving along in the stream line are removed when they come in contact with the surface of filtering medium.
Adhesion	Flocculant particle attach to the surface of filtering medium



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TYPES OF SETTLING PHENOMENA

TYPE	DESCRIPTION
Adsorption	Physical or chemical. Particles when in contact with filtering media are removed by either process.
Flocculation	Large particles overtake smaller particles to form large particles (flocculations) & are removed in filtering medium.
Biological growth	Biological growth within filter will reduce the pore volume & may enhance the removal of particles



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FEATURES OF GRAVITY FILTER

- ❖ Removal of suspended solids upto 5 microns.
- ❖ Backwash water requirement depends upon media size, media depth, temperature of backwash water.
- ❖ Garnet of 0.2-0.6 mm size can remove suspended solids upto 1 micron.
- ❖ Anthracite can remove oil.
- ❖ Head loss depends upon filtration rate. High filtration rate leads to higher pressure loss through bed.
- ❖ Particle Removal Efficiency.

20 micron	:	99%
10 micron	:	98%
5 micron	:	90%
- ❖ Treated water can be reused for secondary purpose.
- ❖ Pretreatment to RO plants.

