

DETAILED CALCULATION ATTACHMENT

Detailed calculation of storage tank unit

Types	Result	Units
Intake Flow Rate	0.051	m ³ /s
Number of Tanks	1	unit
Flow Rate per Tank	0.051	m ³ /s
Detention Time	5	minute
Design Detention Time	5	minute
Detention Time (s)	300	s
Tank Volume	15.23	m ³
Design Water Depth	1.5	m
Freeboard	0.2	m
Freeboard Height	1	m
Total Tank Height	2.5	m
Channel Cross sectional Area (A)	10.15	m ²
length x width assumption (2:1)		
Width (W)	2.25	m
Length (L)	4.51	m
Final Dimensions of the Collection Well		
Height (H)	2.5	m
Length (L)	4.51	m
Width (W)	2.25	m
Hydraulic Radius	1.12	m
Tank Surface Area	10.15	m ²
Volume per Tank	25.4	m ³
Number of Tanks	2	unit
Manhole (1 unit)	60 x 60	cm
Head Loss of storage tank		
Flow Velocity	0.00027	m/s
Hydraulic Radius (R)	0.90	m
Bottom Slope	9.98	degree
Storage Tank Headloss	0.000045	m
Storage tank piping system		
Theoretical Inlet Pipe Diameter (Inner Diameter)	0.04	m
	44.05	mm
Commercial Inlet Pipe Diameter (Inner Diameter)	45	mm
	0.045	m
Commercial Inlet Pipe Diameter (Outer Diameter)	50	mm
	0.05	m

Detailed calculation of slow sand filtration unit

Type	Result	Units
Surface area		
Total Tank Surface Area (m ²)	25.31	m ²
Number of Designed Tanks	2	unit
Surface Area per Tank (m ²)	12.65	m ²
Check Filtration Rate (Vf)	0.4	m/hr
length x width assumption (2:1)		
Tank Width (W)	2.51	m
Selected Tank Width (W)	3	m
Tank Length (L)	6	m
Depth		
Freeboard Height	0.30	m

Type	Result	Units
Water Depth Above the Sand Media	1.50	m
Sand Filter Media Thickness	1	m
Supporting Gravel Layer Thickness	0.30	m
Underdrain Collection Channel	0.20	m
Total Depth	3.30	m
Uniformity Coefficient (UC)		
UC Check	2.48	-
Underdrain system (Manifold, Lateral, Orifice)		
Orifice		
Filter Surface Area per Tank	12.66	m ²
Total Orifice Area	0.03	m ²
Orifice Diameter	0.012	m
Area per Orifice	0.00011	m ²
Number of Orifices	280	hole
Lateral pipe		
Total Lateral Pipe Area	0.063	m ²
Lateral Pipe Diameter	0.10	m
Cross-sectional Area per Lateral Pipe	0.0079	m ²
The lateral pipe dimensions are calculated after determining the commercial outside diameter of the manifold pipe.		
Lateral Pipe Length	1.32	m
Number of Lateral Pipes	18	pcs
Number of Orifices per Lateral	15.55	hole
Orifice Spacing	0.08	m
Mainfold pipe		
Manifold Cross sectional Area	0.09	m ²
Manifold Pipe Diameter	0.34	m
Inlet pipe		
Theoretical Inner Diameter	0.04	m
Check of Theoretical Inner Diameter	42.32	mm
Commercial Inner Diameter	45.20	mm
Commercial Outer Diameter	0.045	m
Velocity Check	1.75	m/s
Maximum Velocity	4.50	m/s
Pipa outlet		
Diameter = Manifold Pipe Diameter		
Theoretical Inner Diameter	0.35	m
Check of Theoretical Inner Diameter	300	mm
Commercial Inner Diameter	327.80	mm
Commercial Outer Diameter	0.33	m

Orifice Flow Rate	Flow Rate per Tank / Number of Orifices	Result
Under Drain Headloss		
Orifice		
Orifice Velocity	Orifice Flow Rate / Area per Orifice	5.023
Headloss per Orifice	-	0.044
Total Orifice Headloss	Headloss per Orifice × Total Number of Orifices	0.0001
Headloss Orifice Total	Headloss 1 Orifice x Total Orifice	0.028
Lateral		
Lateral Flow Rate	Flow Rate per Tank / Number of Lateral Pipes	0.000078

Orifice Flow Rate	Flow Rate per Tank / Number of Orifices	Result
Commercial Inner Diameter of Lateral Pipe	–	0.10
Lateral Pipe Length	–	1.32
Lateral Velocity	Lateral Flow Rate / Lateral Pipe Area	0.0099
Headloss per Lateral Pipe	–	3.38
Total Lateral Headloss	Headloss per Lateral Pipe × Number of Lateral Pipes	0.000061
Manifold		
Manifold Flow Rate	Flow Rate per Tank	0.0014
Commercial Inner Diameter of Manifold Pipe	–	0.32
Manifold Pipe Length	–	6
Manifold Velocity	Manifold Flow Rate / Manifold Pipe Area	0.054
Manifold Headloss	–	0.000011
Headloss total of underdrain		
Headloss total of Underdrain	–	0.029
Headloss of Media Filter		
Design criteria		
Thickness – Sand	–	100
Thickness – Gravel	–	30
Particle Diameter – Sand	–	0.029
Particle Diameter – Gravel	–	2
Shape Factor (ϕ) – Sand	–	0.92
Shape Factor (ϕ) – Gravel	–	0.72
Porosity (θ) – Sand	–	0.42
Porosity (θ) – Gravel	–	0.55
Kinematic Viscosity of Water (μ)	–	0.000086
Filtration Velocity	–	0.43
	–	0.00011
	–	0.011
Sand media headloss		
Reynolds Number (NRe)	–	3.53
Drag Coefficient (CD)	–	6.81
Friction Factor (fx)	–	26.42
fx / Particle Diameter	–	889.66
Headloss	–	9.53
	–	0.10
Supporting Gravel Layer Headloss		
Reynolds Number (NRe)	–	185.83
Drag Coefficient (CD)	–	0.13
Friction Factor (fx)	–	2.15
fx / Particle Diameter	–	1.077
Headloss	–	0.0023
	–	0.00002

Result of disinfection tank unit

Types	Result	Units
Dimension unit		

Types	Result	Units
Volume (V)	5.06	m ³
Cross-sectional Area (A)	2.89	m ²
Tank Width	1.08	m
Tank Length	2.69	m
Tank Height	2.25	m
Water Depth	1.75	m
Chlorine dose		
Chlorine Dose	2.31	mg/l
Chlorine Demand per Second	6.47	mg/s
Daily Chlorine Demand	0.56	kg/day
Weekly Chlorine Demand	3.91	kg/week
Monthly Chlorine Demand	17.33	kg/month
Number of Chlorine Cylinders	1	pcs
Chlorine Volume	0.00020	m ³
Solution Volume	0.0048	mg/s
Dilution Water Volume	0.14	m ³ /month
Chlorine Dilution Tank	Tube shape	
Chlorine Cylinder Capacity	300	L
Piping system		
Injection chlorine pipe		
Pipe Cross-sectional Area	0.0020	m ²
Theoretical Inner Diameter of the Dosing Pipe	0.049	m
	0.000018	mm
Commercial Inner Diameter of the Dosing Pipe	17.60	mm
	0.018	m
Commercial Outer Diameter of the Dosing Pipe	20	mm
	0.020	m
Theoretical Inner Diameter of the Inlet Pipe	0.30	m
	300	mm
Commercial Inner Diameter of the Inlet Pipe	327	mm
	0.33	m
Commercial Outer Diameter of the Inlet Pipe	355	mm
	0.36	m
Theoretical Inner Diameter of the Outlet Pipe	0.042	m
	42.30	mm
Commercial Inner Diameter of the Outlet Pipe	45.20	mm
	0.045	m
Commercial Outer Diameter of the Outlet Pipe	50	mm
	0.050	m
Headloss		
Tank headloss		
Flow Velocity	0.00097	m/s
Hydraulic Radius (R)	0.45	m
Bottom Slope	0.00015	°
Tank Headloss	0.00039	m