



## DHI CASE STORY

# ASSESSMENT OF TAILINGS MANAGEMENT FACILITY

## Evaluation of geochemical and hydrological impacts from a phosphogypsum stack

The materials left over after separating the valuable from the uneconomic part of phosphate rock are cumulatively known as 'tailings'. The phosphogypsum stack at the island of Gråen (Gipsön, Sweden) was established in the 1970s as a tailings management facility for the nearby phosphoric acid production plant owned by Hydro Agri (now YARA AB). After the plant closed down in the 1990s, monitoring of the site continued for two decades. In order to assess future environmental protection measures for the site, YARA AB needed detailed information on the current status of the tailing facility. We helped them do this by conducting an in-depth site assessment, including sampling as well as hydrological and hydrogeochemical modelling.

### OPTIMISING SITE MANAGEMENT, MAINTAINING ENVIRONMENTAL PROTECTION

Over a period of almost 15 years, some 4 million m<sup>3</sup> of waste gypsum slurry with very low pH was deposited in a 320,000 m<sup>2</sup> tailings disposal site called Gipsön. The waste slurry stemmed from the nearby phosphoric acid factory, which was closed in the 1990s. After the closure of the acid factory it was decided that collection and recirculation of treated leachate as well as substantial monitoring of the site should be carried out for approximately 20 years. YARA AB wanted to assess the current status of the disposal site. This would enable them to decide whether, in the future, the site management could be changed to less extensive measures while maintaining a high level of environmental protection.

### SUMMARY

#### CLIENT

YARA AB, Sweden

#### CHALLENGE

Need to:

- Understand the current quality of leachate
- Know whether leachate treatment can be stopped and alternative measures adopted

#### SOLUTION

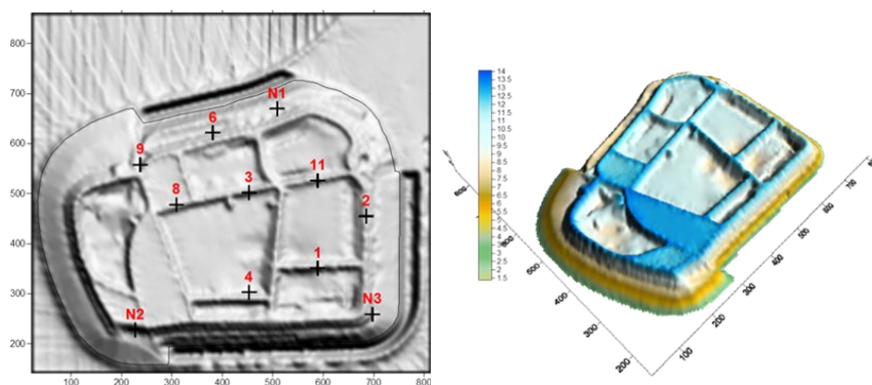
Detailed site assessment, including sampling at the site as well as hydrological and hydrogeochemical modelling

#### VALUE

- High quality site-specific data
- Assessment of potential impacts of the closure of current environmental protection measures
- Potential cost savings by assessing aftercare period for the site

#### LOCATION / COUNTRY

Gipsön, Landskrona, Sweden



A digital elevation model, including the location of sampling points (left), was set up in order to calculate the groundwater volume at the site. © DHI

In order to do to so, the client needed answers to the following questions:

- How did the pH develop? What is the leachate quality at present?
- What development in leachate quality can be expected for the near future?
- What is the outlook with respect to leachate treatment?

### DETAILED SITE DESCRIPTION

We helped YARA AB to reach a qualified decision by:

- setting up and performing a detailed sampling programme
- evaluating the obtained data
- assessing the current status of the phosphogypsum stack

First, a third party contractor performed drilling at Gipsön to extract groundwater and gypsum samples from the disposal site and collected leachate samples. We then sent the samples to another contractor, who conducted a chemical analysis for a full spectrum of elements.



Images from sampling at the phosphogypsum stack, Gipsön, Landskrona, Sweden. ©DHI

### ASSESSMENT BASED ON SITE SPECIFIC DATA

By combining historical data with the newly obtained data, we were able to assess the current status of Gipsön and to predict the development in leaching behaviour based on observed trends. Although leachate concentrations have decreased over the past years there is still a need to treat and neutralise the leachate collected from the site since pH values are low.

### MODELLING GROUNDWATER AND LEACHING

We used the geochemical models Objects Representing CHEMical Speciation and TRANsport (ORCHESTRA) and

PHREEQC models to calculate solution speciation in order to confirm and explain observed trends in leaching. Speciation calculation and subsequent geochemical modelling helped us identify the chemical processes that influence the leaching behaviour of metals and other elements present in the deposited gypsum slurry. We used site specific data as input for the models.

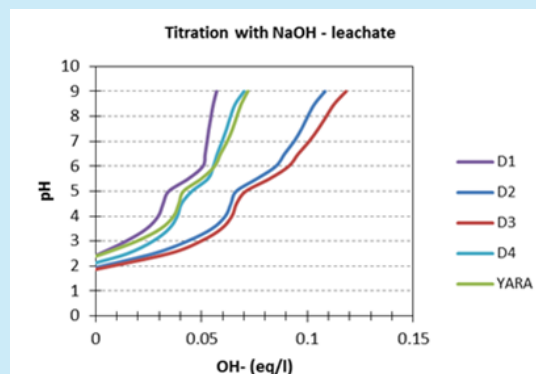
We estimated the amount of residual pollution present in the groundwater at the disposal site. This is the amount of pollution that can potentially affect the surrounding environment. We then used Surfer® to calculate groundwater volume and pollution levels. In addition, we estimated the amount of chemicals needed for neutralisation of the leachate from the site. This was vital information for YARA AB with respect to future leachate treatment. We were able to provide this information by combining test data derived in our laboratory and data from a modelling exercise carried out in PHREEQC.

### THE BENEFIT OF INTEGRATED SOLUTIONS

By combining site specific monitoring and test data with numerical modelling, we were able to predict potential environmental impacts and do a forecast for future operations at the site. Our assessment provided YARA AB with the necessary answers to reach a qualified decision on the future management of the disposal site.

#### SPECIALISED TESTING AT IN-HOUSE LABORATORY

We operate an environmental laboratory in Hørsholm, Denmark. Our laboratory and testing facilities enable us to carry out routine tests as well as specialised and tailor-made tests for our clients. This allows us to generate site specific data when needed. For this project, we carried out the proper handling and treatment of samples taken at the disposal site, before handing them over to the chemical laboratory. Our titration experiments provided YARA AB with valuable information on resources that would be used for future leachate treatment at the disposal site.



Calculated titration curves. © DHI

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