Best Practices for Wastewater Screening Design

The Importance of Screening Grid Velocity

By **Tim Matheis**

This article focuses on screen grid velocity and how this is related to screening performance. Weirs are used with screening equipment to both control flow and depth of water utilized by the screening grid. A weir can aid in optimizing screening operation by providing a consistent screening grid velocity at high and low flow rates. Weirs are also discussed in this article.

Screen Grid Velocity and Why it Matters

The main function of wastewater screening equipment is to capture and remove debris. All wastewater screening equipment is built around a screening grid. A typical design requirement includes a screening grid that maximizes the amount of debris captured without blinding wastewater flow. The screening grid can have several properties, including size of openings in the grid, material of construction, type of seals, stationary or traveling. The screening grid operates within a flowing channel of influent wastewater. The screen grid must operate at peak flowrates and lower flowrates as wastewater useage changes throughout the day or month. Wastewater flowing at differing velocities into the screening grid can impact the operation and function of equipment in the following ways:

- A high water velocity into the screening grid (grid velocity) can push debris through the grid and defeat the purpose of the screen.
- A high grid velocity can push debris into the screen grid openings, making it harder to dislodge material. The screen becomes ineffective if it becomes clogged and cannot be cleared of debris.
- A low grid velocity can deposit grit in the channel approaching the bottom of the screening equipment. Grit accumulation at the foot of the screen is extremely abrasive to moving surfaces and can damage the equipment.

Factors that affect the velocity of water entering the screening grid include:

- Flowrate of water to the screening equipment
- Type of grid that is used, including the size of open area available for screening
- Wastewater characteristics such as the amount of suspended material and blinding capacity
- Downstream configuration after the screening equipment

Why Install a Weir Behind Your Screening Equipment

Weirs are placed behind screening equipment to control the screen grid velocity and level. A weir helps the screening equipment optimize debris capture and unloading.
A screening specific flow control weir can be used in addition to other flow control equipment located after screening, such as a grit trap specific weir or downstream flume. Figure 1 shows a side view of a wastewater channel with a screen used for debris removal and includes a weir located after flow passes through the screen grid equipment.

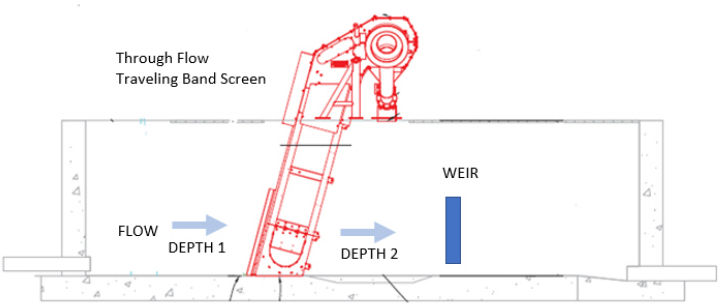

Figure 1 – Side view of a wastewater channel with a weir located after the water passes through screening equipment

Weir Types Used in Wastewater Screening

Weirs can take several shapes: square, triangular, parabolic, notched, etc. The most common weir types with wastewater screening equipment are the proportional weir and the underflow weir.

A proportional weir is used for water level control as it demonstrates a linear relationship between flow and pressure head. This article focuses on the proportional weir, also known as a Sutro weir.

A Sutro weir, named after Henry Sutro, is a proportional weir used for flow control with screening equipment. The Sutro weir has a curved shape with the curve defined by a parabola. The names of this type of weir are used interchangeably between Sutro, proportional or parabolic.

Figure 2 shows a view of a Sutro weir in the water channel. Note the open shape at the bottom provides free flow at low water flow. As the water flow and level increase, the area decreases to both restrict flow and maintain the same velocity as the water level rises above the weir.

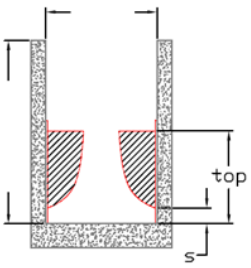

Figure 2 – View of a Sutro weir in the water channel

Why Use the Sutro Weir Shape?

In 1908, Henry Sutro determined the shape of the curve needed to provide headloss proportional to flow rate as a constant. In other words, as flow increases, the headloss also increases in a constant (linear) manner with the flow. Sutro mathematically derived the shape of the curved weir needed to produce a nearly constant velocity as the flow rate increases in open channel flow (see Figure 3). A property of this curve is to hold the mean velocity of water flow constant as the level rises above the weir. This is an important property for screening equipment operation because constant velocity helps the screening equipment operate optimally for debris capture.

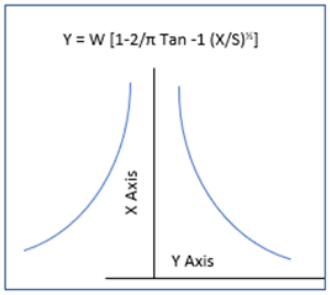

Figure 3 – Sutro weir equation

It is common for wastewater plants to have a wide range of incoming flow rates, usually identified as peak flow, average flow, and low flow. The difference between peak and low flow can vary by a factor of 10 in some cases. Peak flows can cause the screening grid velocity to exceed acceptable limits in operation. The curved nature of the Sutro weir helps to hold the water velocity constant at the screening grid for variable flow rates, allowing the screening equipment to capture debris within design headloss through the screen grid and then offload material from the grid for dewatering.

References

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Keshava, Murthy K., and Seshagiri, N., "A Generalized Mathematical Theory and Experimental Verification of Proportional Notches", Journal of the Franklin Institute, Volume 285, Number 5, May 1968, pp 347-263.

About the Author

Tim Matheis is a chemical engineer by education and Business Developer for Hydro-Dyne Engineering. Mr. Matheis has published multiple technical papers and holds seven patents for processes and methods within the wastewater industry. Mr. Matheis has experience with preliminary treatment equipment and high purity water treatment spanning a 30-year career in the water and wastewater treatment industry.

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