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Primary Survey and Structural Design of Lamella Clarifier Based Water Treatment Plant for Raigarh City

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Abstract: ***It is necessary to utilize a clarifier when the wastewater contains a significant amount of particles that must be filtered out. It works by allowing particles to fall to the bottom of a plate and flow freely past as they settle. Adding polyelectrolyte and coagulant may speed up this natural process of settling. In contrast, coagulants neutralize charges and conglomerate solids into micro-flocs as a result of the polyelectrolyte. Fine filtration, assisted by the use of lamella clarifier settler, or the use of microorganisms, which consume organics as a source of energy, are two common methods of chemical treatment.***
Keywords: Raigarh City, Clean India, Sewage Lamella, Clarifier, Water Treatment Plant, Tube settler clarifiers.

I. INTRODUCTION

Raigarh is an Indian State of Chhattisgarh town and a municipal corporation in the Raigarh District. It is renowned for its coal deposits and electricity production both for the state and the nation as the administrative center of the Raigarh district. Raigarh is also the most significant steel and iron ore manufacturer and Chhattisgarh's industrial and cultural center. Jindal Steel and Power Limited is a sizeable Raigarh-based steel mill and is recognized primarily for this facility.

Raigarh is situated at 21 degrees 53 '51.02' N& 83 degrees 23 '41.46' E. It is 215 meters high on average (705 feet). The river Kelo is one of its major water sources and runs through the town. This study provides an overview of early research on the present condition of Kelo River Raigarh in the city and the necessity for a district Water Treatment Plant.

The first system was established in 1930 at Raigarh, under the British era. In 1967 afterward was an increase in the water supply system. In 1971-1972, 9,54 MLD water delivery systems commission under the Raigarh water supply project. Once again, the population and demand in Raigarh have risen lately in this water delivery system. The latest increase in water is 17.0 MLD and initiated in 2015.

Raigarh is a leading district spanning 46.54 sq. km of the surface. The topography and demographics of the city split into five sections, and the five zones are mentioned below for equal distribution of water.

1) Zone-1: Chakradhar Nagar.
2) Zone-2: Jute Mill.
3) Zone-3: Kotra Road.
4) Zone-4: Circuit House.
5) Zone-5: Central Zone.

Tube settler/ Lamella clarifier should manage the design flow rates provided. Lamella clarifier is a kind of colon intended to remove particles from fluids. The settler is a type of platform settler.

Instead of traditional settling tanks, they frequently are used for primary water treatment. It is used to purify industrial water and also utilizes several inclined plates in contrast to traditional clarifiers. These slanted panels offer a vast and efficient settlement area for a small size, on entering the clarifier, the input stream quench. Solid particles start settling on the plate and build up at the bottom of the clarifier unit to collect hoppers. The sediment pulls on bottom of hoppers, and the cleared liquid leaves the unit over a weir at the top.

Primary and secondary waste treatment systems remove before the water is sanitized and discharged into local rivers, 85 to 95 percent of wastewater pollutants are removed. It is more suitable to use standalone wastewater treatment equipment, such as lamella clarifiers for the effective removal of solids and should explore to optimize solids recovery.

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II. LITERATURE REVIEW

Byonghi Lee (2015) In the Korean Government's Water Works Standards, inclined plates insert into a clarifier to improve the solids in suspension. In this research, two identical rectangular clarifiers of laboratory size creation and eight inclined plates are put inside one of the clarifiers to validate the function of the inclined plates. Both clarifiers handled the inflow from the same source. Dye testing showed that only three front of the seven pitches got the maximum SOR input of 0.57 m3/m2•hr (surface overflow rate). Three different SORs were supplied for both clarifiers, with 12 different SS concentrations at each overflow rate. In addition, an influx of contact with the settled sloud must avoid at the bottom of the clarifier. These measures that may enhance the impact of boycott should include in Korean government-approved standards for water work.

Lan Liu, Michael A. Perez and J. Blake Whitman (2020) The quality management of Stormwater has been a subject of growing importance. This study aims to discover and optimize lamella settler systems configurations designed to treat a range of synthetic soil. Five different kinds of synthetic soils suspended at 500, 1000, and 5000 mg/L concentrations in simulated rainwater have been treated using system configurations for three 0.5, 1.0, and 1.5-hour residency reactors. Statistical analysis using a complete factorial approach followed by regression analysis and variance (ANOVA) analysis indicated between the experimental variables and degrees of turbidity. An optimized lamella colonizing reactor with an area of 1.8 cm (0.7 in.) with 1.5 hours of residency decreased up to 90 percent less turbidity than a control reactor without lamellae with a residence duration of 0.5 hours. Moreover, research for the particle size distribution revealed a decline of up to 84% in the D90, showing that the improved rector captures big soil particles in diameter.

A Yulistyorini et. al. (2019) The quality management of Stormwater has been a subject of growing importance. This study conduct to discover and optimize lamella settler systems design configurations to treat a range of synthetic soil. Five different kinds of synthetic soils suspend at 500, 1000, and 5000 mg/L concentrations in simulated rainwater treat using system configurations for three 0.5, 1.0, and 1.5-hour residency reactors. Statistical analysis using a complete factorial approach followed by regression analysis and variance (ANOVA) analysis indicated between the experimental variables and degrees of turbidity. An optimized lamella colonizing reactor with an area of 1.8 cm (0.7 in.) with 1.5 hours of residency decreased turbidity by up to 90 percent compared to a lamella free control reactor with a residence duration of 0.5 hours. Moreover, research for the particle size distribution revealed a decline of up to 84% in the D90, showing that the improved rector captures big soil particles in diameter.

Chee Yang Teh, et al. (2016) Increased environmental consciousness and higher regulatory requirements have prompted many sectors to challenge themselves to discover adequate solutions for wastewater treatment. The coagulation-flocculation process has limitations and challenges, Toxicity and health risks associated with inorganic coagulants. A large amount of toxic sludge is produced, as well as poor removal of heavy metals and emerging pollutants. Effluent colour is also enhanced, and pollutant elimination is inefficient due to natural blockage. This review also provides an overview of the impact on therapeutic efficiency of process factors. Finally, this evaluation ends with changes and new guidelines for this long-standing procedure.

Sofyan M.S. AL-DULAIMI and Gabriel RACOVITEANU (2018) Sedimentation tanks are the most important component of wastewater treatment facilities. Construction costs for conventional tanks may account for up to 30% of the total cost of the plant's overall cost and sedimentation tanks, covering quite broad regions. They need much less area than traditional sedimentation tanks in addition to their excellent efficiency. The recent research design assesses the tube settler's performance and the impact of tube settler inclination on wastewater quality. In the practice tests, the tube settlers employ at various inclination angles of 48, 54, and 60 degrees. They were composed of four distinct circular tubes with a 27 mm inner diameter. For this aim, the Colentina Laboratoire Complex-UTCB has developed and built a prototype after the sedimentation unit, coagulation-flocculation is the model to be used.

III. METHODOLOGY

A. Chemical Treatment

Primary lamella clarifier, ozone dose, aeration tank 1, aeration tank 2, and secondary lamella clarifier.

1) *Primary lamella clarifier:* A settler(IPS) lamella clarifier is a kind of settler intended to remove particles from liquids. You are using several panels. These slanted panels offer a vast and efficient settlement area for a small size, on entering the clarifier, the input stream quench. Solid particles start settling on the plate and build up at the bottom of the clarifier unit to collect hoppers. At the bottom of the sludge, the clear liquid is taken out and at the top leaves the unit. A lamella clarifier should use to clarify design parameters. The clarifications are for average and peak flow conditions to be designed/checked.

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The loading rate of the tube settler on the effective surface area has to establish.

Designed flow maximum	80 MLD
Flash mix. Tank volume	18 m^2
Flocculation tank volume	338 m^2
Total pre- treatment volume	95 – 98 Ltr.
Effluent piping connection	50 mm dia & 150 mm flange
Solids discharge connection	50 mm dia & 150 mm flange
Sludge capacity	158.76 Ltr.
Plate area	3.62 m^2
Liquid volume	669.06 Ltr
Retention time @ maximum flow rate	18 minutes
Designed solids removal	95+ % @ 200ppm infuluent
Under flow solids	1-2 % solids

Location	After bio digester
Application	To removes solid particulates or suspended solids
Capacity	Suitable to handle 5 kld
Description	With Tube setting and collection compartments withsludge withdrawal system
MOC	MS With Under Lining FRP

2) *Ozoneter:* Waste ozone is an increasingly common technique of treatment. An ozone generator is employed using UV light or an electric field to remove contaminants from the water supply. The generators transform the oxygen into ozone. *Ozone* is a highly reactive gas that may oxidize water contaminants, mold, and organic materials. Ozone offers numerous advantages for treating wastewater:

a) Towards the efficient killing of germs.
b) Oxidizes compounds such as iron and sulfur to remove them from the solution.
c) The treatment generated no fading odors or residues.
d) Ozone rapidly returns to oxygen, leaving no trace after being utilized.

The inconvenience of ozone as a wastewater treatment:

- Treatment in the form of electricity needs energy; this may cost money and cannot function when electricity is lost.
- No dissolved minerals and salts may be removed from the treatment.
- The treatment of ozone may sometimes generate by-products such as bromate that may damage human health unless managed.

	Ozoneter
Location	Near Clarifier
Application	To dose the ozone
Capacity	5 gm
Type	Electronic

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3) *Aeration for MBBR1-MBBR2:* It is ideal for providing a blending pattern that allows for a complete blending of the medium throughout the entire depth, breadth, and length of the volume of the reactor and for media to float on the tank surface or at the basin corners. The aeration diffusion is done using fine bubble diffusers or gross bubble diffusers or by the arrangement of hollowed pipes or all this together. The necessary air amount must be appropriate for the aerobic biodegradation of the organic input in order to provide oxygen. Positive shift, air blower root type must provide with the air. Blowers must have a backup arrangement of at least 50%. No less than 1.2 kg of O2/kg of BOD must eliminate oxygen demand for BOD removal. To maintain the minimum 2PPM essential dissolved oxygen is adequate air amount necessary. The field correction parameters for alpha are computed for oxygenation not exceeding 0.95 and beta not exceeding 0.65. The air provided is adequate to keep the bio-media thoroughly mixed and floated.

4) *MBBR System:* Minimum 2 Nos. MBBR reactors based on the associated biological stabilizing growth process must be available. Reactor and bio media design para meters should be as follows: -

Design Parameters

Average Flow	-	5 KLD
Peak Flow	-	12 KLD
No of Reactors	-	Min 2 Nos
Operation of reactors	-	preferably in series
Minimum HRT(combined for all reactors)	-	3-4 hrs of Avg flow
DO level during aeration face	-	Min 2 ppm
Free Board	-	Min 0.5 m

During the peak drainage time, the reactor also takes care of the organic load.

a) Required by-pass reactors consider for maintenance periods

b) Wastewater from each reactor evaluates for maintenance.

5) *Bio Media*

The specification of Bio media is as under: -

Material	Polypropylene/Polyethylene, non-degradable and UV stabilized from virgin material
Specific gravity	0.95 -0.98 gm/cm3
Effective surface area formicrobial attachment	To be proposed by the bidder. Maximumallowed v alue for design is 400 m2 / m3
BOD loading on media	
Ist stage reactor	Not more than 300gm/m2 of effective area/day
2nd stage reactor	Not more than50gm/m2 of effective area/day
Media Volume	Not less than 20% of the basin volume
Location	Under aeration tank 1-2
Application	For connecting air diffusers for diffused aeration)
MOC	MSEP/GI
Accessories	Complete accessories

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c) *Twin Lobe Rotary air Blower:* The package must include driving guards, vibration insulating bases, pressure gauges, temperature gauges, temperature switches, inlet filters, and inlet silencer valves, pressure relief valve valves, valve connection tubing: complete blower unit, and the engine placed on a shared base plate. A strong air supply capacity must provide via blowers. Duty- and standby blowers should rotate as required in the control system. The motor must have a 415 volt, 3-phase, and 50 Hz power supply with a TEFC enclosure. Cast-iron wavy valves with a disc of bronze or stainless steel must be insulated butterfly valves. The amount of noise from the blower at 1,00 m is less than 85 dB. The bidder must design a coarse bubble aeration system such that the minimum air demands are met according to the specified standards needed for mixing and ventilation in Eq. tanks. The wastewater prevents the aeration system from becoming spectacular and odorous. For optimal mixing and supplying oxygen, COD/BOD biological oxidation requires oxygen in the MBBR reactor. Bidders shall develop a complete diffusion aeration system for fine bubbles with air blower capacity to fulfill the needs.

Location	Near the Aeration Tank
Application	Supply of air in aeration tank
Capacity	10 m3/hr
Pressure	.3 kg/cm2
MOC	

d) *Primary Aeration Tank MBBR1*

Location	After collection sump Tank
Application	To removes solid particulates or suspended solids
Capacity	Suitable to handle 5 kld
Description	With Tube setting and collection compartments withsludg e withdrawal system
MOC	MS With Under Lining FRP

All additional technical information included in the section concerned.

e) *Secondary Aeration Tank MBBR2*

Location	After Aeration Tank mbbr1
Application	To removes solid particulates or suspended solids
Capacity	Suitable to handle 5 kld
Description	With Tube setting and collection compartments withslud ge withdrawal system
MOC	MS With Under Lining FRP

All additional technical details in the appropriate area are mentioned above.

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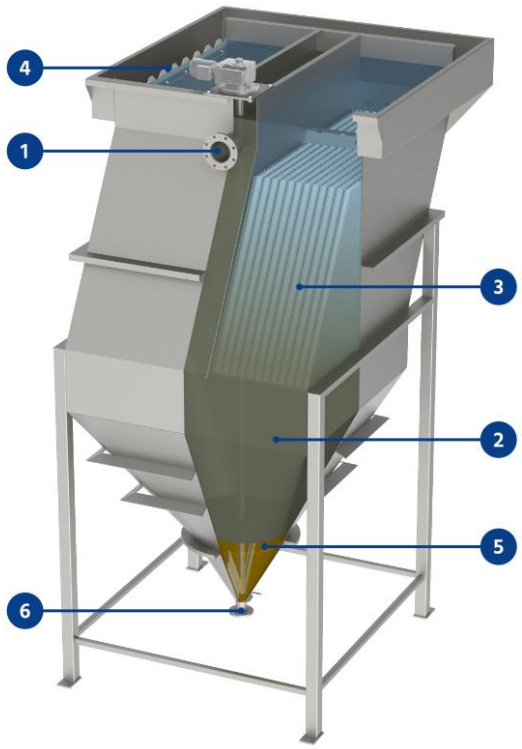
f) Secondary Lamellar Clarifiers

Location	After Aeration Tank MBBR2
Application	To removes solid particulates or suspended solids
Capacity	Suitable to handle 5 kld
Description	With Tube setting and collection compartments withsludge withdrawal system
MOC	MS With Under Lining FRP

All additional technical information mentioned in the corresponding section.

B. Functional Principle Of The Lamella Separator



A pressurized system is a lamella separator—the water push into the intake of the clarifier, where it falls or flows by gravity. The flow is reversed under the lamellae and runs through the lamellae. At now, the solids are placed against the lamellae.
The water runs up and through a customized overflow weir to the outflow. The solids rush down the lamellae and shrink to the sludge. A scraper may be added to the region of the funnel tip to keep the slot flowing. The sludge is constantly or continuously eliminated depending on the following process stages.

IV. CONCLUSION

One advantage of lamella clarifiers in waste treatment plants is the little maintenance they need, and their smaller number of movable components make them simple to maintain. The simplest method to clean the clarifiers is to empty them and remove any surplus accumulation from the plates and cones. The pumps and mixers should also routinely inspect to guarantee their optimum operation. Lamella clarifiers may be understood most easily.

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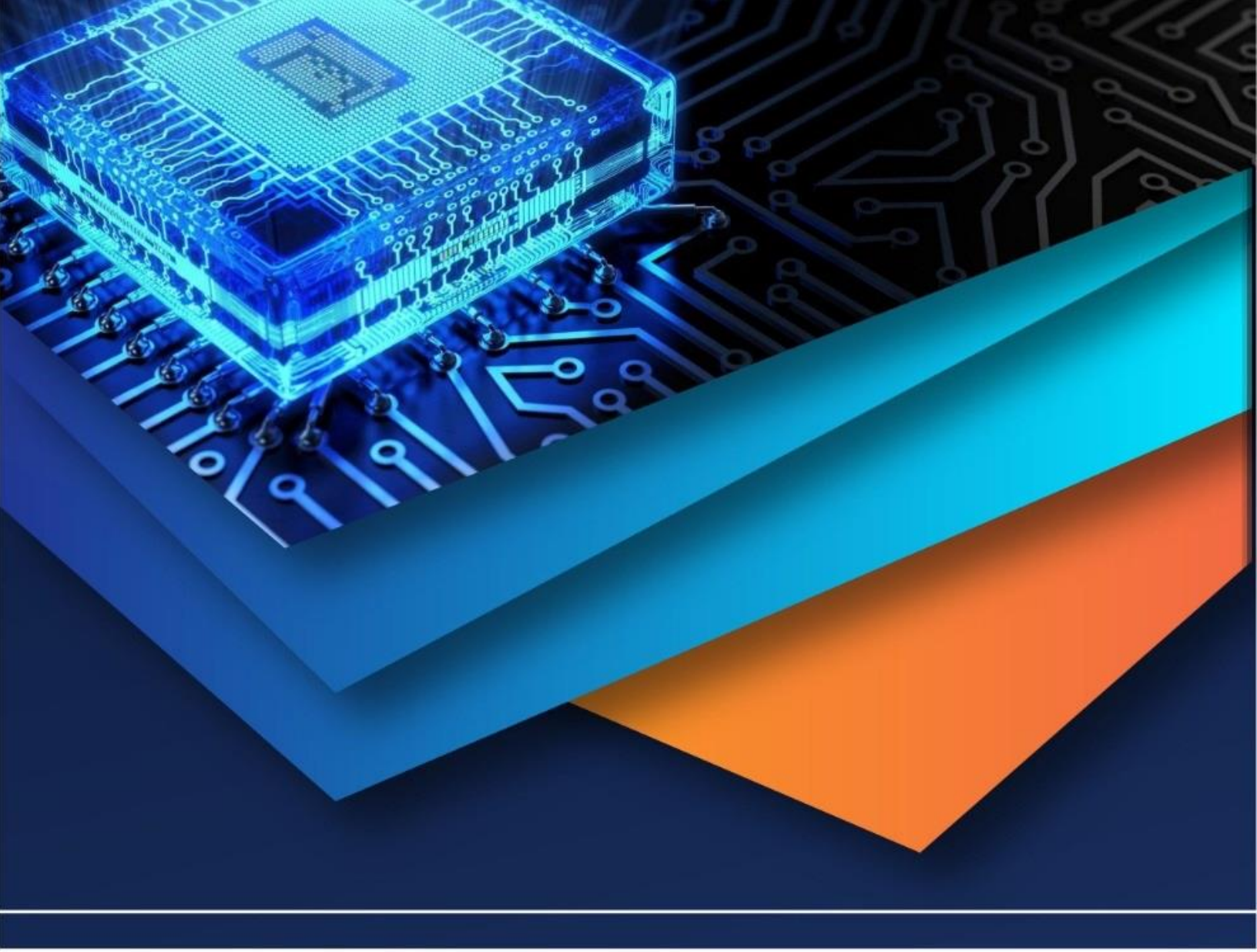

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