S:MAX G

grit removal technology eliminates the short and long-term effects of grit on the wastewater treatment process

Within the wastewater treatment industry the persistent problems associated with grit, and its detrimental effects, have troubled operators for years. However the grit problem is not insurmountable and effective technology can prevent grit problems before they occur. The problems caused by grit and a solution can be seen through a case study in collaboration with Northumbrian Water. Taking a long-term view on the infrastructure used for waste treatment works will simultaneously increase efficiency and reduce expenditure in the wastewater treatment process.

The S:MAX G

The effects of grit

Grit accumulates in all stages of the wastewater process and brings with it both acute and chronic effects. Short-term issues include screen blinding, reduced throughput and pipe and pump blockages, as well as reduced dewatering effectiveness because of damage to the decanter scroll tips. The long-term effects are even more problematic and include excessive wear as grit is passing through the pumps causing unnecessary abrasion, reduced capacity in the digester and the resulting cleanout costs, not to mention the need for additional resources for sludge redirection.

Periods of downtime result in additional costs, not only of maintenance but also by the fact that tankers containing the raw sludge for screening need to be diverted to alternative holding tanks. In addition, an increase in transport also induces increased expense due to high fuel costs.

These problems have almost become tolerated in treatment works today with operators becoming comfortable with a duty/standby approach being adopted. This however is not addressing the core issue; rag and grit should be removed as early as possible in the process to ensure the most efficient flow.

Grit removal technology

The S:MAX G uses high frequency screening and can handle high volume sludge flows with relatively high suspended solids. It includes cyclone technology that is free of moving parts and is highly reliable in the separation of fine solids. The S:MAX G has the following technological advancements:

- ***Surface tension:*** Surface tension, particularly within a high percentage solids feed, has meant that screening flowrates in static screens has hit an upper limit. However, high frequency screens are not bound by this glass ceiling of flowrate. With these vibrations moving the screen through the sludge, the surface tension is broken and the pressure of the liquid is able to drive flow through the screen much more quickly.
- ***Blinding:*** Blinding is prevented within high frequency screening. A traditional screening system, during its best efforts to increase flowrate, must also force material against the static screening mesh. The result is blinding of the screening apertures, reduced efficiency, and before long, manual intervention is needed. However, with a high frequency screen, material is repeatedly lifted off the

screening surface due to the force of the vibrations on the particles. Therefore, material is disinclined from blinding on the screening media.

- ***Recovery rate:*** The recovery rate of inert material on the vibrating screen is unmatched in the industry. With the prior concerns of flowrate and blinding removed, the specification of the screening size, and type, can be relaxed. This allows for two-dimensional screening (square apertures), rather than the spiral slots previously required to assist in achieving the required flowrate. Within a square aperture screening arrangement, particles greater than the intended screening size cannot physically pass through with the sludge, which prevents downstream issues.
- ***Cyclone technology:*** The cyclone technology targets inert material as small as 75 micrometres. The technology has at least a 90% efficiency rate with recirculation systems to increase this to 95% overall removal efficiency. The cyclone has the ability to differentiate between grit and organics because of their differing material properties.

The Northumbrian water research project

Bran Sands WwTW, in Middlesbrough, is one of Northumbrian Water's largest wastewater treatment sites. The site brings in sludge from satellite sites alongside an indigenous feed. The sludge is used to produce biogas and the site has a total capacity of 4.7 MW. Over 40,000 tonnes of dewatered sludge is produced every year.

In August 2016 grit removal technology was installed at Bran Sands Wastewater Treatment site with the aim of removing the rag and grit in the imported sludge coming to the facility. The goal was to show how this could affect the changes to digester tank cleanout intervals. The site has three digestion tanks which require a clean out approximately every seven years due to a build-up of grit. This ultimately reduces the biogas generating capacity. For the sake of a controlled study only imported sludge was used in the project which amounted to 9000m^3 over a five-week period. This accounts for approximately 30% of the incoming sludge.

This sludge was screened at the satellite sites and transported to Bran Sands where it was pumped through the installed equipment. The rag and grit were collected in different skips which were then measured to calculate the resultant weight. This enabled the operators to see how much rag and grit would have previously gone through the process causing wear. The screened sludge then proceeded through the normal path and into the digestion tanks before being used to create biogas. Rag was collected into a compactor to undergo final dewatering before being deposited into a skip. Meanwhile grit was discharged down the chute and into a separate skip after passing over the dewatering screen.

The process

During the five-week project 3.8 tonnes of grit and 2 .2 tonnes of dewatered rag were extracted from the 30% of incoming sludge used for the project. Scaled up to 100% of incoming sludge, this would constitute 127 tonnes of grit in one year and 889 tonnes in the seven-year period. This would also account to 73 tonnes of dewatered rag in one year and 511 tonnes in the seven-year period removed from the digester tank. Prior to the project, this large amount of rag and grit, would have passed through various pumps, holding tanks and processes before entering the digester tanks.

The results

Originally, it was estimated that every seven years a clean out of the digestion tanks would remove 750 tonnes of grit alone across the three digestion tanks. However, this figure did not take in to account grit deposited before reaching the digestion tanks. Some grit will also remain in suspension in the digestion tank. Based on the project conducted it is estimated that in this time, 889 tonnes of grit would be removed. This total included any grit that may remain in suspension.

A removal of rag and grit at the pre-processing stage avoids, from the outset, both the acute and chronic effects caused by the accumulation of such materials. Effective grit removal will not only prevent unnecessary abrasion and wear and increase dewatering effectiveness at the decanter stage but will also maintain optimum capacity in tanks for longer, therefore significantly increasing the time period between digester cleanouts.

Conclusion

The grit removal technology installed at Bran Sands demonstrated the amount of grit that can be removed not only in the digestion tanks but also in the upstream processes in order to prevent problems downstream. Effective separation and removal of grit from sludge at an early stage is both possible and essential for avoiding damage and wear on the complete water treatment system.

This paper was prepared by CDEnviro Ltd.
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Rag removal through compactor

Grit recovery

The S:Max G