

Unique Mine and Process

High Efficiency with Bioleaching and adapted Filtration



Talvivaara is one of the few mines the world using bioleaching.

I. Pöllänen, Finland

Finland is currently witnessing several mine site establishments as the traditional industry strengthens its position within the Nordic countries. Talvivaara Mine is a great example of how alternative mining methods can be economical and how determination and cooperation can spur entry into the global mining markets, sustainably and cost effectively.

Talvivaara is a relatively new, large scale open pit mine project in the north of Finland southeast from city of Kajaani. Talvivaara's mineral resource is 1550 million tonnes with 1121 million tonnes (72 per cent) in measured and indicated categories. The mined ore is further processed to nickel-cobalt sulfide, zinc sulfide and copper sulfide. The ore body is estimated to support anticipated production for several decades.

The entire project has moved on quickly, considering the Talvivaara company was established in 2003, and the mining concessions and exploration and research

data were gained in 2004. In 2005 a 17 000 tonne on site bioheapleaching trial was conducted, and an environmental permit was received in early 2007.

In 2006 Outotec (Larox at the time) was asked to quote for filters for the Talvivaara mine for zinc and nickel processing using the bioleaching method. The deal between Outotec and Talvivaara was closed in 2007, and at that time it was the largest single order in Larox History (now Outotec). In winter 2007 the pilot heap was reclaimed and the secondary leaching phase began. Mining of ore was started in 2008, and the first delivery of nickel

product to Norilsk Nickel in Harja-valta was completed in February 2009.

The Talvivaara Project

Talvivaara is unique in many aspects as it is one of the largest mine sites in Europe, and one of only a few in the world using the bioleaching method for nickel. It is a greenfield project that developed rapidly from the beginning. This has been possible due to the mine owners' persistence, determination and long and thorough pre-work.

"Bioheapleaching is the optimal method for us as the ore amounts are large and the metal grade in the ore is low," states Tapio Hyödynmaa, Talvivaara Mine Project Manager.

"This method provides us with low unit costs for production. Bioleaching is a more cost efficient and less energy intensive process than traditional methods of concentration, in addition proving the benefits of large scale production," Tapio continues.

“The customer’s determination has been obvious from the start of the project, as they knew from the beginning what they wanted. They had selected the technology and determined the capacity needs in a very early stage of the project,” states Reijo Kilpinen, Outotec Project Manager.

The delivery of Outotec Larox RB-SV filters to Talvivaara was agreed to be conducted in two phases. Phase one included five filters, vacuum pumps, filtrate tanks and pumps, air separation tanks and Flowsys hose pumps. The filters were delivered for nickel cobalt, zinc and pre-neutralization purposes.

The installation of the filters took place during summer 2008, and the first slurries were filtered later on that year. The second phase of the delivery includes seven filters with auxiliaries as in phase one. They were mechanically installed during 2009 and are ready for start up during the beginning of summer 2010. Both of the delivery phases included filters for nickel and zinc filtration and for pre-neutralization. In ad-

dition, the second phase includes two filters for copper filtration.

Filtration is essential

The filtration is an essential part of the Talvivaara process as it provides the last phases of the process before delivery to Talvivaara’s customer. For easier handling and to cut down the delivery costs, the cake should be as dry as possible. As the slurry is wet, and must go through three washing stages, the expectations for the filter performance are high as the end moisture must be < 20 per cent.

“There are several stages in the filtration process and as there is alkaline solvent in the slurry, cake washing must be performed several times,” states Tapio. The filters used in Talvivaara are a special design and the filter has been further developed in cooperation between Outotec and Talvivaara.

The filter itself is adjustable, which offers plenty of flexibility to better meet the process requirements. The reason why the



The special design of the filter make the cake significantly dryer than standard designs.

Larox RB-SV belt filter is able to meet the moisture levels with Zn, Ni/Co, is because the filter has a special design with press roller, which makes the cake approx. 8 per cent dryer than standard designs.

The installed filters have been able to meet the challenges of the bioleaching process and offer Talvivaara dry cake, clear filtrate and good cake washing as process results. In addition, the filters are big enough to handle the large capacity. In Talvivaara two production lines are required to manage the extensive amount of slur-



Tapio Hyödynmaa,
Talvivaara Mine
project manager.



The Outotec Larox vacuum
belt filters of the first
delivery phase in operation.

ries and to ensure that the slurry volumes do not grow to be too large to handle.

“We have created together a prototype from this filter, there have been some challenges but still the filter gives better wash results than we expected. The moisture expectation level was 30 to 40 per cent but the filter performs to 20 per cent,” Tapio compliments.

Continuing Cooperation

As both the filters and the process have been through a development process it has created great opportunities for cooperation and development on both the filter

supplier and the customer side. “We have created many new solutions and developments together, which benefit us both and we have been able to reach good results,” Reijo Kilpinen says. A new mine site, a new organization and a new process will always bring challenges. Also the new technology of bioleaching is a challenge, which cannot be met with traditional methods. Most essential in projects such as this is the cooperation and open relationship.

“I believe Outotec main benefits to Talvivaara are that we are a reliable partner, who is available and geographically ideally located. The good cooperation has already resulted in product development and customer’s process development, and

we are able to keep up constantly as the customer’s slurry develops. The close cooperation gives possibilities to enhance our know-how and technologies to serve the customer needs,” Timo Rantala, Outotec Regional Manager, states. ■

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Bioleaching in Talvivaara

The Bioleaching method is a natural process, whereby metals are leached from ore as a result of bacterial action. It is a relatively slow but cost effective way to recover natural metals from the soil.

Bioleaching is triggered spontaneously by micro-organisms in the presence of air and water. Several physiochemical and microbiological process parameters are modified in order to enhance and speed up the metal recovery process. The process includes four main phases; mining, crushing, bioheaping and metals recovery.

- Crushing is done in four stages, followed by agglomeration with sulphuric acid in order to consolidate the fines with coarser ore particles.
- After the agglomeration, the ore is conveyed and stacked eight meters high on the primary heap pad for 1,5 years of bioheaping. The heap pad is equipped with piping, laid on the bottom of the pad, through which low-pressure fans supply air to the stacked ore. From the top, the heap is irrigated with leach solution, which is recycled through the heap until its metal content is sufficient for metals recovery” (Talvivaara). Pure natural fresh water is also being pumped to the pile, as the water includes natural bacteria, which speeds up the metal re-

covery process. The bacteria used in the bioheaping grow naturally in the ore and are well adjusted to the environmental conditions.

- After 1.5 years of leaching on the primary pad, the leached ore will be reclaimed, conveyed and re-stacked onto the secondary heap pad, where it will be leached further in order to recover metals from those parts of the primary heaps, where leach solution has had poor contact. Such areas include, for example, the slopes and possible precipitates formed inside the heap. After secondary leaching, the barren ore will remain permanently on the secondary heaps.
- Underneath the soil the enriched metal is being collected for further refining. In metals recovery, nickel, copper, zinc and cobalt are precipitated from the pregnant leach solution and filtered to produce saleable metal products.

In the further phases of the process Outotec filters are used to filter the zinc, nickel and tailings for further processing and the filtrate from each phase is returned to irrigate the heaps. Despite the northern location of the mine site, even during harsh winter, the stack temperature remains between 50 to 60 degrees celsius.