Study tour in two cement plants, Enci and Lixhe and one sewage sludge treatment plant, Waterschapsbedrijf Limburg

The ALF-CEMIND study tour was held in the borders of Belgium and the Netherlands on the 29th and 30th of August 2007, where the cement plants of Lixhe and Enci experienced in alternative fuels and raw materials and a sewage sludge treatment plant in Susteren were visited. Attendees viewed plant facilities and were also informed about the latest developments for codification of EU laws relating to environmental issues and the problems of ensuring a regular supply of alternative fuels for the European cement plants.

Susteren sewage treatment and drying plant
On visiting the sewage treatment works and the drying plant at Susteren, Maastricht, participants gained a first hand experience of the technical processes required to prepare waste sludge before it is delivered to ENCI’s Maastricht cement works. The Waterschapsbedrijf Limburg (WBL) company has 18 treatment or purification plants and three sludge drying plants. The Susteren facility has a treatment plant and a sludge dryer unit which supplies waste sewage sludge to the ENCI cement plant throughout the year.

The ALF-CEMIND group saw how the drying plant at Susteren works by conveying (7 m$^3$/h max) and then heating the sludge in a boiler before agitating the mixture to breakdown large agglomerations and to remove any metal contaminants. Sludge is then pumped to the vat which is equipped with an oil heat exchanger (max 225°C). Air is induced by two 85,000 m$^3$/h fans through the vat’s bottom lining plates, mixing air through the sludge which has an average depth of 4-5m.

This process continues for a couple of hours while dust and moisture is driven off through the cyclone system which has an air stream capacity of 59,000 m$^3$/h, sending dust and air back to the fluidized bed. This gives a 60% secondary mix in the vat. Evaporation capacity of the system is about 8.3t H$_2$O/h. Sludge cooling is aided by the exhaust gas taken from the oil boiler to bring sludge temperature down to below 40°C.

The end product is made into a pellet 0.5-2mm wide with a low moisture content consisting of around 92% suspended solids for ENCI’s needs.
Storage capacity at the facility is 280m$^3$. There are about one or two deliveries by tanker of the dried sewage sludge to the Maastricht cement factory every week. In total, the ENCI plant requires some 56 Mta of dried sewage sludge from WBL by contact, 17 Mt comes from the Susteren facility while another two other plants each provide similar quantities of sludge.

*Lixhe cement plant, Belgium*

CBR's Lixhe cement plant forms part of the HeidelbergCement Group and in 2001 it underwent a modernization programme to raise capacity. The plant chose to erect an Onoda (now Taiheiyo) preheater which was installed by Technip, France. The new four-stage preheater and kiln line also enables Lixhe to increase its use of alternative fuels including sewage sludge.
Since 2005, Lixhe’s cement production capacity has been 4400tpd or 1.5Mta. The plant utilizes two quarries, Loen and Romont, from which CBR expect another 70 years working life at an extraction rate of 4 Mta. The first is composed of wet chalk that was predominantly fed to the old wet production line. The second quarry is a marl/loam deposit which is crushed and blended with the chalk before being conveyed to the plant through a 2.2 km tunnel.
Mr. Benoit Gastout, director of the Lixhe plant, informed the ALF-CEMIND group about the production process and the use of both dewatered and wet sewage sludge at the plant as well as a host of other alternative fuels that are used for combustion. These fuels can either be fed to the preheater, precalciner or the main burner. Among the other alternative fuels utilized at Lixhe are whole tyres, (impregnated sawdust plastics, solvents, grain = resofuel), shredded oil filters, waste liquids, animal meal etc.

Lixhe has split combustion with the main burner providing combustion for finer fuels, the RSP Minox® precalciner taking coarser fuels which are less than 3 cm in size (like dried sewage sludge pellets at 10 tph or animal meal at 3-5 tph) and the kiln inlet feed for bulky, whole tyres (2.5 tph) and dewatered sludge. The overall substitution rate for fossil fuels with alternative fuels is around 53%. Coal is still used as a main fuel at a rate of 1.5-2 tph, meaning not more than 50 tpd.

![Lixhe cement breakdown of alternative fuel usage](image)

The tour of the Lixhe included visiting the storage facility for the dewatered sewage sludge (residuary sludge drawn from water treatment farms, urban waste water and industrial waste water) consisting of a 30 m³ hopper for the trucks to unload product, a 500
m³ storage silo, a screw conveyor and a Schwing sludge pump (rated at 1-7tph). The sludge is pumped through a pipe to the top of the preheater tower where it can be fed to the kiln inlet.

At the top of the 100 m preheater tower, the visitors received an overall picture of the cement plant. A couple of levels down the preheater tower is the whole tyre feed which are dropped into the preheater every few seconds from the automatic conveyor.

Walking along the dry kiln to the Pillard multi-channel main burner the group could look back to see the large twin-goose neck ducts of the preheater towering above them. A quick descent and the tour continued with a walk to the modern control room where screens for the pyroprocess were on view with two staff monitoring the displays of data.

_ENCI, The Netherlands_

The second cement plant to be visited by the ALF-CEMIND group was another HeidelbergCement group member, the ENCI cement plant at Maastricht. This cement plant is right on the Belgian/Dutch border and is well situated for transport of cement and clinker along the river systems. The story of the ENCI plant is something of a turnaround as it was due to close in 2005, but has since further strengthened its position as market leader in the use of dry sludge and other biomass fuels.
Reasons for the planned shutdown included limited quantities of marl stone reserves, but mainly the economic situation in 2005 of over capacity in the region and the relatively high production costs and low cement prices. However, today the kiln operates at maximum capacity ≥0.9 Mta as there is a storage of clinker and cement, clinker export prices increased and production costs have been significantly reduced.

The restoration of the plant at ENCI was planned with a staffing programme of three levels – plant management, team leaders and team members. The plant runs with a staff of 185 and plans to continue manufacturing cement until at least 2015. Limestone reserves at the Sint Pietersberg quarry will be exhausted around 2020. Other ENCI locations in the Netherlands include the two grinding plants at Ijmuiden and Rotterdam making a combined group cement capacity of 3.3 Mta.

BMH Claudius Peters (now Claudius Peters, Langley Holdings) provided the first BioMill or vertical roller mills for the plant in February 2000 for milling dried sewage sludge. The mill is supplied by ambient air and consists of five large grinding balls which revolve around a grinding table that is less than 2 m in diameter. Energy consumption of the mill is approximately 40 kWh/t. BioMill 1 is housed in an enclosed building and once product has passed through, it reaches a separator before heading to the silos. Nuisance odours are
reduced by the mill’s exhaust air being vented off to the kiln’s planetary cooler. BioMill 2 was added to the plant in 2004, and is virtually identical to the first mill, doubling sludge milling capacity. By 2006 the plant was processing some 73,000t of sewage sludge.

Waterschapsbedrijf Limburg (WBL) and ENCI operate a joint venture for the BioMill project. WBL supply 35,000 tpa of sludge for the BioMills and the remainder comes from other suppliers in Northern Holland. The constraint of utilizing sludge is the high ash content (33%). Hg and Cl as well as the impact of the sludge’s P₂O₅ on early strength levels. The organic part of the sludge (biomass) burns and the heat generated in the kiln is a valued energy source, while the inert material, like ash or sand, is incorporated in the clinker.

Biomill project at ENCI
The long dry kiln No 8 was installed in 1968 and measures 180m in length and 5.5m in diameter. The kiln line has a two-stage preheater with no precalciner. Heat consumption of the kiln is 3.6 GJ/t clinker and it is equipped with a planetary cooler. Kiln capacity is approximately 3000tpd.

An FLSmidth Swirlax burner has been adapted to burn alternative fuels via an extra burning tube mounted on top of the main burner.

The alternative fuel substitution rate at the plant is even higher than at CBR's Lixhe facility. Maastricht's 90% substitution rate of traditional fuels has been achieved by processing fuels like sewage, paper sludge, plastic, animal meal, glycolbottom, finecokes and anode dust. HeidelbergCement has a strategic plan for the use of alternative fuels and reached a substitution rate of 33% in 2006 that
will rise to 40.2% in 2007. By 2011 around 55% of the ENCI’s fuels should come from alternative fuel products. ENCI’s impressive 90% substitution rate already exceeds the HeidelbergCement group’s long-term substitution rate targets.

A recent investment at the plant in this respect is the SBI installation. SBI refers to a secondary fuel installation that is aimed at reducing fuel costs, it handles coarse fuels such as paper sludge, paper and plastic derived fuels and, in the past, shredded iron-free tyres. Material is unloaded and stored in a separate building on site and is handled by an automated grab system. Tow dedicated bunkers and two feeders transport the material to rotating valves from where the material is pneumatically transported to the kiln’s coarse waste fuel burner. Limitations of the SBI include truck unloading capacity, crane capacity, burnout of the coarser fuels as opposed to the fine fuels burnout, equipment availability and chlorine build-up in the kiln.

Early in 2007 the plant added an additional simple feeder unit for the feeding of extra low calorific coarse fuels.