The paste tailings plant delivered by Outotec as an EPC project to Yara’s phosphate mine, increases tailings solids content, improves tailings beaching properties and extends the capacity and lifetime of the existing tailings storage facility.

**CHALLENGES**
- Tailings area was filling up
- Tailings with high content of coarse mica creating problems in mixing tanks, thickeners, pumps and pipelines

**SOLUTION**
- Initial test work and a pilot plant to test thickening, pumping and tailings discharge system
- Full-scale Outotec paste tailings plant delivered as an EPC project

**BENEFITS**
- Yara’s phosphate mine can continue operation until the end of its lifetime
- Increased tailings solids content
- Improved tailings beaching properties
- Extended capacity and lifetime of the existing tailings storage facility

Yara International ASA is a Norwegian fertilizer company. Its largest business area is the production of nitrogen fertilizer. Yara Siilinjärvi site in the Eastern Province of Finland consists of a phosphate mine, two sulphuric acid plants, one phosphoric acid plant, one nitric acid plant and one NPK-fertilizer plant. The mine together with the phosphoric acid plant supplies the phosphorus raw material to the NPK fertilizer plants and feed phosphate plant in Finland. Annually the mine produces about one million tonnes of apatite concentrate, and about ten million tons of tailings.
The Yara Siilinjärvi paste tailings plant has been in operation since February 2017.

Background to the project
In 2015, Yara’s tailings area was filling up and was close to its end of life capacity. Teija Kankaanpää, Head of Siilinjärvi Mine had three options: build a new tailings storage facility, raise the dams, or invest in new technology that would allow the use of the old tailings storage facility for years to come.

Not wanting to go the route of creating a new tailings pond and expanding the footprint of the facility, Teija decided to turn to a trusted partner.

Thickening of the Yara Siilinjärvi tailings was first studied in the 1980s. At the time, the technology to process tailings and achieve a two-degree or more beach angle at the tailings discharge was not yet available. The challenge was the unique properties of the tailings material. The material is coarse, but also contains a high proportion of mica and a fine fraction, which is difficult to aggregate with the coarse particles using flocculation. The material settles and consolidates rapidly to form a highly structured material at a high density and yield stress. This creates problems in mixing tanks, thickeners, pumps and pipelines, and causes blockages if the material segregates and consolidates.

In 2010, Outotec worked with Yara for a thickened tailings project at the Siilinjärvi site. The work included initial test work and sizing for two 35-meter high compression thickeners. Based on the test work, Yara commissioned Outotec to build a demonstration plant with a 14-meter thickener. The plant was in operation in 2013-2014. During its operation the design criteria for the full-scale thickener plant and discharge system was established. In 2015, Yara awarded Outotec with the €40 million contract for the full-scale paste thickening plant as an Engineering, Procurement and Construction (EPC) project.

Not wanting to go the route of creating a new tailings pond and expanding the footprint of the facility, Teija decided to turn to a trusted partner.

“The meaning of this project is that Siilinjärvi mine can continue operation until the end of its lifetime, which is today 2035.”

The third party equipment and services included positive displacement pumps, building and piping materials, auxiliary mechanical equipment, construction and installation work.
There are few companies in the world that can supply this kind of technology that we were looking for, and who had also track record in supplying this kind of plants,” said Teija. “We chose Outotec because they have good technology, and they were willing to offer us an EPC contract.”

In 2017, the paste plant with two 30-meter paste thickeners went through water testing in freezing minus 25 degrees Celsius (-13 degrees Fahrenheit) weather. The performance test passed within one month of the start-up, and the plant has been in operation since February 2017.

Project Scope
The scope of the EPC project included basic and detailed engineering, project management, procurement, construction and civil works for the foundation and buildings, installation of piping and equipment, site management, training, commissioning, start-up and the performance test. Outotec’s proprietary equipment included two 30-meter paste thickeners, OKTOP slurry tank and flocculant-dosing unit. The third party equipment and services included positive displacement pumps, building and piping materials, auxiliary mechanical equipment, construction and installation work.

Outotec Paste Thickeners
- Diameter 30 m and height 26 m
- Feed 45-48% w/w solids; slurry flow 1720 m³/h
- Underflow 68-70% w/w solids; slurry flow 940 m³/h
- Overflow to water ponds; flow 810 m³/h

Thickener developments have been in important part of the successful operation
While paste thickening is not new, it still comes with challenges and risks, especially with material behaviour as seen with the Siilinjärvi tailings. Through the piloting work and with new developments in Outotec Paste Thickener mechanism design and control systems, solutions to these challenges have been realised. The combined results deliver reliable and predictable performance for paste thickener applications.

Co-operative approach delivers results
The new, high-density tailings disposal system is able to increase the overall percentage of solids in the slurry, which has a significant impact on how it can be stored. In fact, projections suggest a potential beach angle of four degrees, meaning the material is so thick that it forms piles. Higher-density tailings also minimizes chances of leaks and seepage from the storage area, improving safety. Meanwhile, reclaimed water is returned to the process, reducing overall costs and waste.

The project brought with it plenty of challenges that Outotec and Yara had to overcome. As Teija puts it: “We have had some tough times during this project, which is happening in all projects. Nothing new in that one, but we were able to solve even the difficult problems in co-operative way. I have to give credit also to Outotec’s good safety performance and safety attitude during the project.”

She continues: “The meaning of this project is that Siilinjärvi mine can continue operation until the end of its lifetime, which is today 2035. For the Siilinjärvi town it means that there are around 800 jobs still existing here for the years to come.”
Outotec provides leading technologies and services for the sustainable use of Earth’s natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec shares are listed on NASDAQ Helsinki. [www.outotec.com](http://www.outotec.com)