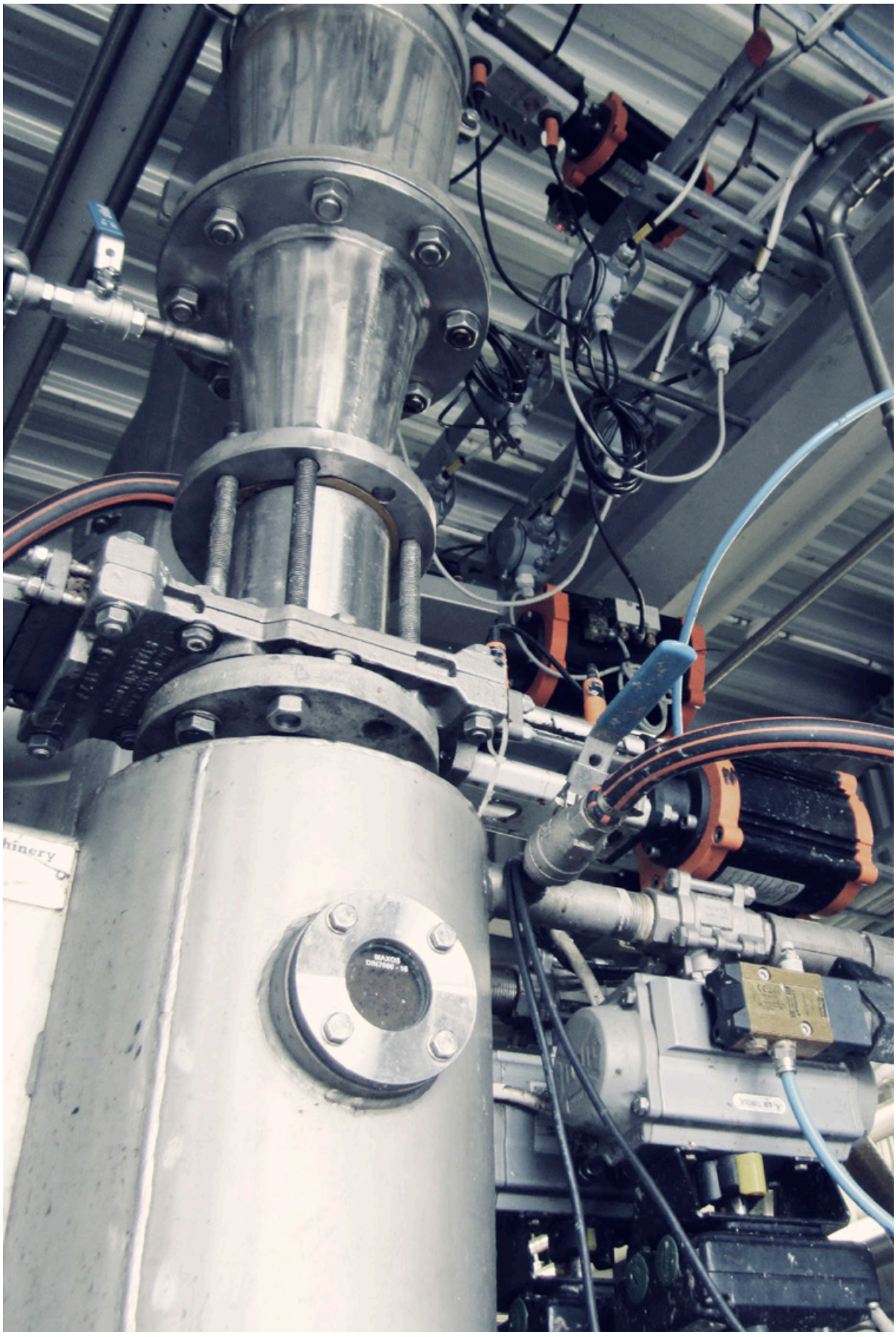

When the substrate passes through the hydrocyclone a vortex motion is created, separating high density particles and collecting them in a reject chamber.

Tanks free from grit

HYDROCYCLONE PREVENTS SEDIMENTATION FROM BIOGAS SUBSTRATE

The biogas plant at Tekniska verken in Linköping, Sweden, covers the full process of pre-treating organic waste, digesting it into biogas, and refining it into fuel for vehicles. In the pre-treatment process a hydrocyclone from Cellwood is used to clean the substrate from grit.

Erik Nordell works as a development engineer at Tekniska verken. He has long been a driving force in optimizing the process. "There has been a biogas plant here for twenty years. I have been here since 2008 and seen a huge development. Initially most of the work was put into getting machinery into place and making them work. But the last few years we've had the opportunity to optimize the process more and more."

One step of development took place in 2011, when the plant started receiving organic waste from households.

"Before that, all incoming material was from slaughterhouse waste and other food industry remains. When we started receiving household waste new challenges appeared. You may think that sorted household waste is pure organics. Unfortunately, that's not the case. Gravel, glass, eggshell and cat sand are examples of particles that come with the household waste."

The problem with those high density particles is that they form a sediment in tanks and digesters. They are left in there, filling up valuable volumes.

"When we first began with household waste, we immediately saw that our storage tank was filling up with grit. During a period, we had to manually empty it as often as four times per year. That meant disturbances in production as well as added costs. Dry vacuuming the tank means 2–3 days of work."

This is where the Cellwood hydrocyclone comes into the picture.

Well-proven solution

Peter Ek is Cellwood's business developer and process specialist for bioenergy applications. "Cellwood's focus on bioenergy began in the early 2000s," Peter says. "At that time, I was responsible for our pilot plant, where we have a complete set of machinery installed for trials. Our background is in the pulp and paper industry, but through years of testing we have also built a big know-how on pre-treatment of organic waste. Based on this experience we have developed our machines, which are now found in bioenergy applications all around the world."

The reject consists of glass, gravel and sand.

"When we started our project we had seen other plants with Cellwood solutions," Erik says. "But our application had some differences which led to several specific requirements. We didn't want to dilute our substrate, so the hydrocyclone had to manage a consistency of 15% DS. It also had to work at temperatures of 70˚C and have a high selectivity for inert material."

"Our pilot plant is always an important part early in the projects," Peter says. "It gives us the possibility to test our machines on material from the customer's own plant. Depending on unique properties of each substrate – such as viscosity and reject content – we optimize all configurations."

"It was a big comfort to know that everything would work out with our specific material," Erik adds. "The trials were crucial to get the investment in place."

Three years in operation

Today the hydrocyclone has been operating at Tekniska verken for almost three years.

"We see that it is very useful," Erik says. "Since it was installed we've only had to dry vacuum the tank one single time. That's a huge improvement compared to every quarter, like before. Today the hydrocyclone separates nearly 650 tonnes of reject every year – that means more than ten tonnes per week!"

"Today the hydrocyclone separates nearly 650 tonnes of reject every year."

"Imagine all of that left in the tank!" Peter exclaims.

"It is more reject than we expected," Erik says. "But the quantity proves the value of separating the reject in a process friendly way. We don't want to be back in a situation with manual cleaning of the tanks."

"We have a number of hydrocyclones in operation in different plants around Scandinavia," Peter explains. "With years of field experience, we have developed our machine and optimized it for bioenergy applications.

Peter Ek and Erik Nordell fronting the hydrocyclone.

Data on the biogas plant at Tekniska verken

In operation since **1997**
Household waste since **2011**
Total amount of incoming waste **100,000 tonnes/year**
Incoming household waste **47,000 tonnes/year**
Production **120 GWh/year**

We have adapted the internal geometry and we have introduced ceramic treatment for better durability. How much the lifetime increases with the ceramics we still don't know – since it was introduced a few years ago, nobody has had to replace it!"

"The need for service is very small," Erik agrees. "Compared to emptying the whole tank the service costs are insignificant."

Less wear

The amount of reject that is separated depends on several factors – one is the number of times the substrate is recirculated through the hydrocyclone.

"It is important to optimize the operation for each specific substrate," Peter says. "Recirculation is a trade-off between separating the smallest contaminants without losing organic matter. The optimal balance is one example of know-how we've acquired through the years."

"About 2% of incoming material are high density particles," Erik says. "Analysis shows that the reject has an ash content of more than 80%. That means considerably less organic losses compared to dry vacuuming."

"The hydrocyclone typically handles particles in the range of 0.25 to 4 millimeters," Peter says. "The biggest particles are the first ones to be separated, then the process can be optimized to reach the smallest ones."

Not only does the hydrocyclone prevent sedimentation – it also leads to less wear on other machinery. Gravel and glass entering the plant would otherwise lead to shortened lifetime on pumps, pipes and agitators.

"In general we recommend installation of the hydrocyclone at the earliest possible stage in the process," Peter says. "That way you get rid of the particles before they can do any harm."

"In our case the hydrocyclone is recirculating substrate from a buffer tank," Erik says. "We have two such tanks of 700 m³ each, located between the pre-treatment and the biogas plant. We are currently considering the possibility of installing a second hydrocyclone, to increase capacity even more."

"For cases like this, Cellwood can offer a mobile test unit," Peter concludes. "It includes a sand dewaterer, instrumentation and PLC – all is ready to be connected to the customer plant. That is a both easy and realistic way to evaluate the effect of our hydrocyclone."