# Weighing Your Grit Removal Options

## Choosing an optimized grit removal system

*Across the U.S., wastewater treatment plant operators face a common problem that threatens the effectiveness of their plants—grit. Grit erodes mechanical equipment and accumulates in channels and process chambers, causing capacity and operational problems. Grit accumulation in primary and secondary process basins diminishes a plant's performance, reduces its treatment capacity and increases operational and maintenance costs. Grit is a continuous and common problem that impacts treatment plants worldwide. Furthermore, the solution which will most effectively remove grit can vary by plant.*

**By Robert Y.G. Andoh**

Geography and geology play critical roles in determining what types of grit find their way into a wastewater system. Texas, for instance, is an arid climate without much vegetation. The land is laden with medium and coarse sediments, and treatment plants are impacted by high concentrations of medium to coarse grit. Georgia's topsoil has very fine characteristics; therefore, storm water runoff and wet-weather infiltration into sanitary sewers tend to collect very fine grit due to the infamous Georgia red clay. Florida plants tend to collect very fine grit due to the "sugar sand" found in this coastal environment. Grit also tends to be coarser further north along the East Coast, where roads are sanded in the winter. Sediment grains are also coarser on riverbeds in upper catchments and finer in lower catchments.

Grit quality also depends on the nature and type of collection systems used in a community. If a community has a combined sewer system, the collection system will gather additional gravel and sand from storm water, leading to a higher concentration of sediments, including coarse grit. Those with a separate sanitary sewer will offload more of the sediments to the storm sewer, leaving a larger proportion of the finer grit to be handled in the wastewater stream.

It is more difficult to remove fine to very fine grit—particles ranging from 75 to 150 microns. To remove fine grit, higher-efficiency systems are required because fine particles do not settle out as easily as larger particles. In addition, finer grit tends to have more organic material attached. So, the finer the grit, the more likely grit washing will be needed once it has been captured.

### Grit Removal Technologies

Grit removal chambers and technologies have evolved over the past several decades from the use of detritus tanks and constant-velocity channels to the use of vortex chambers. Vortex systems have become the preferred technology due to the centrifugal and other rotational forces that assist gravitational forces in the separation of grit from organics and liquids. Consequently, a smaller footprint can be used to achieve equivalent or better treatment goals as a conventional aerated grit chamber, detritus tank or constant-velocity channel.

Different configurations of vortex separators have evolved for grit removal at wastewater treatment works. These devices can be broadly classified as either mechanical vortex grit removal systems or induced vortex separators. The induced vortex separators rely to varying extents on a tangential intake to induce vortex motion, gravity and boundary layer effects to separate solids from liquids and unique geometric arrangements of internal flow-modifying components.

Vortex chambers that rely solely on hydraulics, without a need for power or mechanical equipment, have the added advantage of further reducing operational and maintenance costs over the life of the system.

Various types of vortex grit removal devices offer the best solution for certain grit removal situations. The primary differences in these systems are a combination of headloss and grit capture efficacy.

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## High Headloss

The Eutek TeaCup and Eutek SlurryCup are examples of high-headloss vortex separators. These separators rely on a tangential feed to generate high centrifugal forces and a free vortex-type flow regime within a circular chamber that leads to effective solids-liquid separation and classification—particularly for the TeaCup and SlurryCup, which use boundary layer effects to enhance classification.

They have no moving parts and can effectively remove very fine grit in the sub-106-micron range. The irrecoverable headlosses across these types of vortex separators are significantly higher than the other two types of vortex separators, typically being in the 3- to 10-ft range—though for some cyclones headlosses can exceed 20 ft.

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## Medium Headloss

Medium-headloss vortex separators have losses in the 4- to 12-in. range and can maintain grit removal efficiency over a wide range of flow rates. These devices are typically used to remove grit particles with diameters in the 106- to 150-micron range. The Grit King separator is an example of such a device.

The Grit King has no moving parts and uses a tangential feed to induce rotary motion within a circular chamber. The rotary flow patterns are stabilized by flow-modifying members within the vessel to ensure long flow paths and virtually no short-circuiting. This type of system is suited to upstream applications—ahead of fine screens, upstream of equalization basins, at satellite treatment sites within collection systems and upstream of drop structures into deep tunnels.

The Eutek HeadCell is another type of nonmechanical medium-headloss vortex separator that uses a high-efficiency flow distribution header to evenly distribute influent over multiple stacked conical trays. The tangential feed establishes a vortex flow pattern where solids settle into a boundary layer on each tray and are swept down to a centrally located underflow collection chamber.

Efficiencies are enhanced due to the large surface area and short settling distances (stacked tray clarification). Evenly splitting flows to multiple trays eliminates thermal short-circuiting, which reduces the performance of conventional grit basins. The system particularly lends itself to being retrofitted into existing chambers (e.g., aerated grit chambers), providing scope for significant cost savings on treatment plant upgrade projects.

## Low Headloss

The low-headloss vortex separators, often referred to as paddle-type grit removal systems, are devices with irrecoverable headlosses typically less than 4 in. These rely on a mechanically induced forced vortex-type flow pattern in a shallow cylindrical chamber with relatively short detention time to capture grit solids in a central hopper. The mechanical moving parts are usually in the form of a turning paddle. Such systems tend to be used at wastewater treatment facilities where the treatment objective is to remove relatively coarse grit down to 300 microns in diameter.

## Finding a Fit

The key to choosing an optimized grit removal system is to know the gradation of grit for the locality as well as the average daily flow and the peak wet-weather flow for the treatment plant. Economics are always a factor for municipalities and regional wastewater treatment plants, so plant operators are increasingly cognizant of their options. Mechanically or induced, low-, medium- and high-headloss vortex systems offer different capabilities and efficiencies in the removal of coarse to very fine grit.

In the current climate of increasing regulatory compliance requirements and the need for treatment plants to improve nutrient removal capacity and efficacy of biosolids systems, there is a growing trend toward the use of more intensive processes. These include membrane bioreactors, microscreens and other high-efficiency treatment systems and processes that require high-quality upstream preliminary treatment processes (i.e., fine grit removal and washing).

Different systems can handle different grades and characteristics of grit. Wastewater treatment plants in localities collecting a preponderance of coarse grit can often turn to low- or medium-headloss systems.

The need to future-proof investments in treatment plant equipment is spurring municipalities and their consultants to look closer at higher-efficiency grit removal systems that target all grades of grit. These systems harness the inherent energy within flows to effectively capture, classify, wash and dewater fine, medium and coarse grit with minimal maintenance and low operational costs. WWD

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