

# Engineering Checks for the Water and wastewater treatment plants

The following tables show how to check for important engineering aspects , Each table describes checks for a particular stage  
 The methods of checking are as follows:

Code	Method	How to check
V	Visual	Check for presence (or absence) of the indicated feature
M	Measurement	Measure the indicated dimensions and compare against specified limits
T	Performance Test	Conduct a test and compare the results against the specified limits
D	Documentation Check	Check in drawings and calculations

## Preparation

no	Item	Check	Acceptance criteria	Method	Category	Rationale
1	Design verification	Very against design	All dimensions must be as per design - All deviation must be reviewed and approved	M	Mandatory	Before scanning the for engineering aspects, the entire process-chain must be verified against the design, so that we do not end up wasting energy only to realize that it is inadequate in the first place
2	DG backup	Sufficient DG backup	Min required backup power = combined power for all units + 20% margin , (for working only )	M	Mandatory	This is a continuous process. If aeration breaks down for over an hour, all bacteria may die. If pumping stops, the tanks may overflow. Thus uninterrupted power is essential

## Bar Screen

sno	Check	Acceptance Criteria	method	Category	Rationale
1	Chamber	The manhole (or the opening from where the debris is	V	Mandatory	Must allow safe and hygienic way of collecting and disposing

	location	removed) must not lie in a public area.			off the debris.
2	Accessibility	The top of the screen must not be more than two feet below the operating floor level. Best efficiency can be achieved if waist-level access is provided to the chamber.	V	Mandatory	If access is not easy, the chamber will not be cleaned as frequently as needed
3	Screen inclination	The screen must be inclined (Recommended inclination: 45° to 60°)	V	Mandatory	The bar screen has to be cleaned several times in a day. Therefore this operation must not be difficult and tiring. An inclined screen is far easier to clean. This prevents operator fatigue. On the other hand, vertical screens are difficult to clean.
4	Robustness of bars	Bars are robust to withstand abuse and corrosion. (Typically, MS flats of 20x5 mm are to be used)	M	Recommended	The operator may use heavy-handed methods to remove the trapped debris. The bars must be robust enough not to bend (-and allow enlarged gaps-) under such abuse. Further, the bars must withstand moderate corrosion with passing time without weakening.
5	Coarse screen used	Coarse screen (with 15 mm opening) fixed. The screen is inclined at 40° to 60°. The coarse screen is fixed BEFORE the fine screen. Note: Mandatory for large Plants (>500 KLD) only.	M	Mandatory	This screen traps larger items and reduces the load on the fine screen
6	Platform	Minimum width= 2 ft Must carry 120 kg weight without sagging Must be rust-proof (e.g. made of RCC)	V	Mandatory	The operator must be able to work safely without falling off the platform by accident. The platform must be able to carry the operator's weight. It must be able to hold the screened debris for drip-drying. The construction must be corrosion-proof so that it does not weaken with time.
7	Hand-rake for operator	Rake must be capable of picking trapped debris from the screen, and also picking up debris from any corner of the floor.	T	Mandatory	If the rake cannot remove the debris from the floor and grill, it will remain in the chamber and block the flow

8	Epoxy coating	The bars should be painted with epoxycoat. (Not required for Stainless Steel bars)	v	Recommended	For longer life of the grill
9	Stainless Steel Bars	Bars are made of Stainless Steel	V	Optional	For longer life of the grill

## Equalization Tank

sno	check	Acceptance criteria	Method	Category	Rationale
1	Easily accessible	The tank must be easily accessible	V	Mandatory	For periodic cleaning with safety and comfort for a gang of cleaners to carry out the task
2	Safe entry	The following features must be present, at minimum: Ventilation to dispel the gases/odor Good lighting that reaches inside the tank Platform that allows easy reach inside the tank	V	Mandatory	The operator has to access the inside of the tank for periodic cleaning and to maintain the diffusers. The tank has relatively low oxygen level and the raw wastewater emits hazardous gases and strong odor. So the operator must be provided with safety equipments such as mask, gloves, full body harness, gum boots.
3	Aeration & mixing	Diffusers in sufficient number to cover the entire floor Uniform placement of diffusers The aeration is uniform across the surface.	V, T	Mandatory	To prevent the solids from settling in dead zones (which in turn avoids the necessity to clean the tank frequently)
4	Diffusers type	Coarse bubble diffusers are used (not fine-bubble diffusers)	V	Mandatory	Unlike the fine bubble diffusers, the coarse bubble diffusers are not affected by fluctuating water level
5	Floor slope towards suction pit for pumps	Floor slope towards suction pit for pumps	V	Mandatory	For complete evacuation of contents by pump. Floor slope is given so that during tank cleaning, all the water is collected in the suction pit of the pumps and the equalization tank is evacuated by pumps alone, with minimum manual cleaning required.
6	Openness	The tank must be open to the	V	Recommended	To prevent accumulation of

	of the tank	extent of being able to disperse the gases, access all the diffusers placed in the tank, and for safe entry of operators during cleaning operations.		ded	gases , easy access to diffusers for maintenance purposes, and safe and secure entry for periodic cleaning
7	Diffusers in retrievable execution	The PCC ballast block holding down the diffusers must be provided with a Nylon rope which extends to the top of the tank and tied to a convenient post.	V	Recommended	For periodic maintenance of membranes without shutting down the aeration tank

## Raw wastewater lift Pumps

sno	check	Acceptance criteria	method	category	Rationale
1	Pump rating	The pump must have around 110% to 140% of the treatment flow rate			Since pumps are available with a few discrete operating points (head vs volume), it is difficult to get a pump that exactly meets the requirement. Thus it is necessary to select a pump that rated only a little higher than the ideal. Too high a rating would waste energy. Too little a rating would mean the treatment plant would not be able to handle the daily volumes.
2	Redundancy ( in case of 1W + 1 S )	Both pumps must be of same rating. Control circuits must prevent both pumps from running simultaneously	v	mandatory	This is a critical unit; so it must have a standby to avoid stoppage of the pumping.
3	Easy accessibility	Minimum clearance of 1 ft on all sides	v	mandatory	Space must be available for regular maintenance, since these pumps are prone to frequent choking.
4	Proper suction piping	The pipe size must match with the pump's suction port or one size higher only. The suction pipes must NOT be fitted with foot valves	v	Mandatory	Mismatching pipes would lower the efficiency of the pumps.  Foot valves get choked frequently; therefore must be avoided
5	Proper delivery head	Control valves are provided in the outlet to shut off any branch (for pump repair, etc.) Elbows are used for corners instead of tee-joints, necessary fittings such as unions/ flanges are provided	V	Mandatory	In order to maintain pump efficiency

		for easy dismantling and maintenance of the piping system, etc.			

## Aeration Tank / Reactor

sno	Check	Acceptance criteria	Met hod	Category	Rationale
1	Head room	Minimum headroom = 3 ft Not obstructed by pipes, or ventilation ducts etc.	V , M	Mandatory	Required to let the gases escape and also for regular maintenance/cleaning of diffusers
2	Work platform	Must provide waist-level access to tank Must have safety railings, Minimum width=3 ft Must have anti-skid surface If made from MS, must be painted to prevent corrosion	V	Mandatory	Required for MLSS check, and maintenance of the diffusers
3	Shape of tank	The shape of the tank must not obstruct placement of diffusers.	V , T	Mandatory	The shape of tank must allow uniform aeration, and also thorough mixing of sewage and sludge for vigorous and healthy growth of bacteria.
4	Inlet pipe	Elbow/T joint at the end to deliver the wastewater downward	v	Mandatory	The pipe must not propel the sewage toward the outlet
5	Inlet pipe placement	The raw wastewater and sludge inlet pipes are above the wastewater level (i.e., above the weir of the outlet-side launder)	V	Mandatory	Discharge of both raw wastewater and sludge into aeration tank should be visible for monitoring purposes, and not immersed inside water.
6	Baffle Wall	A baffle wall is provided	v	mandatory	To prevent short-circuiting of wastewater: The incoming wastewater must not head straight toward the exit without adequate retention (digestion) in the tank.
		The height of the baffle wall above the water surface must be equal to the other walls of the tank	v	Mandatory	To ensure that the incoming sludge does not "boil" over the baffle wall (no overflow).
		The depth of the baffle wall under the water surface must be between 0.25D and 0.30D. • Where D = Depth of water in	V	mandatory	To prevent possibility of creating a dead zone immediately behind the baffle wall.

		the tank			
7	RAS inlet and wastewater inlet pipe placement	Maximum distance between the wastewater inlet pipe and return sludge inlet pipe= 2 ft.	v	Mandatory	Recirculated sludge must be delivered in close vicinity of the raw wastewater inlet, to ensure maximum, intimate contact between wastewater and bacteria.
8	Inlet - outlet separation	The inlet is positioned to give maximum possible linear distance from the outlet	v	mandatory	The inlet and outlet must be placed farthest from each other; to ensure maximum possible retention time of wastewater (and thus treatment) in the tank.
9	Launder for outlet	It is easy to reach the mesh on the outlet port, for cleaning purposes.	v	Mandatory	If the mesh is not cleaned regularly, it would lead to blocking of outlet, and overflow of the tank
10	Free board	The freeboard must be 0.3 to 0.5 m.	M	Mandatory	To prevent emergency situations. A recommended practice should be level-monitoring and warning system (float switch in the tank connected to an alarm annunciator).
11	Air hose	The hose must be rated for high temperatures.	v	mandatory	To be able to handle the compressed air, which becomes hot. This avoids softening of the hose and rupture
12	Retrievability of diffusers	Check for maintenance features: The headroom and horizontal clearance between pillars must be adequate to allow easy removal of the diffuser assemblies.  Nylon rope must be of sufficient size to lift the diffuser assembly	v	Mandatory	To avoid messy shut down of aeration tank. Add checks for structural features that allow this.
13	Air control valves	Each set of diffusers must have individual air control valve	v	Mandatory	Required for pulling out of individual sets of diffusers for maintenance
14	Membrane type diffuser	Makeshift diffusers, such as PVC/ HDPE pipe with drilled holes or Coarse bubble diffusers must not be used.	V	mandatory	The aeration tanks need to transfer oxygen to sewage with high efficiency. Only fine bubble diffusers are suitable for this purpose.
15	No of compartments	Tank is divided in two compartments, each with diffusers.	v	Recommended	Enables temporary shut down of one aeration tank while the other tank continues to work.

## Secondary Settling Tank ( with hopper – bottom )

sno	check	Acceptance criteria	Met hod	Category	Rationale
1	Inlet pipe size	The inlet pipe from aeration tank to clarifier must be large enough to handle recirculation flow also	M	Mandatory	The inlet pipe handles almost double the average hourly flow of the wastewater , because of almost equal amount of sludge that is recirculated.
2	Feed well ie influent well	Inlet to the clarifier must be through a feed well The feed well is of sufficient size typically 300 dia in small tanks to 800 mm Dia in larger tanks The well is located at the center of the tank An inlet baffle wall can be used in place of a feedwell, but <b>only if</b> there is a single launder at the opposite side (i.e., the outlet end) of the settling tank.	v	mandatory	To kill kinetic energy of the incoming flow and present calm conditions for settling, and prevent short circuiting
3	Inlet flow direction	Inlet flow must not drop down vertically into the feed well, but must enter radially.	v	Mandatory	Vertical flow will transfer kinetic energy downwards, disturbing bacteria that has already settled.
4	Overflow weir	Weir is provided all round in case of a circular tank. Weir is provided on at least two sides in case of square tanks up to 200 KLD Weir is provided on all four sides in case of square tanks above 200 KLD	v	mandatory	The longest-possible weir should be provided to reduce the localized high upflow velocities that can pull up the solids from the depth of the tank.
5	Weir level	The weir is at a uniform level all round (check with tube level gauge)	T	Mandatory	If weir is uneven, the overflow will occur only in some sections of the weir, resulting in high localized upflow velocities; which in turn will pull up the flocs, overloading the filters that follow
6	Total water depth	The water depth at the center of the tank must be 2.5 m or more.	M	Mandatory	To achieve sufficient clarification in the supernatant overflow and thickening of solids in the underflow
7	Depth of	The depth of hopper at the	M	Mandatory	To provide for the minimum 100

	central sludge hopper	center must be 200 mm or more.			mm dia sludge withdrawal pipe
8	Straight depth	Minimum straight depth must be 1.2 m	M	Mandatory	To achieve sufficient clarification in supernatant water and thickening of sludge in the underflow
9	Hopper slope	Sloping hopper must have minimum 45° slope	M	Mandatory	To enable rolling down of settled sludge on the sloping walls to a central pit
10	Dia of sludge pipe	If sludge pipe is buried beneath the tank floor, its dia must be 100 (nominal) or more. This minimum Diameter ensures that smaller articles do not choke the pipe frequently.	V	Mandatory	To prevent clogging of buried pipe
11	Bottom pit	The square bottom floor pit must not be more than 300x300mm	V	Mandatory	If the pit is too large, the suction pipe cannot remove the bacteria settled at the periphery of the pit.
12	Air lift pump	Air lift sludge recirculation suction-head must be placed about 0.5 m from bottom of tank	V	Mandatory	If the suction-head is placed too high/low, the pipe will not be able to collect all the bacteria settled at bottom.

## Clarifier water Tank

1	Tank capacity	Sufficient holding capacity to match filter sizes and hours of filtration 2-3 hours of average hourly flow in large plants if the filters are run continuously over 24 hours 8-10 hours if the filter operation is for only 16 hours in a day, as in smaller treatment plants	m	Mandatory	To provide sufficient stock of water to cover the rest period of pumps and for backwash water requirement

Likewise there are many checks and crucial parameters for below mentioned equipments also which are known to an engineering based company only , and these are the parameters which determine the performance of any treatment plants

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