Aspects of limestone mining

Chief Geologist Häkan Pihl, Nordkalk Corp.
Limestone – part of our everyday life

Limestone-based products play an important role in the manufacture of most of the necessities each one of us uses daily – starting from bread and water.
Rettig Group – value for generations

Turnover about 898 million euro • 4,204 employees in 28 countries • www.rettig.fi

Indoor climate comfort
www.rettigicc.com

Europe's leading supplier of heat emitters and indoor climate comfort.

Limestone-based products
www.nordkalk.com

Northern Europe’s leading supplier of limestone-based products for industry construction, agriculture and environmental care.

Industrial shipping services
www.bore.eu

European industrial shipping service provider.
Mission, vision and values

Rettig mission
We create value for generations through sustainable and long-term growth.

Nordkalk mission
More clean water, food, energy, and products with less resources and emissions.

Nordkalk vision
“Northern Europe's leading supplier of limestone-based products. Growth from high value businesses and new markets.”

Our shared values:

Openness    Fairness    Modesty    Trust and respect
Sales by customer segments

Main products

- Limestone
- Limestone Powder
- Paper Pigments
- Quicklime and Hydrated Lime
- Others

% of turnover in 2015

- Agriculture
- Environment
- Other Industries
- Metals & Mining
- Construction
- Pulp & Paper

Sales by customer segments
PART OF THE COMMUNITY

NORDKALK IN BRIEF
1898
Nordkalk’s story begins

2010
Rettig Group acquires full ownership

2016
Northern Europe’s leading supplier of limestone-based products
Varied geology

- The existing geologic base must be considered
- Explains partly the number of sites
- A general outline of where to do prospecting for certain qualities of limestone
Right stone for right application

- Approximately 13 million tons of limestone per year
- Wide range of geological types and qualities of limestone

1900 million years old
Crystalline limestone from Pargas, Finland
Suitable for e.g.:
- Construction materials
- Fillers
- Paper Pigments

430 million years old
Silurian dolomite from Kurevere, Estonia
Suitable for e.g.:
- Fertilizers
- Mineral wool
- Soil improvement

430 million years old
Silurian limestone from Gotland, Sweden
Suitable for e.g.:
- Steel industry
- Chemical industry
- Sugar industry
- Environmental applications

180 million years old
Jurassic limestone from Wolica, Poland
Suitable for e.g.:
- Flue gas cleaning
- Agriculture
Mostly open pits but also three mines
History

- Nordkalk’s history began in 1898 in Finland when the joint-stock company Pargas Kalkbergs Aktiebolag was established. The name was changed later to Partek. Nordkalk was part of Partek until February 2003.
- 1980s: Leading producer in the Nordic region – Sweden
- 1990s: Leading producer around the Baltic Sea – Estonia and Poland
- In August 2010 Rettig Group acquired full ownership of Nordkalk.
Nordkalk in a nutshell

Sales by customer segments

Main products

Turnover MEUR

EBITDA MEUR

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover</th>
<th>EBITDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>369</td>
<td>62</td>
</tr>
<tr>
<td>2012</td>
<td>351</td>
<td>53</td>
</tr>
<tr>
<td>2013</td>
<td>358</td>
<td>60</td>
</tr>
<tr>
<td>2014</td>
<td>332</td>
<td>59</td>
</tr>
<tr>
<td>2015</td>
<td>311</td>
<td>56</td>
</tr>
</tbody>
</table>

Turnover
EBITDA

Nordkalk | Member of Rettig Group
Mining volume was 14.1 Mtonnes in 2015

- Biggest quarry in Poland
- 2 Mtonnes other rocks removed
- Silicate rock of aggregates quality in Finland
- Wollastonite production in Lappeenranta
Long term approach in our business

- Nordkalk’s history dates back to 1898 and the mother company Rettig’s mission is *value for generations*.

- Typical issues in the minerals business:
  - Long payback time on investments
  - Long customer contracts

- Important issues are:
  - Secured access to the raw materials base – possibility to invest
  - Competitiveness through a local raw material base
  - Competitive and profitable companies can carry their social responsibility
Legislation differences

- **Finland**
  - Regulation within the Mining Act
  - The rights to a deposit can be claimed
  - Compensations to the land owner

- **Sweden**
  - Quarry permit within the scope of the Environmental Act
  - Limestone is not a concession mineral
  - Land owner mineral
    - Usual procedure is to buy the land

- **Estonia**
  - Natural resource compensated to the state

27/04/2016
A predictable (and short) permit process is desired

- **Finland**
  - Mining license granted by the Mining Authority (subordinate to the Ministry of Enterprise)
  - Environmental permit granted by the Regional State Administrative Agency

- **Sweden**
  - Quarry (and environmental) permit is granted by the County Administrative Board or the Land and Environmental Court

- **Estonia**
  - Environmental Board
  - Environmental Ministry
  - Multiple permits (Mining, Land lease, Water, Air, Waste)
Geological survey (investigation issues)

- Finland
  - Investigation permit granted by the Mining Authority or agreement with the land owner

- Sweden
  - Agreement with the land owner
  - Limestone is a land owner commodity
  - Announcement to the County Administration Board

- Estonia
  - Investigation permit
    - Seems more regulated on plans of what will be done

27/04/2016
Exploration – mainly expanding where we are

- The aim is to secure the raw material to our production plants

- When a deposit is exhausted we look for new ones, preferably in close neighbourhood

- Ideally we are aiming at 30 years of reserves base for each site
Exploration methods

- Starting with general areal geological knowledge
- Old areal drilling data if available (in Estonia usually, yes)
- Understanding of the region as such
  - Co-operation with universities or Geological Surveys
- Limiting the potential area of interest
- Geophysics gives useful information on depth, is non-destructive and helps to plan drilling
- Diamond drilling gives the best verification
  - Sampling and chemical analysis
GTK spatial databases

- Geological mapping
- Mineral resources
- Airborne geophysics
  - Magnetics
  - Electromagnetics
  - Radiometrics
- Geochemistry
  - Till
  - Bedrock
  - Ore showings
  - Boulder samples
  - Drilling data
  - Assay data
RMT12 Geophysics instrument

- Radio Magnetotelluric method
- Reflections based on radiomagnetic signals from distant transmitters
- Resistivity measurements
- Good experience in sedimentary limestones; Sweden, Poland, Estonia.
- Nordkalk has financed its own R&D project and we do now have an instrument for use
Geophysics penetrate the underground

- In ideal cases the interpretation may be very good
- Permit by land owner should be enough as nothing is destroyed
Biogeochemical exploration

- Chemical analysis of soil organic matter, peat, and plant tissues
  - Bedrock minerals affects the chemistry of plants e.g. via groundwater
  - Anomalous concentrations of certain elements indicate mineralizations. (P. Närhi 2013)

- Exploring the chemical response of organic matter to a known limestone deposit mineralization
Biochemical exploration

- 40 samples, 5 duplicate samples and 4 reference samples
  - Sample type; pine
  - Sampling linearly over the deposit (2a-c)
  - In cooperation with GTK

- Samples were sent to Canada were the branches and needles were analyzed separately.
  - The final report -by the end of January (GTK).
Mine survey moving to UAV age

- UAV in mine survey and storage investigation
  - Improved accuracy and productivity
  - In the future (maybe) also carrier for remote sensing cameras

- Liberate regulations in Finland – within sight distance

- Not approved for mine survey in Estonia so far?
Good experience in Finland

- Easy to get the prospecting permit
- Ongoing process to review the Mining Act and to reduce regulations in some aspects
- The possibility to claim the right to a mineralisation may pave the way for access without being forced to buy the land
Good experience in Sweden

- Geological survey may be done with land owners approval

- It used to be convenient to agree upon land purchasing. Limestone may also be exploited based on land owner agreement. Environment (quarry) permit is needed

- All legislation and permitting within the Environment Act guarantee in theory a ‘one stop shop’
  - Though evaluation

- Public interest (compare EU project MINATURA)
  - Valuable mineralisations (deposits) are pointed out by the Geological Survey and they are considered in the land use
Multiple permits add to the application period

- Recent Estonian examples
  - Geological survey permit: 14 months
  - Mining permit renewal: 20 months
  - Land lease agreement: 12 months
  - Additional permit needs:
    - Air
    - Water
    - Waste

- The process seems quite long as total
- Simplified or parallel processes would be good from a enterprise point of view
3 totally different Estonian carbonate deposits

✔ Karinu / Rakke is the quick lime raw-material. Lime kiln feed.

✔ Vasalemma is the limestone powder raw-material. NOT suitable for burning. Decr iptitates if burned.

✔ Esivere is the dolomite deposit.
Quality aspects according to customer needs

- No limestone deposit fulfills the requirements by every customer
  - There is a need of access to different limestone qualities
- High quality lime kiln raw material is scarce
  - High chemical purity
  - Good thermal behaviour – producing lump lime
- Balance issues – targeting efficient use of all mined natural resource

- THE CUSTOMER REQUIREMENTS ARE GUIDING US
NOT JUST LIME
BUT RESPONSIBILITY FOR A SUSTAINABLE TOMORROW
Survey of entire life span from start

- After care is described in the application phase
- Nordkalk is now converting to the international IFRS accounting standard. Monetary reservations must be made over the entire life span right from start.
- In Nordkalk we apply internal ‘Recultivation Data Sheets’ to document the preliminar recultivation plans for each site
  - The plans are revised as time pass
After-care options in a swedish application

- Financial guarantee in this case given as part of the permit

- In final stage and before final decision a dialogue with the local community and stakeholders is recommended

Cultural venue  Lake Bunge  Fresh water reservoir
Quarry and mine site reuse (circular thinking)

- Quarry
  - Back to nature concept, with restored/improved biodiversity
  - Water reservoirs
  - Recreation – lake
  - Culture – concert facility
  - Tourism – museums, restaurants
  - Race track
  - Wind mills
Additional activities in Tytyri underground mine

- museum on level +110
- water sold to the city of Lohja
- empty stopes filled with e.g. fly ash
- an old shaft rented by KONE oy (scy scraper elevators being tested)
- old tunnel being used for measurements by the Institution of Geodecy
Tänan kuulamast!

Thank you for Your Attention