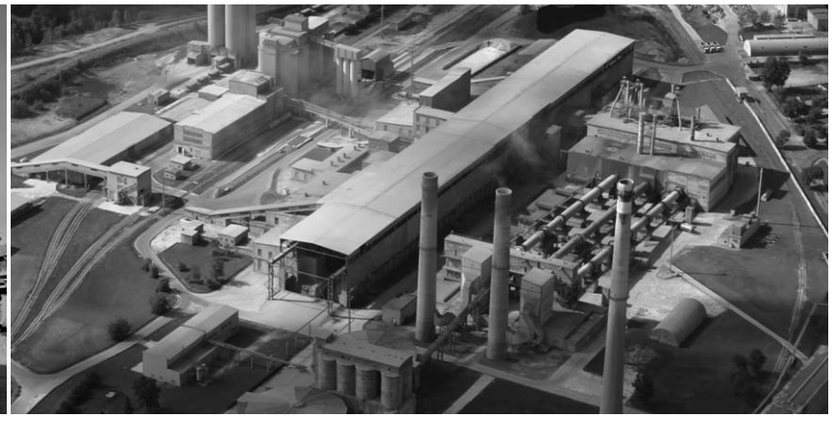
Case Study 1	**Kunda Nordic Tsement Ltd.** Estonia	


Kunda Nordic Tsement – from environmental disaster to environmental recognition

1 The Cement Production in Kunda

Natural Conditions for Cement Production

A stretch of limestone going through the Baltic Sea region is very visible on the Estonian north coast, and on the islands of Gotland, and Öland in Sweden and Bornholm in Denmark. This has made possible three large cement factories, using limestone as raw material, situated on the coast of Gulf of Finland in Estonia (Kunda), on the east coast of Gotland (Slite) and in southern Öland (Degerhamn). Their locations on the coast allow them to export by ship large amounts of cement for construction work over the entire Baltic Sea region.

The Estonian cement factory in the small town of Kunda, established in the 1870s and state owned up to the recent systems change, was privatised in 1992 as Kunda Nordic Tsement. Later the owners changed and presently Heidelberg Cement Group (Germany) has 75% and CRH (Ireland) 25% of the shares.

The Worst Polluter

During Soviet times Kunda Tsement was environmentally a disaster. In 1992, according to statistics, cement production in Kunda was the third largest contributor to air pollution in Estonia, after two oil shale power plants. In particular it caused a significant deterioration in the quality of life in the town of Kunda, as thousands of tonnes of cement dust was emitted into air, covering houses, gardens, fields and people. Virtually everyone in the area suffered from breathing disorders. Relations between the company and the local community and environmental authorities were poor. At one stage, the closure of the factory was even discussed seriously as an option. The main reason for the environmental problems was that the equipment installed by Kunda in the 1960s to reduce air pollution was worn out and no longer able to deal with emissions. Kunda was losing 10% of cement – into the air – due to poor technology.

Thus in 1992 the situation was bad. In addition to the expense of production losses, Kunda also had to pay high environmental fines. Even in the case where fines were relatively low, there were clear signs that they would rise. Kunda was also faced with the danger that Western customers would refuse its cement because of its poor environmental reputation.

Production and Business

Kunda operates a wet cement production process. Its main energy source is oil shale. The main raw materials that it uses, oil shale ash, clay and limestone, are mined in nearby quarries. Cement, or Portland cement, is made when limestone, clay (or sand), and fuel is burnt in a rotating oven, so-called rotary kiln. The kilns in Kunda are about 4x150 meters, slightly slanted, and heated in its lower end up to 1450°C. During the burning process the material is forming a gravel-like, extremely hard-burned brick, clinker. The clinker is either used as such or

ground in cement mills together with small amounts of other material (plaster) to form the cement.

In 1994 Kunda operated four rotary kilns with a total annual capacity of over one million tonnes of cement. Today it operates two fully-renovated kilns with an annual capacity of over 560,000 tonnes of cement. The main products are cement and clinker. Since the mid 1990s Kunda produces around 600,000 tonnes of clinker and 400,000–500,000 tonnes of cement (506,000 tonnes in 2003) yearly. The number of employees has during the last ten years decreased from 650 (1994) to 350 (2003).

The company also operates a limestone quarry, a clay quarry, an oil shale quarry, and a port. All operations are located within a radius of 10 kilometres.

During the period of Soviet rule Kunda exported a significant percentage of its output to the north-western region of the Soviet Union and the Baltic States. Since then the market has opened up and Kunda competes with western manufacturers. Its main customers are retail trade companies, which sell cement to construction companies and wholesale agents in Scandinavia and in the Baltic States. In 2003 its net sails was 483 Mln EEK (about 32 Mln Euro).

The Main Environmental Problems

The main environmental impact of cement production is air pollution caused by emissions of dust and of sulphur dioxide (SO_2), nitrogen oxide (NO_x) and carbon dioxide (CO_2). Cement production is also energy intensive and involves the extraction of non-renewable mineral resources. The latter can also cause surface water and ground water pollution.

The cement industry is a significant contributor to carbon dioxide emissions. About 5% of global CO_2 emissions are due to cement production caused by (1) the decarbonisation of limestone, (2) the use of fossils fuels in the clinker kilns and (3) the high consumption of electricity for the motors in the plants.

Kunda Cement has addressed these problems by collecting dust in filters, reducing SO_2 and NO_2 emission by flue gas treatment, by substituting fossil fuel, and finally by substituting part of the clinker in the cement by e.g. burnt oil shale, limestone filler, slag etc. These changes will be described in some detail below.

2 Developments 1993–1998

Renovation and Environmental Policy in 1993–1998

The new owners started already in 1992 to discuss a plan for renovation of the plant. The plan incorporated substantial environmental investments. Loans were obtained from the International Finance Corporation (a subsidiary of the World Bank) and the Nordic Environmental Finance Corporation, institutions that consider the environmental performance of the projects that they fund.

The environmental considerations had to include not only the cement production itself but as well the quarries, the oil shale mining and the port. Even if the main concern at this point was dust emissions, also effluents into the Kunda River – the factory used large volumes of water – as well as solid waste and the landfill were important.

The environmental policy developed was based on three overall objectives:

- To meet Estonian environmental legal and regulatory requirements immediately.
- To meet all World Bank requirements within three years.
- To be the best environmentally-managed industrial company in Estonia within five years.

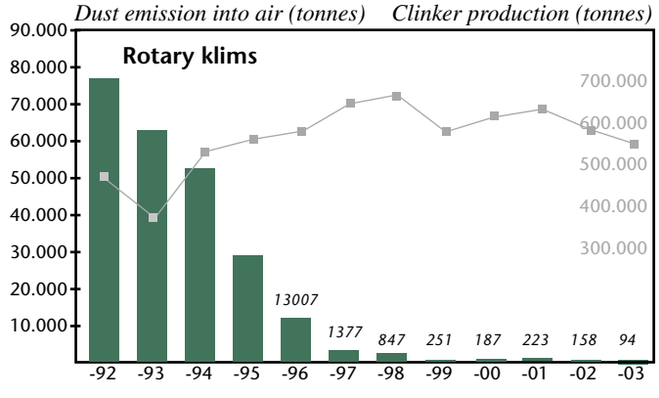


Figure 1.1 Dust emission from rotary kilns in 1992-2003.
The clinker production is shown as the dotted curve (■) in gray.

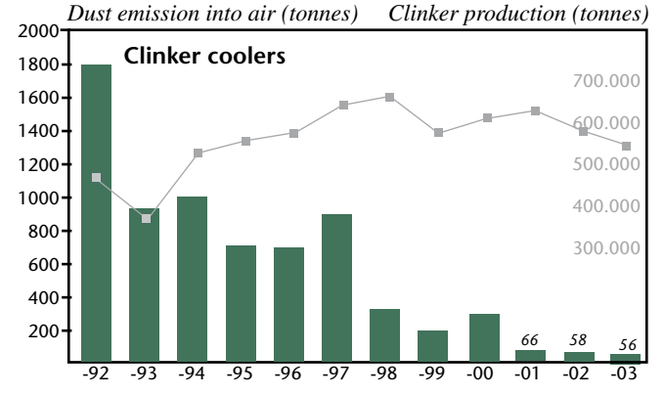


Figure 1.2 Dust emission from clinker coolers in 1992-2003.
The clinker production is shown as the dotted curve (■) in grey.

Figure 1.3 Port Kunda is the biggest commercial port between Tallinn and the Russian border. *The annual capacity of the port is up to 2 million tons of goods. The enlargement of wharf areas, the development of bulk materials warehouses and the preparations to receive new goods are ongoing.*

The following targets for improving environmental performance were also defined:

- Reduction of emissions of dust from the cement kiln.
- Reduction of emissions of oil shale dust.
- Construction of a new industrial landfill for solid waste.
- Reduction of risk from handling asbestos during renovation work.
- Prevention of oil spillage into the Kunda river.
- Development of a new port in accordance with environmental regulations.

Based on the policies a major renovation of the cement production facilities in Kunda took place in 1993–1997. Investments totalled nearly 800 million Estonian Kroons (about 53 Mln Euro), including 220 million for environmental protection. Progress, successes and problems in realising these objectives are assessed regularly. Results and future plans are communicated to different stakeholder groups.

Reducing Air Pollution

The majority of measures aimed to reduce air pollution. Renovation of the kilns and the installation of new electrostatic precipitators (filters) were expected to significantly reduce dust emissions. Of Kunda's original four kilns two were renovated and had new electrostatic precipitators installed. Production was carried out at the third kiln during renovation and during periods of peak demand. The electrostatic precipitator at the third kiln was repaired. The fourth kiln was closed down in 1996. To achieve further reduction of dust emissions, operations at the third kiln were stopped in 1998.

EEK 130 million (about 9 million Euro) were invested in the installation of new bag filters on three oil shale mills in order to reduce dust emissions. New filters were also installed in the cement mill and, in 1997, filters were installed at the cement packaging line and the kiln dust silo. The old multicyclones in the clinker cooling system were repaired to increase cooling efficiency. Dust emission from the kilns thus have decreased

from almost 80,000 tonnes (!) in 1992 to 2,000 tonnes in 1997, and even lower values later (see Figure 1.1). The installation of more efficient filters and electrostatic precipitators resulted in the generation of higher volumes of collected fine cement dust, in 1997 a total of 63,400 tonnes, a figure that increased to 86,000 in 2003. The cement dust represented almost 98% of the total waste volume of the operations. In 1997 12,000 tonnes were given to farmers for liming, and the remainder was disposed of in the company's landfill. To expand the use of dust for liming Kunda needed to develop further cooperation with farmers, and environmental and agricultural authorities. Kunda then launched a programme to promote the use of fly ash as fertiliser.

Reducing Emissions to Water

In the mid 1990s Kunda consumed about 2.5 million m^3 of water per year. 0.3 million m^3 were used for cement production and the remainder 2.2 million m^3 for cooling purposes. In 1998 the cooling water was reduced by some 20% to 1.8 million m^3. In 2002 the figure had decreased to 1.1 million m^3 and in 2003 to 784,000 m^3. Reductions were due to improved techniques, e.g. pumps, and later to recirculation of cooling water to the production (preparation of slurry), and the use of air instead of water for cooling.

Water is supplied from the local Kunda River. Wastewater is discharged into the same river. The company introduced a physical treatment (mud and oil removal) of its wastewater, making the quality of the water discharged within the permits. Extraction of mineral resources from Kunda's clay and limestone quarries results in high sulphate concentrations in the wastewater. New explosive and blasting technologies were introduced which resulted in the elimination of nitrogen pollution.

The wastewater which is drained from Kunda's landfill was heavily polluted. In 1997 Kunda diluted the wastewater from both its mining activities and its landfill with about 12,000 m^3 of water. Later the drainage water from the landfill was taken to Kunda town treatment plant, while the water from the quarries were taken to a special treatment plant of the factory.

Table 1.1 *Reduction in dust emissions.*

Year	Dust emissions per unit of production
1992	146 kg/tonne
1996	22 kg/tonne
1997	3.2 kg/tonne

Table 1.2 *Air quality improvement in Kunda town.*

Year	Number of times MPL* was exceeded per year
1994	120
1995	127
1996	50
1997	4

** MPL = Maximum Permitted Level.*

Relationships with Stakeholder and Local Community

In order to improve relations with the public and the local authorities, the company began to publish environmental reports. Each new report was presented at a public meeting where representatives of interested groups have the opportunity of finding out more about the company's environmental policies and activities. Initially, a report was published twice a year. As the most urgent environmental problems had been dealt with, a report is now published once a year. A dialogue has been established with the Ministry of Environment and local Regional Environmental Department of Lääne-Viru County and Kunda municipal government.

3 Developments 1998-2005

Introducing an EMS and ISO 14001 Certification

In late 1998 the company made the decision to implement the ISO 14001 environmental management system. Two consultancies were asked to lead the operations, the Estonian Emi-Eco and the Finnish Enemi Oy. 1999 became a year filled with documenting the industrial process in the cement plant, the procedures in the port, and in the administration.

Environmental responsibilities were allocated within the company. Top management became responsible for developing, reviewing and ensuring compliance with the environmental policy. The Administrative Manager, with the support of the Environmental Manager, was responsible for keeping up-to-date with developments in environmental legislation and regulations.

External support was obtained from international and Estonian consulting companies in conducting environmental audits and in measuring and monitoring environmental performance. The results of audits and performance measurements have helped Kunda to evaluate and modify its environmental policy and investment plans.

A very important part of the work was the training of the personnel. Top and middle managers participated in environmental training twice a month. The Environmental Manager did this training. The main message and the objective was that

environmental management was the concern of everybody's daily work, a constantly ongoing process with the objective to reduce the environmental impact caused by the company, and to each year reach the commonly set goals. The task has been received with enthusiasm by the personnel, and it has paid off financially as well.

The first audit was carried out in autumn 2000, and in December that year the company was certified according to ISO 14001, by Det Norske Veritas. The certificate was valid for the period Dec 2000-Oct 2003.

Using Clinker Dust in Agriculture

About 80,000 tonnes of clinker dust is collected as waste from the filters every year. This material consisting mostly of chalk is a valuable material to lime the acid soils in Estonia. In a state financed project Kunda cement during the period 1997-99 re-established the old procedure to lime agricultural fields. At the beginning the more than 30-year-old technology was used – compressed air was used to spread the dust on the fields – which had very uneven results. In cooperation with Finland the company Silento Oy constructed and delivered five machines for proper delivery of clinker dust to the fields in 1998. The amount of dust used for liming then increased dramatically:

Table 1.3
Amount of clinker dust used for liming of agricultural fields.

Year	**Clinker dust** (tonnes)
1996	500
1997	10,500
1998	50,300
1999	60,000
2000	63,000
2003	55,000

The project has the potential to develop, as a total of 180,000 ha in Estonia require annual liming for a good production. Simultaneously the amount of clinker dust sent to landfill in Kunda will be reduced or eliminated. In 2003 still 30,000 tonnes were sent to the landfill.

Energy Management

Cement production is an energy intensive operation. In 1995 the energy used per tonne of cement was 176 kWh, this figure decreased to 124 kWh in 2001 and to 116 kWh in 2003. The fuel used was oil shale from the local quarry. In 1999 a programme to introduce alternative fuel started. These were mostly petroleum coke and coal. The inclusion of residues of the fuel in the cement is a normal operation which produces a product that is of similar quality as ordinary Portland cement. Later burning of wastes has been an important part of the energy provision in the process (see below).

In 1999, the company installed a natural gas driven cogeneration plant for local production of electricity and heat. The capacity of this new plant was 3.1 MW of electricity and 3.2 MW of thermal energy. The plant provided for 25% of the electricity used by the company, while the thermal power was used for district heating of 2/3 of Kunda town. This allowed the town to close its old heating station operating on oil shale, and transfer its boilers to operate on liquid fuel. As a result the air pollution in the city was considerably reduced and the dumping of oil shale ash on the municipal land fill ended.

Waste Management

The burning of cement at a high temperature allows for incineration of all kinds of mixed-in organic material. This has been used as an opportunity of large-scale incineration of organic hazardous waste with a much higher efficiency than traditional dedicated waste incineration plants. The cement industry offers a possibility to incinerate waste safely, as the added waste stays in the rotary kilns a long period and at a high temperature. The owners of Kunda started in year 2000 a large-scale programme for utilisation of liquid waste (waste oils and oil shale refuse). A contract for management of hazardous waste from all over Estonia was at the same time signed with the Ministry of Environment.

In 2001 the amounts of waste fuel used in the new project was 1,200 tonnes of waste oil, 4,400 tonnes of oil shale refuse and 9,400 tonnes of semi-coke or a total of 15,000 tonnes. The total has increased rapidly and was 47,000 tonnes in 2003.

Figure 1.4 *The control room.*

Introducing an Integrated Management System

In October 2003 the ISO 14001 permit for the EMS expired. The company then decided not to prolong the EMS but rather to combine the two systems then in operation, the environmental management system, EMS, and the quality management system, QMS according to ISO 9000, and add an occupational health, safety and risk management system into a so-called integrated management system, an IMS. The plans were that the integrated system will be submitted to certification in late 2005. It should be noted that the EMS during the period will be operated in the same way as during the period of certification.

A development plan of the management for the period 2003-2005 was established. The plan contains a listing of all training periods for the different categories of personnel, as well as all audits that need to be done to develop all three partial management systems. It ends with the certification of an IMS in late 2005.

A complete plan for environmental improvements for the period 2004-2006 has also been published. The plan contains items such as renewal of the dewatering system in the limestone quarry, modernisation of cooler No 2, supplying clinker coolers with filters, with time of execution and budget and responsible project leader (See Table 1.4).

Table 1.4 *Kunda Environmental Plan 2004-2006.*

Measure	Content	Reduction of environmental impact	Investment (Mln. EEK)	Year
Renewal of the dewatering system of the limestone quarry.	Reconstruction of the dewatering pump station, replacement and automation of the pumps, renewal of the drainage system, construction of a sludge pool.	Prevention of the Toolse River from the pollution with plankton.	0.5 1.0 0.5	2004 2005 2006
Modernisation of cooler No 2.	Renewal of the hot end of the cooler No 2 and the aspiration ventilator.	Increase of the efficiency of the cooler. Reduction of the consumption of the electric energy and the amount of dust emitted into the air by the cooler.	2.5 4.4	2004 2005 2006
Project concerning the supply of clinker coolers with filters.	Elaboration of a certain solution to avoid dusting of clinker coolers.	Evaluation of the scope of investment and finding an optimum solution of the problem.	17.0	2004 2005 2006
Filter for the clinker cooler No 4.	Installation of dust collecting equipment (EP or a bag filter) on clinker cooler No 4.	Considerable reduction of dust pollution, in particular, near the plant.	18.0	2006
Filter for the clinker cooler No 2.	Installation of dust collecting equipment (EP or a bag filter) on clinker cooler No 2.	Considerable reduction of dust pollution, in particular, near the plant.	0.5	2007
Filters for cement silos.	Installation of bag filters on cement silos No 10-12.	Reduction of the amount of dust emitted into the air.	0.5 0.5 3.8	2004 2005 2006
Modernisation of cement silos.	Reconstruction of cement silos (discharging and control equipment).	Reduction of the amount of dust emitted into the air during cement discharging. Reduction of the risk of accidents with potentially big dust pollution.	1.5 0.5 2.0	2004 2005 2006
Use of alternative fuels.	Use of oil shale residues (refuse), semi-coke and other wastes in the burning process as a fuel component.	Reduction of the use of natural resources. A solution for waste recycling.	3.2 5.0 10.0	2004 2005 2006
Separator for cement mill No 1.	Reconstruction of the cement mill No 1 to be used for closed cycle grinding. Construction of a separator.	Reduction of energy consumption during cement grinding. Increase of the use of cement additives.	10.0 1.0	2005 2006

Economy and Public Image

Investments and improvements in technology have not only improved the environmental performance of Kunda Tsement. It has also helped the company to significantly reduce its costs. Total expenditure on environmental taxes and fines has decreased. Reduced fuel and electricity consumption have also cut energy costs. The company has achieved compliance with environmental regulations and improved its relations with the regional environmental authority in Rakvere and the Ministry of Environment. Undoubtedly one of the most significant outcomes is the improvement in Kunda's public image, especially vis-à-vis local people. The development has certainly contributed in a dramatic way to improve the social and public health situation in Kunda town.

During the period Kunda Nordic Tsement has won the environmental Top 10 Contest and has been declared the most environmentally friendly company in Estonia. Kunda continues to work towards its objective of being the best environmentally managed industrial company in the country. It has developed a plan to identify sites, which were polluted in the past, and carries out an inventory of the extent of the damage done to remediate the polluted sites.

Kunda Nordic Tsement is thus an example how an environmentally disastrous old heavy industry in the former Soviet Union can be transformed to modern environmentally safe production unit. It will continue its environmental activities with the aim of improving the quality of the environment and the ecosystems in and around the town of Kunda.

Table 1.4 continues...

Measure	**Content**	**Reduction of environmental impact**	**Investment** (Mln. EEK)	**Year**
Bag of filters for the fuel bunkers for oil shale mills.	Dust filters for the fuel bunkers of heating element of the fuel department.	Reduction of the amount of dust emitted into the air.	1.6	2004
On-line equipment for measuring gaseous emissions.	Installation of emission measuring equipment in accordance with the requirements laid down in the EU directive 2000/76/EC concerning waste incineration.	Reduction of the atmospheric emissions of gaseous wastes and optimization of the burning process.	0.5 1.6 0.5	2004 2005 2006
Measures concerning the reduction of dusting during storing on the industrial land fill.	Application of the watering system for the irrigation of clinker dust stored. Regular measurements in different types of weather.	Decrease of the amount of dust emitted into the air during storage on the land fill. Enables to plan the storage of dust pursuant to the conditions.	0.5 0.5 0.1	2004 2005 2006
Reconstruction of the mud and oil collector.	Procurement of the project solution and performance of the renovation.	Reduction of the risk of oil pollution in the Kunda River. Improvement of the cleaning effect.	1.5 0.6	2004 2005
Implementation of the solutions developed for the reduction of noise level.	Analysis of the projects and implementation of appropriate variants.	Reduction of the noise level and maintenance within standard.	0.6 0.7 1.3	2004 2005 2006
Increase of the return of the dust from the kilns.	Increase of the productivity of the fuller pumps of the kilns. Supply of each fuller pump with its own compressor.	Reduction of the amount of dust stored on the land fill. Reduction of the consumption of compressed air in the network. Increase of the productivity of the fuller pumps.	1.0 1.0	2004 2006
Dust collecting equipment for clinker loading trucks.	Dust collecting equipment for clinker loading.	Reduction of local dust emissions.	1.0 2.0	2006 2007
Blast furnace cement.	Equipment for producing and testing blast furnace cement.	Reduction of the share of clinker in cement and CO_2 emission.	13.0	2006 later

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Parts of this article is based on a case study published 1997 by INEM. Further sources were the annual environmental reports No 1-5 of Kunda Nordic Cement Corporation from years 2000-2005.

Internet Resources

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http://www.eestipank.info