LAYMAN'S REPORT

ABSOILS

Sustainable methods and processes to convert abandoned low-quality soils into construction materials

LIFE 09 ENV/FI/575

RAMBØLL

Rudus

Lemminkäinen

BACKROUND

Construction activities are among the biggest waste producers in Europe. Waste rock, redundant soil and sediments are the second largest waste stream in Finland. Finland shows also a very high percentage of the average annual use of material - 35 tonnes per person - whereas the average in Europe is 16 tonnes per person. Finland is constantly undergoing the process of infrastructure development. The development of industrial activities frequently results in a demand for a new land in the vicinity of the main operation. In many cases, there is a shortage of land that is characterised by good geo-technical features or there is a need to rehabilitate or clean-up the contaminated land. In such cases, the most common solution is mass exchange including transportation and landfilling of poor quality soils.

Some of the left-over masses like stone materials can easily be reused in on-going and future construction works, for instance in noise barriers or fillings. However, there are other spoils like muddy clay, silt, humus or peat which are challenging for reuse. Unfortunately, landfilling is a common practice as soft soils are generally considered unsuitable construction material. This exerts a negative impact on the environment due to associated transportation and the need to increase landfill capacity. In many cases – especially in the vicinity of cities – surplus soils landfill capacity is exhausted and soil masses need to be transported for considerably long distances to available reception sites. In general, landfilling of soft soils brings about the necessity of importing non-renewable virgin materials (e.g. natural gravel or crushed rock) as replacement. This requires quarrying and transportation with all the associated negative environmental impacts such as landscape deterioration, deforestation, ground water pollution and greenhouse gas emissions.

WHY ABSOILS PROJECT?

- The Absoils project came as a response to the problem of surplus, excavated soft soils resulting from infrastructure development
- In the Uusimaa region alone, the amount of the annually generated surplus soils - in most cases soft clays - has been about 4 million tonnes per year
- In the year 2009, the annual generation of excavated soils in Helsinki was about 0,6 million m3. At that time, 70% of this amount was landfilled
- In 2012, the landfill for surplus soil masses in Helsinki was closed down due to its exhausted capacity and transportation distance increased up to 40 km
- At the same time, various industrial activities generate versatile waste streams which in most cases are still deposited in landfills. From the economic and environmental point of view, this constitutes a considerable loss with serious negative impacts on the state of the environment and the competitiveness of the EU
- There has been a burning need to change this situation, which is possible only when successful pilot applications set an example to follow and provide reliable and verified data on the material engineering and environmental properties, their performance (also long-term) and economic factors (actual savings that can be obtained with the use of alternative solutions).

AIMS AND OBJECTIVES

- To address the challenges of the European policies and legislation concerning waste
- To promote waste recovery and sustainable recycling with a focus on life-cycle thinking and the development of recycling markets
- To tackle the challenges related to surplus soft soils and their conversion into useful earth construction materials including the use of fly ash as a binder material in stabilisation process
- To provide technical, environmental and methodological data and information on materials, materials mixtures and additives, their treatment, as well as the diverse stages of construction
- To demonstrate the practical implementation of four challenging types of civil-engineering applications in full-scale pilots based on the use of redundant soft soils: flood barriers, noise barriers, supporting banks and landscape construction.
- To create and demonstrate a Model for Sustainable Regional Material Service System (RMSS) for the Uusimaa region. The role of the RMSS is to direct the use of regionally generated surplus materials to short-term and long-term infrastructure construction projects with the assistance of an Internet operated database.

SOIL IMPROVEMENT METHOD USED IN THE PROJECT PILOTS

With the application of proper design and innovative treatment methods, surplus soft clays and sediments can be turned into construction materials. The prevailing soil improvement method used in the ABSOILS project was mass stabilisation.

Mass stabilisation is the process of utilising chemical admixtures and stabilising agents to alter the engineering properties of a soil mass so that cost-effective development results are achieved. The goals of the mass stabilisation programme are typically to improve the geotechnical engineering performance of a given subgrade, or to achieve environmental performance objectives. The application of mass stabilisation techniques alters the technical engineering and environmental properties of soft soil in such a way that it is possible to construct directly on top of the stabilised soil or to utilise it as filling or construction material. Owing to the development of versatile binders, various kinds of soft soils can be stabilised in a cost-effective way.

All mass stabilisation projects utilise a binder, or chemical stabilising agent which reacts with the soil mass to change its properties. As a result of the ground investigation and laboratory testing programmes, the quantity and quality of the binder are optimised to achieve target properties with minimal investment. The use of various industrial by-products as binders in mixtures with commercial binders enables cost-effective application of the mass stabilisation method.

PILOT APPLICATIONS

- **Flood barriers**
  - Dog Park in Espoo (2012/2013)
  - Pirttiranta in Vantaa (2012)

- **Noise barriers**
  - Jätkäsaari 3 IN Helsinki (2014)

- **Supporting banks**
  - Arcada 2 in Helsinki (2011)
  - Dog Park in Espoo (2012/2013)
  - Honkasuo in Helsinki (2014, 2015)

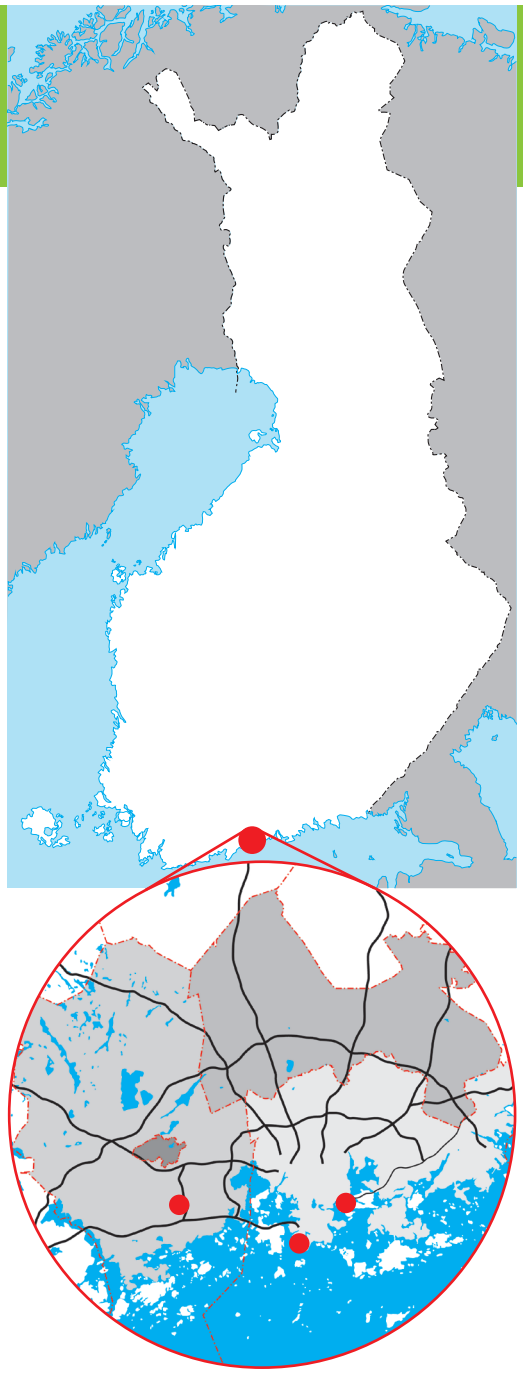
- **Landscape construction**
  - Jätkäsaari I ja II in Helsinki (2011/2012/2013)
  - Dog Park in Espoo (2012/2013)

RESULTS

The ABSOILS project has provided the stakeholders with new knowledge and guidance (European Guidelines) on the possibilities and methods of using earth construction materials based on various types of redundant, poor quality soils. The project has served as a successful example demonstrating environmental and economic benefits based on the utilisation of surplus soft soils for versatile engineering purposes.

Quality control activities, as well as the LCA studies carried out in the framework of the project provide the construction sector with reliable data on how such materials fulfil the technical and environmental criteria set for intended applications. The LCC study gives a proof of the economic competitiveness of the project pilot solutions.

The project has created an efficient and user-friendly system – the RMSS - that will allow for monitoring the current and future sources of surplus soils in order to plan their effective utilisation.



ENVIRONMENTAL BENEFITS

The most important impact on the environmental problems targeted has been exerted by the implementation of the Piloting Actions.

- The piloting actions (Arcada 2 and Jätkäsaari I and II) allowed for the stabilisation and utilisation of 142 000 m^3 of surplus soft clays and dredged sediments, and owing that the need for landfilling of these masses was minimised
- The Pirttiranta pilot enabled the reuse of 4 000 m^3 of surplus clays
- The Dog Park pilot allowed for the stabilisation of about 15 000 m^3 of poor quality, soft clays. It gave the possibility to use fly ash and FGD as binder components, which is very important from the point of view of future permit applications of similar kind
- The Jätkäsaari III pilot gives the possibility for utilisation of 90 000 m^3 of dredged soft sediment for various future engineering applications, thus allowing for saving virgin materials that would have to be otherwise used for the construction of noise barriers in the city of Helsinki. Fly ash as binder was also tested at this site.
- The so-far expected impact of the Honkasuo pilot is saving of 45 000 m^3 of non-renewable materials.
- Additionally, about 40 000 m^3 of rock aggregate material was recovered in the Arcada 2 pilot site by processing and reusing. This, in turn, diminished the need for virgin rock material.
- Stabilised masses from all the three stages of the Jätkäsaari pilot have been used for various construction purposes. Part of the masses were transported to other parts of Helsinki and utilised there, e.g. for the Vuosaari landfill cover or landscaping purposes in the Ida Aalberg park.
- Due to the pilot applications, long-distance transportations to soil deposit sites were avoided, as well as the need to transport virgin rock material as replacement masses.
- The impact of the pilots on the decrease of CO_2 emissions was calculated during carrying out the LCA studies.
- Diminished transport of materials has improved the quality of air in the cities involved in the project resulting in a positive influence on the inhabitants' health.

DISSEMINATION

The ABSOILS project team members have taken an active role in disseminating the information on the project and its objectives in discussions with various stakeholders both in Finland and internationally. Continual networking activities have increased the level of knowledge and raised the awareness of the importance of solving the issue of surplus soft soils. The project has received a very positive feedback from the representatives of the cities involved as a pioneering initiative in this field.

- Project webpage: *http://projektit.ramboll.fi/life/absoils/index_eng.htm*
- DVD presentation (available on the project website)
- European Guidelines on the methods of converting surplus soils into useful construction materials (on the project website)
- LCA/LCC Report (on the project website)
- Conference papers, conference presentations, posters, numerous networking activities, publications, media articles
- Road shows: 2013-2014
- International Workshop in Finland, September 2014

ABSOILS PROJECT IN A NUTSHELL

- **Start: September 2010/ end: June 2015**
- **Co-ordinated by Ramboll Finland http://www.ramboll.fi/**
- **Project partners:**
  - Lemminkäinen ***http://www.lemminkainen.com/***
  - Rudus ***http://www.rudus.fi/***
- **Supported by the Finnish Ministry of the Environment and the Uusimaa cities - Helsinki, Espoo and Vantaa**
- **Co-financed by the EU LIFE+ Environmental Policy & Governance programme (LIFE09 ENV/FI/000575)**
- **Total project budget: 2 736 363 €**
- **EC financial contribution: 1 312 869 €**

FURTHER INFORMATION AND CONTACT

Ramboll Finland Oy
Säterinkatu 6
02601 Espoo

- marjo.ronkainen@ramboll.fi
  +358 40 551 1922
- pentti.lahtinen@ramboll.fi
  +358 40 093 9082
- ville.niutanen@lemminkainen.fi
- katja.lehtonen@rudus.fi

LIFE PROGRAMME

LIFE is the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU. Since 1992, LIFE has co-financed some 4 171 projects, contributing approximately €3.4 billion euros to the protection of the environment and climate. More information available on:

http://ec.europa.eu/environment/life/index.htm