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Concept of sediment filtration intake design for raw water drinking water

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Abstract. The drinking water intake capacity of drinking water is very susceptible to sedimentation, and is one of the main obstacles in drinking water services. The existing intake building is not yet equipped with a filtration system that takes into account turbidity. The level of turbidity of water entering the intake and flowing to the water treatment plant (WTP) through the transmission pipe will greatly affect the workload of the PAPs. Sedimentation problems and turbidity of raw water need special handling, starting from the design of the intake building that has the ability to dodge sediment so that the level of turbidity of the water can be minimized. Sediment evasion filtration intake designed with a 0.2 mm strainer nozzle filter system so that the sediment with a size above 0.2 mm will not enter the intake. In the cleaning process the filters installed at the intake door can be done by replacing with a backup filter, so that filter cleaning can be done easily and does not stop the intake operation for a long time. With sediment evasion filtration intakes, the raw water entering the water treatment plant (WTP) will also have a lower turbidity level so that the WTP workload is lower

1. Introduction

Provision of raw water for drinking water from surface water is the main choice in the construction of raw water units. The use of groundwater is avoided wherever possible in the supply of raw water both for drinking water and for agriculture or rice fields [1], [2]. Construction of raw water intake for drinking water is carried out by building dams and also free intake. Both types of intake are often constrained by the amount of sedimentation that enters the intake, so that it often inhibits the continuity of the intake function [3], [4]. Sedimentation that occurs not only at the intake, but in certain conditions often results in sedimentation in the transmission pipe, which can reduce the production capacity of raw water entering the Water Treatment Plant [5]. The intake building must meet several technical criteria so that the intake building can function properly and is not prone to floods and heavy river currents [6], [7]. The building of raw water intake should be built by minimizing sedimentation, so as not to clog the water gap that will be taken. Usually intake buildings are built by the river (large intake, some are built by damming the river to direct the water into the intake [8], [9]. There are also intakes built in the lake with pontoon systems and several other types of intakes. Some types of intake that are currently vulnerable against the threat of sedimentation, in which operational and maintenance costs are not cheap, and are often a constraint for managers due to budget



constraints and sediment dredging equipment, the intake model that can avoid sedimentation is equipped with a filtration system, so that in addition to raw water can be continuously flowed in all conditions (floods or non-floods) the flowed water also has a lower turbidity level compared to water that comes out of the intake in general. Low turbidity levels will ease the workload of the Water Treatment Plant and reduce water production costs which in the end will be more affordable by community [10], [11], [12], [13].

The main problem faced in the supply of raw water for drinking water is the problem of sedimentation. Existing intake buildings, both intake dams or free intakes, are not spared from sediment problems. The difficulty in handling sediment often hampers the supply of raw water will also hamper drinking water services.

2. Types of Existing Intake

Clean water is an important requirement that is used by humans for various activities. Explanation of raw water and intake according to the literature, namely:

- Raw water for household drinking water, hereinafter referred to as raw water, is water that can come from surface water sources, groundwater basins and / or rainwater that meet certain quality standards as raw water for drinking water [14].
- Intakes are buildings that capture water or place water from rivers, lakes or other surface water sources to processing plants [14].

Some types of existing intake building are:

1. Reservoir intake (intake tower)
The tower intake is located on the overflow section or near the side of the dam. The foundation of the tower is separated from the dam and built in the upstream part. The tower consists of several inlets located at varying heights to anticipate the fluctuations in water level can flow gravity to the water purification facility, the intake tower is not needed.
2. River intake
River intake consists of 3-6 m diameter concrete wells equipped with 2 or more large pipes called penstock. The pipes are equipped with valves that allow water to enter the intake periodically. Water collected in the well is then pumped and sent to the processing plant. River intake is located in the upper part of the city to avoid pollution by wastewater.
3. Lake Intake
Lake intake consists of one or more bell-mouthed pipes installed at the bottom of the lake. Bell-mouthed closed with a screen. As a pipe support bridge is made that connects the pipe from the lake to the water treatment plant.
4. Canal Intake
Canal intake consists of concrete wells that are equipped with bell-mouthed pipes installed up to the top. There is a fine filter at the top to prevent the entry of small fish and floating objects. The room was also covered with a filter of gravel.
5. Intake of the weir
is a type of intake that uses a weir to get the water.
6. Direct intake
is the type of intake to take or utilize surface water directly if a water suction pipe is installed or placed directly on the river, lake or reservoir.
7. Intake of pontoons
is a type that uses buoys or pontoons as a suction pump (the pumping device follows the rise and fall of the water surface).
8. Intake of wells
is a type of intake by using a channel at the bottom of the river to get the water.
9. Take the tyroller
is a type of intake using a channel in the river to get the water [15].

3. Design Concept of Intake Filtration

3.1 Intake Planning

Some things that need to be considered in the intake planning:

1. The intake should be located in a place where there is no heavy flow which could endanger the intake
2. The soil around the intake should be quite stable and not susceptible to erosion
3. Inlet, should be under the surface of the body of water to prevent the entry of floating objects. Besides that the inlet should be located just above the water
4. The intake should be located long before the source of contamination
5. The intake should be located in the upper reaches of the river or city
6. The intake should be equipped with a rough filter that is always cleaned. The end of the water intake pipe associated with the pump should also be given a strainer (strainer)
7. For fluctuating water levels, the inlet to the collecting well should be made at several levels
8. If the surface of the water body is always constant and the riverbank is submerged in water, then the intake can be made near the river [16].

3.2 Intake Planning Criteria

According to [17], [18], intake planning criteria are:

1. Bell mouth strainer
 - Speed through the strainer hole 0.15 - 0.3 m / s
 - Strainer location, 6-1 m below the minimum water level
2. Collecting wells
 - The bottom of the well is taken 1 m below the strainer
 - Construction must be strong and the placement of pipes and equipment can be easily operated and maintained
 - Detention time is not more than 20 minutes
3. Pipe for raw water distribution with gravity flow
 - Flow rate 0.6 - 1.5 m / s to prevent irritation and sedimentation in the pipe
 - The pipe diameter size is determined by maintaining a flow rate of 0.6 m / s at the lowest water level, and no more than a flow rate of 1.5 m / s at the highest water level
4. Raw water supply pipes with drainage using pumps
 - Flow velocities range from 1 - 1.5 m / s with diameter diffusion similar to the criteria of gravity pipe
 - The pump center is placed not less than 3.7 m below the lowest water level and not more than 4 m above the lowest water level

3.3 Sediment Evasion Filtration Design Intake

Intake filtration is designed by conditioning the flow in the intake building more profusely and the side side is made to slow down so that sedimentation will gather away from the intake

building. The method used is to make the dam oblique, so that acceleration and deceleration occur inside the dam [19]. From the filtration system at the intake door, the filter door is installed by using a strainer nozzle to filter the water entering the intake building with a density of 0.2 mm. the use of this nozzle strainer filter besides the use of this type of filter is intended for water filter systems also with consideration of the ease of cleaning. Filter cleaning can be done with a replacement system with a new filter, so cleaning does not interfere with raw water service for drinking water [20]. The use of filters with a 0.2 mm filter density will also be able to prevent excessive sedimentation in the intake building and in the transmission pipeline. The use of this filter will also reduce the WTP workload so that the price of water production will also decrease the filtration intake design can be seen in Figures 1 and 2. In the figure it is shown that the weir is made not perpendicular to the river flow but made 25° sloping so that acceleration and deceleration will occur water flow, on the side of the intake structure the water flow will be quite heavy compared to the opposite part of the intake due to turbulence of the water flow that triggers sedimentation [21], [22].

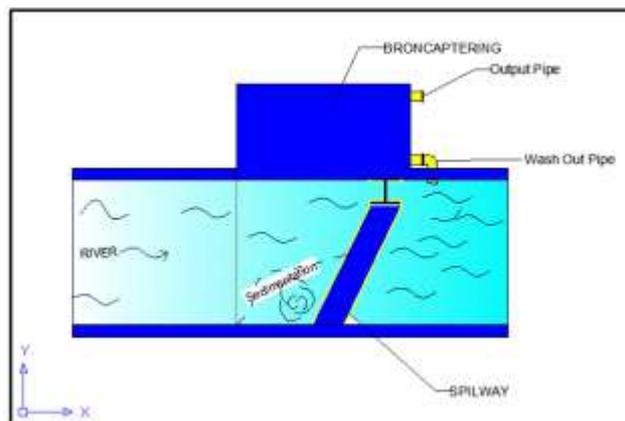


Figure 1. Top View of Intake Filtration

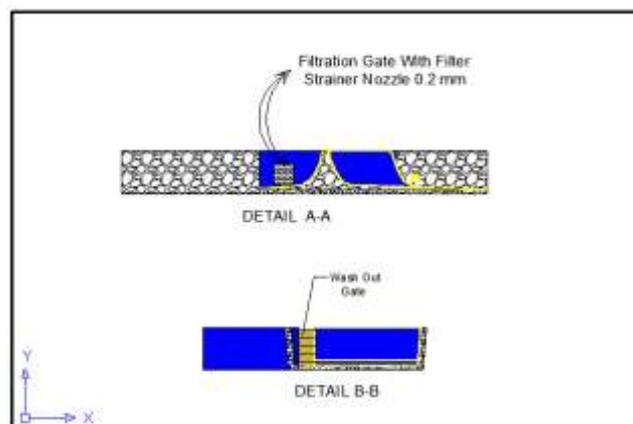


Figure 2. Side View of Intake Filtration

4. Conclusion

The intake building needs to pay attention to the level of sediment, so as not to burden the manager in the operation and maintenance process. With the sediment evaporation intake

filtration design concept for raw water for drinking water, it will reduce sedimentation into the intake and pipeline networks, which in turn will reduce the PAP workload and improve the quality of the drinking water produced. By using a 0.2 mm filter strainer nozzle, the sedimentation that passes into the intake building is smaller than 0.2 mm.

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