

An aerial photograph of a water treatment plant. The image shows several large circular clarifiers with floating scrapers, numerous rectangular aeration basins, and several large blue cylindrical storage tanks connected by a network of pipes. The facility is surrounded by green grass and some industrial buildings.

Water Treatment Plant

Components and functions

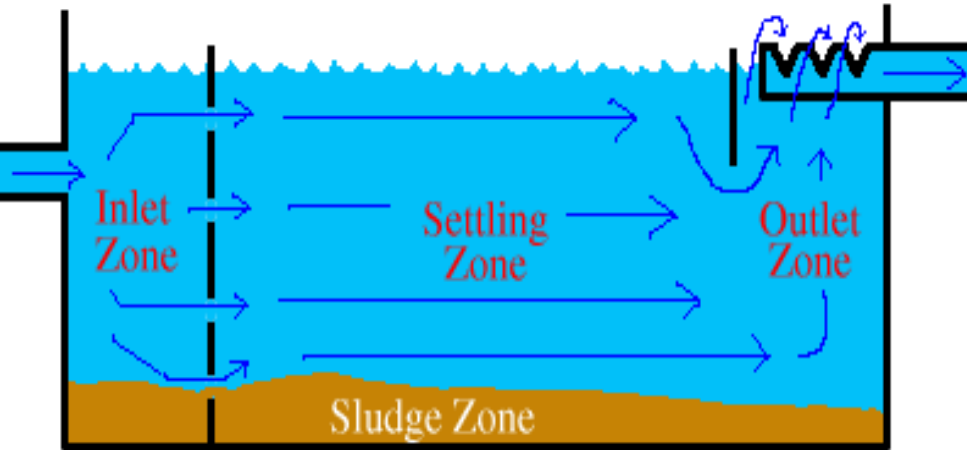
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Aeration



- *Brings Water and Air in close contact. Water is drawn from the source through central shaft and falls over cascades also called water fall aerators. Water is allowed to flow downwards after spreading over series of steps in thin sheets.*
- *To control Tastes and Odors. When water is aerated it dissolves or liberates Gases, Dissolved gases such as Hydrogen Sulphide caused due to de composition of organic matter which causes tastes and odors.*
- *Removal of CO₂ varies from 20 to 45 % and H₂S up to 35%.*
- *Maintenance – Periodical cleaning of algae deposits with bleaching powder.*

Stilling Chamber



➤ *A Stilling Chamber is a rectangular or circular chamber having two Compartments. It is specially designed to allow the liquid flow rate to decrease the entrapped gas can rise to the surface, degassing the liquid. It is called stilling chamber because the liquid is allowed to be relatively motionless.*

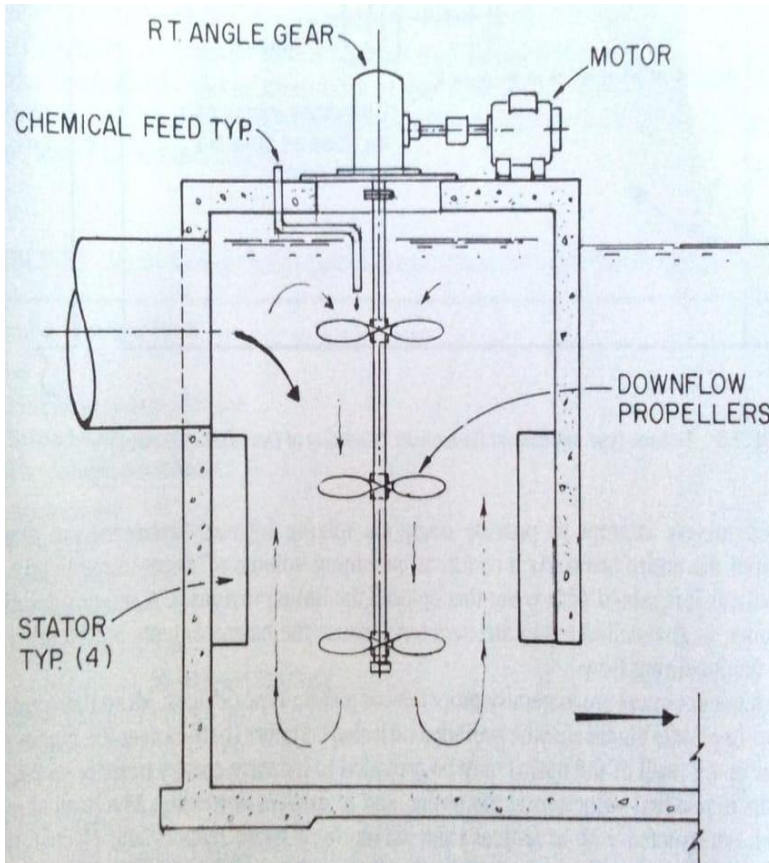
Coagulation & Flocculation

- *Coagulation is a process to neutralize charges and then to form a gelatinous mass to trap or bridge the particles thus forming a mass larger enough to settle or trapped in the filter.*
- *Principle of Flocculation is aggregation and Binding together of Colloids. It is process of Reduction / Removal of Turbidity caused due to the presence of Suspended Solids like silt, clay, finely divided organic and inorganic matter and Micro organisms.*
- *Flocculation is gentle stirring or agitation to encourage the particle to agglomerate or to join together into masses large enough to settle or be filtered from solution.*
- *The size of these particles is 1 to 10 microns.(1000 microns = 1 mm). Colloidal particles in water smaller than 10 microns are difficult to remove by simple settling or by filtration.*

Coagulation & Flocculation

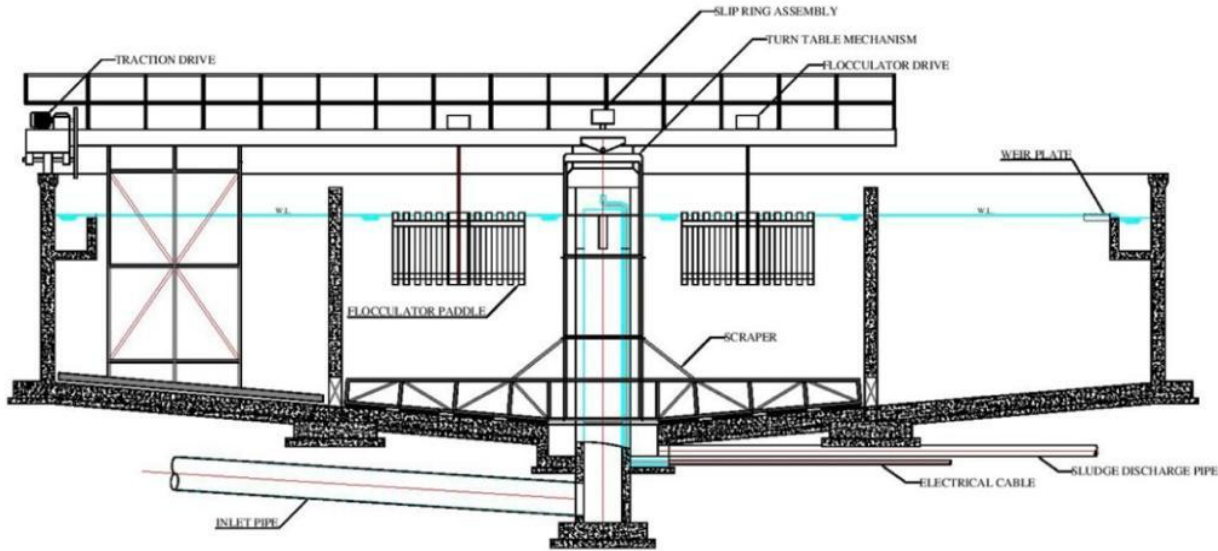
- *Turbidity causing Organic and Micro Organisms which are Suspended Solids has –Ve Charge, Since all of them have same Charge they repel with each other and remain in Suspension and will not Clump or Attract or Join and settle down.*
- *Hence Coagulant having + Ve Charge is added to Neutralize non settable Solids and to attract and form Bigger Flocs.*
- *Coagulant Recommended is Ferric Aluminium Sulphate Octadecahydrate ($Al_2(SO_4)_3 \cdot 18 H_2O$). IS: 299 – 2012 – Grade – IV in Solid form. Grade I & II are in solid form, Grade III is in liquid form, Grade V in liquid form. Grade IV & V are recommended for Drinking Water Purification.*

Flash mixing



- *Mechanical flash mixers are utilized for homogeneous of chemical into water and to facilitate formation of Micro Flocs.*
- *Once the charge is neutralized small suspended particles stick together and form slightly larger particles called Micro Flocs. A high energy Rapid Flash Mixers with paddles are provided in the system having RPM of 100 to 120 to achieve homogenization of Coagulant and to facilitate formation of Microflocs. This is called Peri Kinetic Flocculation.*
- *Charge neutralization occurs very rapidly during rapid mixing results in formation of micro flocks which enter flocculation zone of CFL.*

Clariflocculation



Clariflocculation

1. Flocculation zone

- *Flocculation is a gentle mixing stage in flocculation zone having paddles rotating at 8 to 12 rpm. During this gentle mixing process the particle size increases from sub microscopic to micro and macro flocs visible whose size may be 2 to 100mm. The detention time varies from 20 to 45 minutes. During this period these particles become bigger and settle down and move towards bottom and enter Sedimentation zone where the detention period is 1 to 4 hours.*

Clariflocculation

2. *Sedimentation zone*

- *Sedimentation is the process of separation by gravity / gravitational settlement of suspended particles heavier than water. Sedimentation tanks are designed for a detention period of 2.5 to 4 hours. Surface loading shall be 30 to 40 m³ / m². The efficiency of sedimentation tanks depends upon the factors such as turbulent flow and temperature gradients. The loading shall be uniform across the tank and flow shall be uniform into the open channel or launder.*

Clariflocculation

2. Sedimentation zone (Continued)

- *Sedimentation is very important process as this unit prepares the water for further process of filtration. The operation and control of this unit is therefore very necessary to feed properly prepared water on to the filter units. Imperfect performance of sedimentation tank will shorten the length of filter runs, washing would become difficult and consequently the quality of filtered water will deteriorate. If water is properly settled through a well engineered sedimentation process the turbidity should be under 10 NTU and the RC of effluent water shall be 0.5 to 1.0 ppm.*

Clariflocculation

3. Sludge Removal

- *The tanks are equipped with revolving bridges with slopes of 1 in 12 and in case of manual it can be 1 in 10. The scraping mechanism is rotated slowly to complete one revolution in about 30 to 40 minutes or the scrapper velocity shall be 0.3m / min or below.*

Filter House



- ***The standard rate of filtration recommended in CPHEEO manual is 80 to 100 lpm/m² (4.80 to 6 m³ /m² /Hr). The maximum area recommended for each unit is 100 m² for single unit and plants exceeding 100 MLD may have to halves each of 50 m². In order to have flexibility of operation a minimum of four units are recommended. Filters are generally designed for 20% or more overloading in order to avoid overflowing during back washing.***
- ***Raw water shall be drawn into the filter beds under immersed condition of the inlet valve to avoid disruption of flocs.***

Filter House



- *Constant head of 1.5 to 2.0 m to be maintained in all beds under all water drawl conditions. All beds shall be in operation under all water drawl condition except during back washing.*
- *Rate control valve shall be operated to ensure constant head over the sand media for effective filtration.*
- *The minimum filter run rate shall be 24 hours and not less than 24 hours.*
- *Filters shall be declining rate type with filtration rates varying +20 % and -20 % of the average over filter run length. When the filter is clean the filtration rate shall be at least 20% above average and at the end of filter run rate it can be 20% below the average.*

Back Washing



- *The filter shall be washed when the head loss of -20% is attained or flocs starts to break through the filter or when the turbidity increases or filter run reaches a given hour of operation or if the filter is taken out of service for maintenance or some reasons it must be back washed prior to putting back into service. Some filters of very good quality can run for very long period for 6 to 8 days before needing to be back washed. However it is not recommended as long filter run can cause the filter media to pack down and will be difficult to expand the bed during back washing (36 to 48 hours) is recommended.*

Back Washing

- *Ensure that there is sufficient water is present in the wash water tank before back washing. Washing of filter is to be done only with clean filtered water having at least 0.5 to 1.00 of RC.*
- *Close the inlet valve and allow the water level on the top of the sand media to drop till it reaches a point just 15 cms or 6 inches above the sand.*
- *Open the drain / scour valve.*
- *Air shall be forced at the rate of 0.6 to 0.9 m³/m²/minute of the filter area with air pressure of 0.35 kgs/m² so as to facilitate sand expansion of 130 to 150 % of its volume for 5 minutes. Air blowers shall be adjusted accordingly.*
- *Followed by water wash is applied with at least 5 mts headslowly for about one minute to permit removal of entrapped air from the filter media with wash water having 0.5 to 1.0 ppm of RC at the rate of 400 to 600 lpm/m² for 6 to 10 per standards.*

Back Washing

- *Ensure that flooding of wash water trough shall not happen – or carryover of filter media shall not happen and then reduce the backwash rate. Fall of wash water into the trough shall be uniform across the bed and where ever it is uneven the edges shall be ground for achieving uniform back washing.*
- *If the pre treatment is effective the quantum of water required shall be 1 to 2.5% of the filtered water. If it exceeds 2.5% it indicates the need to investigate for correction of sand media.*

Chemical House



- *Chemical house shall be constructed with a storage area to accommodate alum required for 90 days. At least 3 tanks shall be provided each with capacity to hold solution required for 8 hours of operation (Shift) requirement of maximum demand of chemical at design flow rate.*
- *Alum is to be dissolved in tanks with perforated trays to hold the lumps of alum. Solution flows into the bigger storage tank.*
- *Adequate scour arrangement is to be made is to be provided to each of the tanks for cleaning the tank for flushing out the insoluble residue after emptying and before recharging.*
- *Bigger tanks are equipped with mechanical stirring devices (Flash Mixers) for mixing the chemical before releasing for dosing.*
- *Electrically driven Chemical feeding pumps of reciprocating type having variable speeds are employed for feeding the chemicals. Different speed pulleys are provided with stroke adjustment device having variations from minimum to maximum during pumping.*
- *Acid resistance anti skid tiles shall be provided to the storage area.*

Disinfection: Chlorination



Disinfection: Chlorination

- *Chlorine is being used as disinfectant for the last 170 years and found to be most effective and economical in water treatment for disinfection.*
- *Pathogenic organisms and many other bacteria are killed by its use.*
- *Gaseous chlorine is greenish yellow in colour and is 15 times heavier than water and 2.5 times heavier than air.*
- *Liquid chlorine is vaporized in order to be withdrawn as gas this tends to reduce its temperature and thereby its vapour pressure. Hence only 1% of its volume shall be drawn from the tonner. Excessive drawl results in over cooling of tonner resulting information of frost on the outside of the container.*

Disinfection: Chlorination

- *In order to achieve good results the solution dosing pipe with perforations must be immersed in the water.*
- *Contact period of at least 15 minutes between point of chlorination and the point of supply to the last consumer is available.*
- *Tonnners shall be stored horizontally, slightly elevated from the floor level and blocked to prevent rolling duly supporting both ends of the containers on rails or I beams.*
- *Full and empty tonners shall be stacked separately in single row.*
- *Exhaust fans shall be provided at the bottom to the floor level*
- *When leak occurs first chlorine container valve shall be closed.*
- *Cylinders and Tonners should be stored in cool place away from direct heat and exposure to sun.*
- *Shall be governed as per Gas Cylinder Rules – 1981 of Central Government.*



**SAVE
WATER**

**Thank
You**



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