Environmental dredging project in Finland

A 1,7 million euro environmental dredging project was completed during fall 2003 in Lake Lohja in Finland.

Background

Typically untreated paper mill waste waters contain wood fibres and clay. Until the 80s waste waters were only mechanically screened and allowed to settle before pumping them back into the natural waters. Thus close to old paper mills lakes typically have sediments of fibres and clay on the bottom. This sediment may be toxic or non toxic depending on the process used at the mill. However the sediment always contains vast amounts of organic material, which has a negative impact in the lake´s nutrient balance and oxygen content and thus water quality. Today new sedimentation is practically eliminated by effective effluent treatment plants, but the old sediments from the past still lie in the lakes.

Conditions at Lake Lohja in Finland have followed this path. The paper mill effluent has been pumped into Osuniemi bay since the paper production started in Kirkniemi in 1966. A 10 - 100 cm thick sediment layer from the early years of operation covers the bottom. The bay area is 10 hectares and the average depth is less than 2 m. The paper mill built a modern effluent treatment plant in the 80s, and after that new sedimentation has practically stopped.

In the 90s the University of Turku carried out a sediment study at Osuniemi bay. The sediment was detected as the biggest single source of internal phosphorous in Lake Lohja. Removing this sediment would improve water quality in the lake more than any reasonable investment in the already modern effluent treatment plant of the paper mill. No toxic compounds were detected in the sediment.

The planning of Osuniemi bay rehabilitation started in cooperation between M-real Kirkniemi paper mill and the Finnish Environmental Institute. The sediment layer thickness was measured, and a 3-dimensional sediment map was made over the bay area. Different methods of removing the sediment were examined and analyzed. The final conclusion was that carefully executed environmental suction dredging and sediment disposal into a pond on the land was the most effective and environmentally friendly method to remove the sediment.

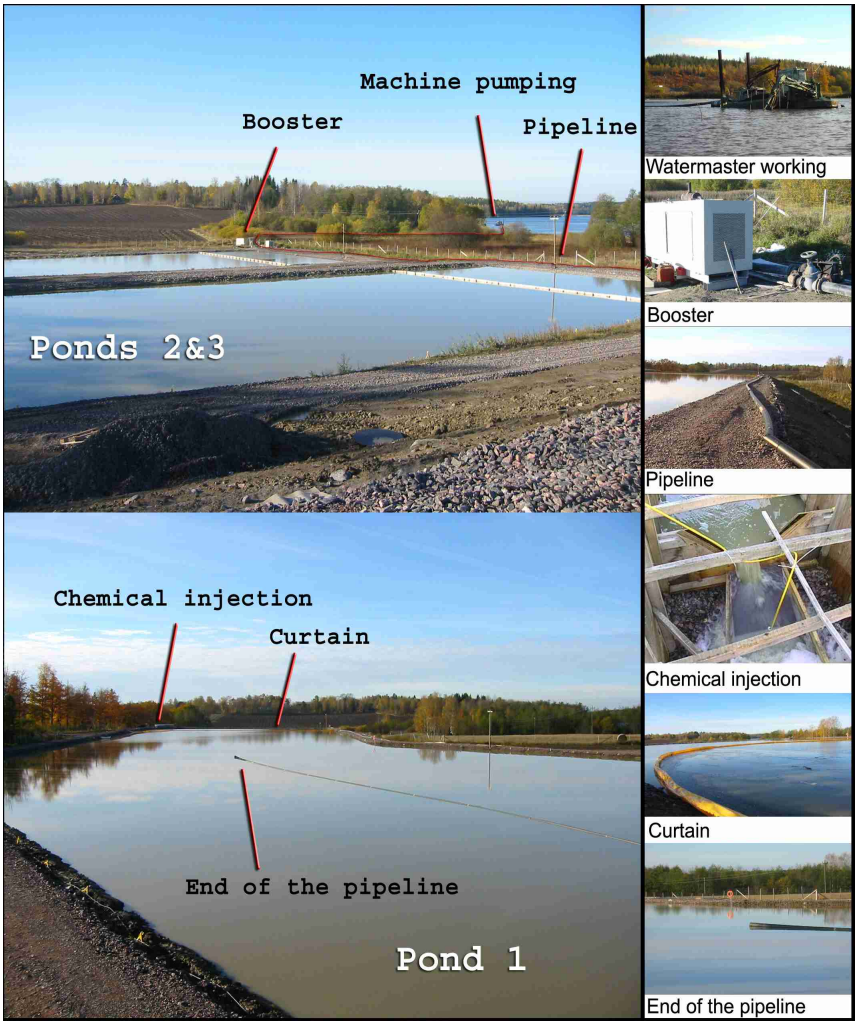
Test environmental suction dredging was carried out in 1997. The impact of dredging on the water quality was carefully monitored, sediment settling speeds with and without chemical additions were measured and settlement pond sizes were estimated. After completion of the rehabilitation plan and evaluation of the environmental impact a dredging permit was applied for from the water authorities. The permit for executing the project was issued in 2001.

Project implementation

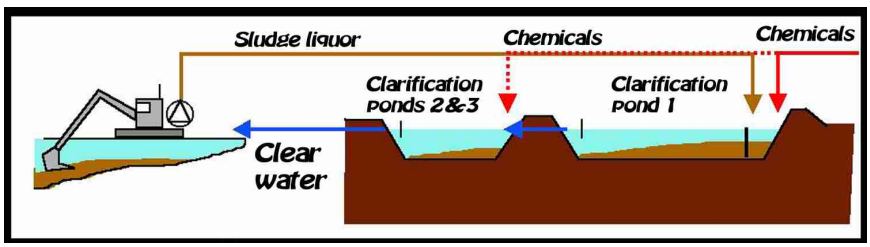
Three settlement ponds were constructed in the spring of 2003. They are located about 0,5 km away from the bay. The primary sedimentation pond has a capacity of 70 000 m3. Two secondary sedimentation ponds are 4200 m3 and 2700 m3, respectively. The ponds are connected together in series. To enhance settling speed and phosphorous and solids removal polyaluminium chloride (PAC) dosage was arranged in the pipeline from the dredger to the primary sedimentation pond. PAC and polyelectrolyte were also dosed between the primary and secondary ponds.

To execute the dredging work M-real chose an experienced reputable Finnish company, which operates Watermaster Classic dredger. Several facts supported this selection:

- Osuniemi Bay is shallow and the bottom is soft. No other suction dredger can effectively operate in the area.
- Before the suction dredging it was necessary to dig flow channels and ditches in the soft wetland area. Watermaster is also a backhoe dredger, and thus it can also perform the digging part of the project.
- The surface area to be dredged is quite large (60 000 m2), but the layer to be removed is relatively thin. Also the thickness of the layer to be removed varies from place to place (20 - 100 cm), but at each place the layer removed must be accurate (within +- 2 cm). The settlement pond capacity did not allow any over dredging. Watermaster was considered to have the accuracy and efficiency to fulfil these requirements
- The consistency of the dredged mixture must be as high as possible. Watermaster pump bucket with submersible dredging pumps is able to meet this requirement
- The 3 month time frame to do the dredging work demanded an experienced reputable operator.



Before the dredging started in September 2003, the bay mouth was closed with silt curtains. Also the Watermaster Classic was equipped with an integrated DGPS and depth measurement system to meet with the tight accuracy requirements.



Results

In November 2003 the dredging had been successfully completed on time. The bay had been dredged everywhere, where the original sediment thickness was 20 cm or more. This corresponds to 6 hectares dredged area and 40 000 m3 of sediment removed.

Controlling of the dredging progress and dredging accuracy was effectively arranged. The dredge master had a screen in the cabin showing the real time actual sediment map. This enabled him to selectively dredge the paper mill sediment only, although its thickness varied considerably even within small areas. The dredge operator e-mailed the actual sediment map to the M-real project manager every week.

Water returned to the lake was analyzed regularly. Daily return flow analysis included solids content, turbidity, conductivity, pH and flow measurements. Chemical dosages were adjusted daily. Total nitrogen, phosphorous, oxygen demand and other parameters indicating the nutrient content in the return flow were analyzed from weekly collection samples. Good control over the sedimentation process was a mandatory prerequisite to achieve the environmental targets of this project. The settlement pond arrangements used in Osuniemi bay fulfilled expectations. For instance the average return flow solids content value over the whole project was less than 0,002 % (20 mg/l). Visually the return flow water was all the time as clear as the lake water.

Thick mixture coming from the dredger to the 1st sedimentation pond

Today the removed sediments lie in the settlement ponds, and they do not pollute the lake any more. After the pools have dried enough, they will be covered with fresh soil and the area will be landscaped. The recreational value of Osuniemi bay has considerably improved through this project.

Clear return water from the 3rd sedimentation pond flows back to the lake

The water quality in Lake Lohja has been monitored closely for several decades. Regular water samples and analyses reveal trends and changes in water quality in various parts of the lake. In the coming years we will see how big improvement this 1,7 million Euro environmental dredging project has made in the water quality in Lake Lohja.

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