

Achieving greater substitution

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With cement production requiring a very high energy input, it has always been Cemex' aim to replace traditional fuels by other renewable sources. The company has continued to follow this process even though the price of fossil fuels has fallen considerably in the recent months. The use of alternative fuels and raw materials is one of the key projects followed by Cemex Spain, from senior level management to new employees, as utilisation of alternative sources is one of the four pillars for Cemex as a global company.

The main projects that Cemex Spain is committed to, in terms of lowering its environmental impact and reducing fossil fuel usage, are:

- reduction of 25 per cent on CO₂ emissions per tonne of clinker (using 1990 levels as reference)
- usage of alternative fuels at 60 per cent and 12 per cent for raw material replacement
- reduction of emissions: 15 per cent of NO_x and 10 per cent of SO_x (based on 2005 figures).

The process of sustainable development is not only a commitment for Cemex and authorities but also for all the stakeholders involved with the company (eg neighbours, unions, etc). In line with this, in 2008 Cemex founded 'Sustainability Committees' for each of its Spanish cement plants. Such committees offer all stakeholders the opportunity for open dialogue and a platform to exchange information on sustainable development. They also help ensure all parties support future developments and view them as an important step to making the European market "greener" and more competitive. Usually, committees include the mayor of the town, representatives of the neighbouring and regional communities and some Cemex employees (eg plant director and those responsible for environmental issues related to that specific operational facility).

After having lower utilisation rates in the past, this year Cemex Spain will reach a substitution rate close to 30 per cent for alternative fuels. A significant increase in usage began in 2008 with the use of refuse derived fuels (ENERFUEL) at its Alicante plant. State-of-the-art technology will allow substitution rates above 40 per cent just for this secondary fuel, which is composed of a mix of paper, plastics, textiles and wood, on top of existing alternative fuels presently used.



Alternative fuel usage

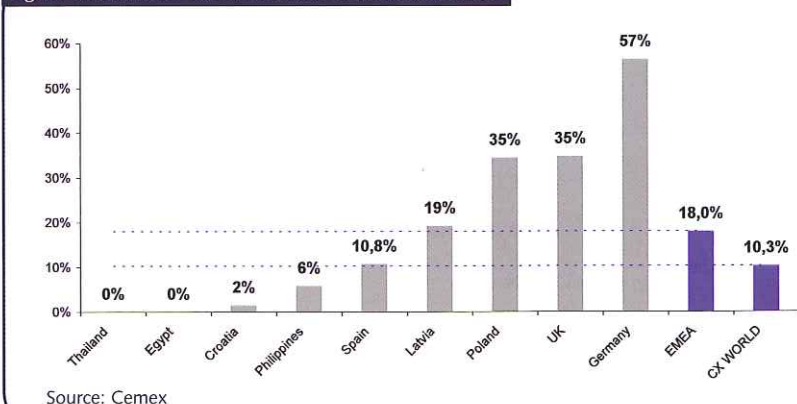
Along with other members of the EU, Spain is obligated to implement the 2008/98/EC waste directive guiding Spanish Environment legislation.

Spain has the possibility to adapt (in a more restrictive way) the national waste directive. Some regions in Spain do have stricter regulation, and others have a further developed waste

sorting and collection industry, so the national landscape in Spain is quite inhomogeneous.

Thermal recovery of waste materials (urban or industrial) is common practice in Europe, but worldwide it is also recognised as one of the best technologies available to close the loop in the waste value chain. Germany took the lead in the 1980s by replacing coal by fluff.

Figure 1: alternative fuel substitution Cemex EMEA 2008



The main advantages of waste usage as a thermal energy source are:

- CO₂ emission reduction
- saving fossil fuels for future generations
- energy independency
- reduction of landfill sites.

Up to 2009¹, Cemex Spain had invested nearly €30m to extend feeding and storage of alternative installations. Cemex is committed toward a greener development in all its operations and, despite the global economic downturn, the company has proceeded with investments in alternative fuel technologies, having started several projects in 2008. Some projects have been completed with others to be finished in 2009. They include:

- biomass (Lloseta, Alcanar, and Morata cement plants)
- plastics (Castillejo cement plant near Toledo)
- ENERFUEL^{®2} (Alicante and Buñol plants in Valencia and the Alcanar works in Catalunya).

The investments undertaken will allow Cemex to widely exceed substitution rates achieved at 8.1 per cent in 2007 and 10.8 per cent in 2008. Cemex estimates that it will save more than 250,000t of CO₂ with the use of renewable energy sources.

Alicante target: substitution rates above 40 per cent

Internal research & market analysis

In 2008, Cemex started a process to systematically assess the Spanish market for waste residues. The study was focused on industrial and municipal waste. The results paved the way for approaching the administration and possible suppliers as they clearly indicated that there is enough material available to supply the plant in Alicante. Spain still has one of the highest land-fill quotas in Europe (above 50 per cent) and many illegal land-fills. Compared to other markets, like the UK or Germany which are developed and offer ENERFUEL in different qualities, the market in Spain has just started to discover the potential of refuse-derived fuels.

Evaluation at the plant

The authorities of Valencia have been very supportive in the pioneering process of using ENERFUEL in Spain, as they also see the thermal use of waste as a possible solution against increasing amounts of urban waste. With production of nearly 1.1Mt of clinker, the Alicante plant has

ENERFUEL: the source of the future



ENERFUEL is considered as one of the most important energy resources of the future for many countries. For regions with a high energy dependency on imports, it's vital they increase autonomy in this area. In Germany ENERFUEL already accounts for 47 per cent of energy requirements for clinker production.

As in other European regions the main source of ENERFUEL is MSW (municipal solid waste) or ISW (industrial solid waste). Waste is collected and transferred to waste sorting centres. Usually the main objective is to extract recyclables and to reduce the biomass content of the remaining fraction.

This fraction, which contains plastics, paper, cardboard, organic material and other residues is typically land-filled or going to incinerators. In Spain the main proportion of waste is still land-filled; but instead of that, residues can be directed to a second process step of screening and treating needed to reach a homogenous fuel with characteristics needed by cement kilns.

The production of ENERFUEL in Spain is just about to start but Cemex has the advantage of being able to use its experience from other countries to shorten the learning period of cement plants employees and suppliers.



the potential to thermally recycle up to 60,000-100,000tpa of ENERFUEL. With a preliminary installation for ENERFUEL trials (November 2008), the Alicante works already had permits for 45 per cent of other alternative fuels including sewage sludge, animal meal and used tyres. Jointly with the University of Alicante the emissions analyses required were made at different ratios of replacement: 0 per cent, 10 per cent, 20 per cent, 40 per cent and 70. All of them have already been evaluated and Figure 3 shows, there is no significant negative change in the emissions as they were below regulated limits all the time.

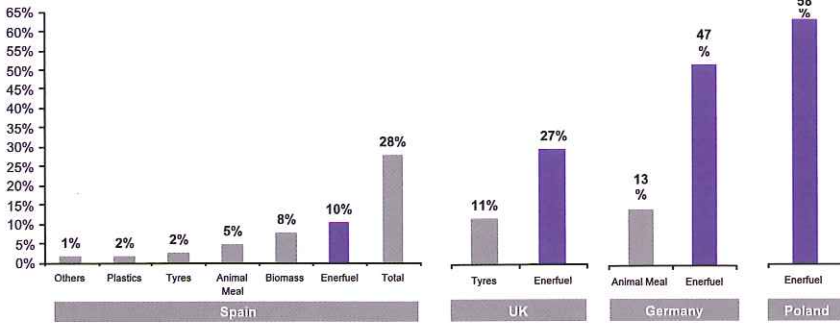
After finishing long-term trials, the next step will be to apply for a permanent permit to substitute fossil fuels by ENERFUEL. Due to the high content of biomass in the ENERFUEL, a classification

for the CO₂ savings will be carried out and those savings will be part of the effort to reduce CO₂ emissions from the clinker production process.

The installation

The system in Alicante for ENERFUEL feeding was designed by well-known German supplier Di Matteo, for a maximum of 14-16tph (up to 60 per cent of substitution rate). To feed the kiln main burner and the calciner independently but also using different types of material, two similar installations were built. Each of them consist of a reception unit for two walking floor trucks and a belt weighfeeder to assess the material which is then fed to a DN150m pneumatic system. This blows ENERFUEL using air at 55m³/min, sending it directly to the calciner which has two injection points.

Figure 1: alternative fuel consumption estimate Cemex 2009



Spain estimate 2009 full year; UK, Germany and Poland year-to-date (May 09)

The main achievements are:

- reduction of humidity from ENERFUEL
- increase of homogeneity from different sources
- decrease in chlorine content
- less foreign bodies
- covered storage building for the raw material and final product.

Improvements in sorting and shredding technology (eg windsifter), which Cemex is developing jointly with manufacturers and suppliers, will deliver an optimal product in the future.

Efficiency improvements

The learning experience at the Alicante plant, but also favourable layout of the Buñol works has helped to design a better system. The main changes were:

- the weighfeeder is located at the same level of the kiln burner with a short distance to the feeding point and only one but very open curve
- two pneumatic transport tubes from the weighfeeder to the kiln burner
- only five curves used
- use of a 60m long mechanical transport system has reduced pneumatic transportation.

This equipment was also designed to feed the calciner of the world's largest white cement kiln which is located at the Buñol cement plant.

Cemex will be the first cement company in the world to replace a significant amount of fossil fuels with a mix of solvents and ENERFUEL in a white cement kiln. The preliminary results are very promising with a substitution rate of more than 20 per cent without any negative influence on any variable from clinker production.

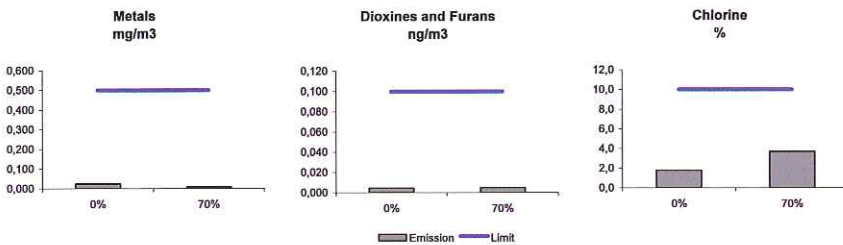
The future is in our hands

Cemex Spain has taken all necessary steps to reach a national level of replacement above 25 per cent for alternative fuels. As a result of continuing improvements on existing and new installations to be completed this year, the long-term target of 50 per cent for Cemex Alternative Fuels replacement seems to be a challenge but an achievable one.

Notes

1. Including estimates for full year 2009
2. Enerfuel is a registered trademark of Cemex Spain (also known as RDF, fluff or Climafuel).

Figure 2: emission levels during the trial with ENERFUEL



Emission levels at 0% substitution rate and 70% limit RD6353/2003 directive 2000/76

Reception of ENERFUEL

Required fuels are delivered and unloaded continuously by lorries equipped with walking floors. Arriving trucks unload the material to the fixed walking floor trucks with 120m³ of capacity. This system is advantageous in that it can compensate short interruptions from the delivery process or from any technical problem. On the other hand, using the fixed walking floor trailer, time for unloading process is reduced by nearly 20 per cent. Therefore logistic costs could be reduced as well.

Belt weighfeeder and removal of foreign bodies

Transportation between the reception unit and the weighfeeder is carried out by a short mechanical transport (9m).

To reduce downtime of the system the ENERFUEL passes by a disc screen (0.8m x 2.5m) and a magnetic separator. The material size has to be smaller than 30mm.

Pneumatic transport to calciner and kiln main burner

After the screening process, material is directed to two streams which are connected to a screw conveyor.

From there, the material is transported by a pneumatic system (DN150) nearly

75m long, to the calciner to be injected in the process.

Process improvements Changes in the plant

The ENERFUEL produced in Spain has a significant proportion of foreign bodies (glass, sand or other particles highly abrasive leading to damage metal valves, gates and the tubes). Therefore, Cemex had to change some of the tubes with special, long lasting curves, and change the layout of the tubes to reduce curves and feeding distance (down from 100m to 75m). New floodgates – which are more resistant and less likely to be damaged by foreign bodies – were installed and they are helping to reduce maintenance. Dust emissions have been reduced by installing a bag filter.

Further improvements are expected to increase the efficiency of the magnetic separator and adapting disc for the screen to eliminate oversized and harmful items.

Improvements of suppliers

The main improvements were reducing maintenance and also increasing the reliability of the system. This has been achieved by intensive collaboration from the suppliers.