Waste recycling through energy recovery

# A Kiln Solution

EUGENIUSZ MOKRZYCKI
Mineral and Energy Economy Research Institute, Kraków
Polish Academy of Sciences
mokrzy@min-pan.krakow.pl

ALICJA ULIASZ-BOCHEŃCZYK
Mineral and Energy Economy Research Institute, Kraków
Polish Academy of Sciences
aub@min-pan.krakow.pl

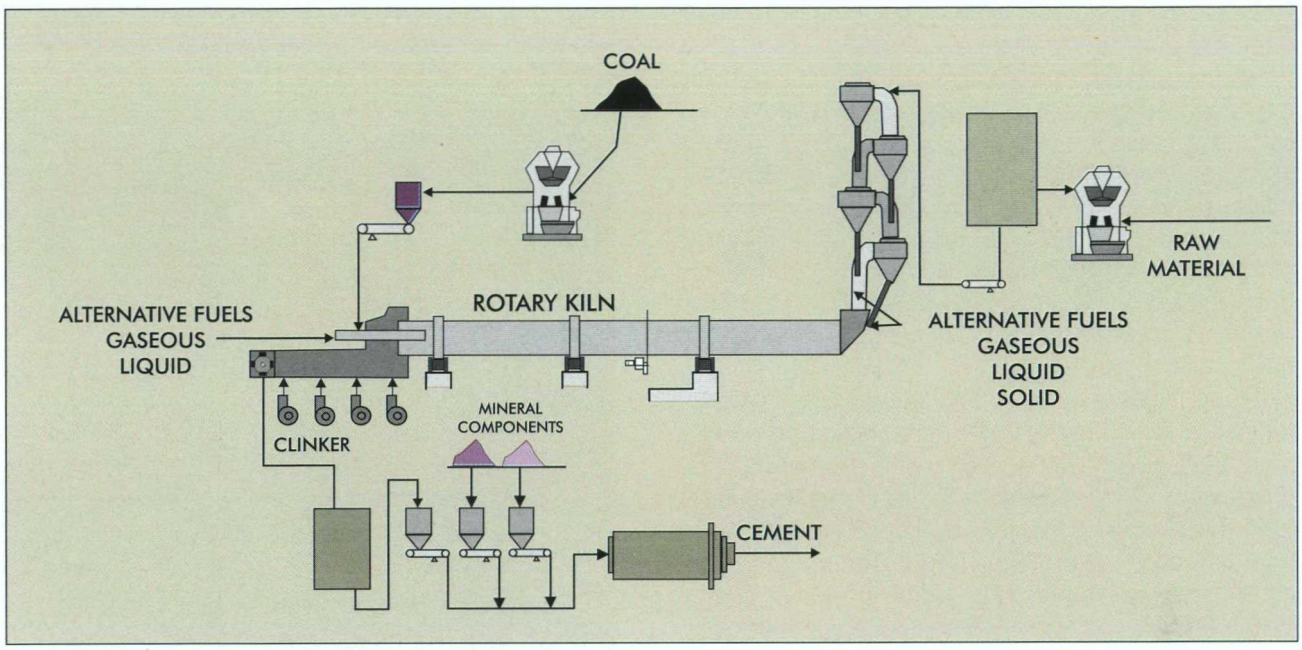
**The progress of civilization is inevitably connected with the ever increasing production of waste. Waste has become humanity's global problem. All over the world, new technologies are being developed that strive to decrease the amount of waste and seek ways of utilizing waste in industry. One of the opportunities for this involves the use of the combustible fractions of waste as an energy source**

Wastes that may be used as energy sources are called alternative fuels. Both liquid and solid wastes may serve as such fuels, and they may be used in most technologies that employ high-temperature processes. The cement industry is a branch of industry that has been using alternative fuels made from waste for over twenty years. The technological requirements of this industry make it particularly well suited to the incineration of fuels made from waste.

Alternative fuels for the cement industry can be made from household and industrial waste, or from mixtures of the two. Such fuels must be characterized by a suitable amount of chemical energy, which depends on the nature of the components and on the organic matter content. The alternative fuels most frequently used in the cement industry are: used grease, rubber, wood waste, used solvents, oil, meat-and-bone meal and combustive fractions of household waste.

**The Małogoszcz cement plant owned by Lafarge Cement S.A. using alternative fuels made from processed waste**

Courtesy of Lafarge Cement S.A.




E. Mokrzycki, A. Uliasz-Bocheńczyk (1994)

**Places for inserting alternative fuels in a cement production process**

Waste has different chemical and physical features and may be of varying calorific value, but alternative fuels need to exhibit stable average composition and characteristics. The burning process of an alternative fuel may be affected by the dimensional inhomogeneity of grains, unstable calorific value, a high level of humidity, or the presence of substances which may affect combustion (such as metal or glass).

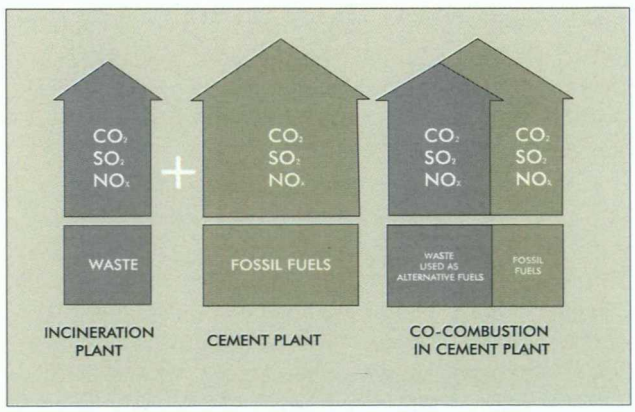
## The right stuff

Cement producers that use alternative fuels made from waste have set their own standards. For example, all the Polish cement plants owned by Lafarge pose the following requirements: a calorific value of over 14 MJ/kg (weekly average) and 11.7 MJ/kg (daily average), a chlorine content of less than 0.5%, a sulfur content of less than 2.5%, a PCBs (polychlorinated benzenes) content of less than 5 ppm, and a heavy metal content of less than 2500 ppm (mercury less than 10 ppm, cadmium + thallium + mercury less than 100 ppm). When a plant is being supplied with an alternative fuel, whether liquid or solid, it is also very important to observe other factors such as: self-ignition point, humidity content, ash content, grain composition, etc.

Alternative fuels for the cement industry are classified according to their aggregation, into gas, liquid and solid fuels. CEMBUREAU (the European Cement Association) divides alternative fuels into five categories: *gaseous alternative fuels* (examples: coke oven gases, refinery waste gas, pyrolysis gas, landfill gas), *liquid alternative fuels* (low chlorine spent solvents, lubricating oils, vegetable oils and fats, distillation residues, hydraulic oils, insulating oils), *pulverized, granulated or fine crushed solid alternative fuels* (ground waste wood, sawdust, planer shavings, dried sewage sludge, granulated plastic, animal meals, agricultural residues, residues from food production, fine crushed tires), *coarse crushed solid alternative fuels* (crushed tires, rubber or plastic waste, wood waste, reagglomerated organic matter), and *lump alternative fuels* (examples: whole tires, plastic bales, material in bags and drums).

## Greener cement

The cement industry is exceptionally well suited to use waste as fuel. The incineration conditions in cement kilns make them suitable for using alternative fuels made from waste, because of such factors as: a high temperature, a sizable kiln length, a long total time of fuel




Climate Change, Cement and the EU (1998)

**Emission reduction when burning alternative fuels in the cement industry**

staying in the kiln, and the alkaline environment present within the kiln.

Temperatures in the kiln are very high (the gas temperature in the combustion zone reaches 2000°C); the gas staying time in temperatures over 1200°C is about 3 seconds given a 2-3% oxygen content in the gases. These conditions are far above the temperature level and time necessary for the total combustion of highmolecular hydrocarbons, the dechlorination of dioxins, and the destruction of benzene rings, while protecting against conditions favoring the recombination of dechlorinated dioxins and furane.

It is ecologically safe to use alternative fuels in cement kilns because of a high temperature present inside such kilns, high gas stream speed, and the long total time during which particles remain in the gas stream. Cement kilns work on a constant basis. The temperature of the material and its distribution within the kiln are quite stable in time, and due to a kiln's high heat capacity even in a case of emergency stoppage the temperature does not fall too quickly, thus guaranteeing total fuel combustion. The alkaline environment present inside a cement kiln allows the acid components of gases to be neutralized and captured before combustion gas is released into the atmosphere. Fuel combustion in a cement kiln is a no-waste process, as the ash is a component of the clinker. The high efficiency of combustion gas purification eliminates metal emissions. Metals are condensed in the dust particles captured by the purifying unit, returned into the process and, in the end, bonded by the clinker.

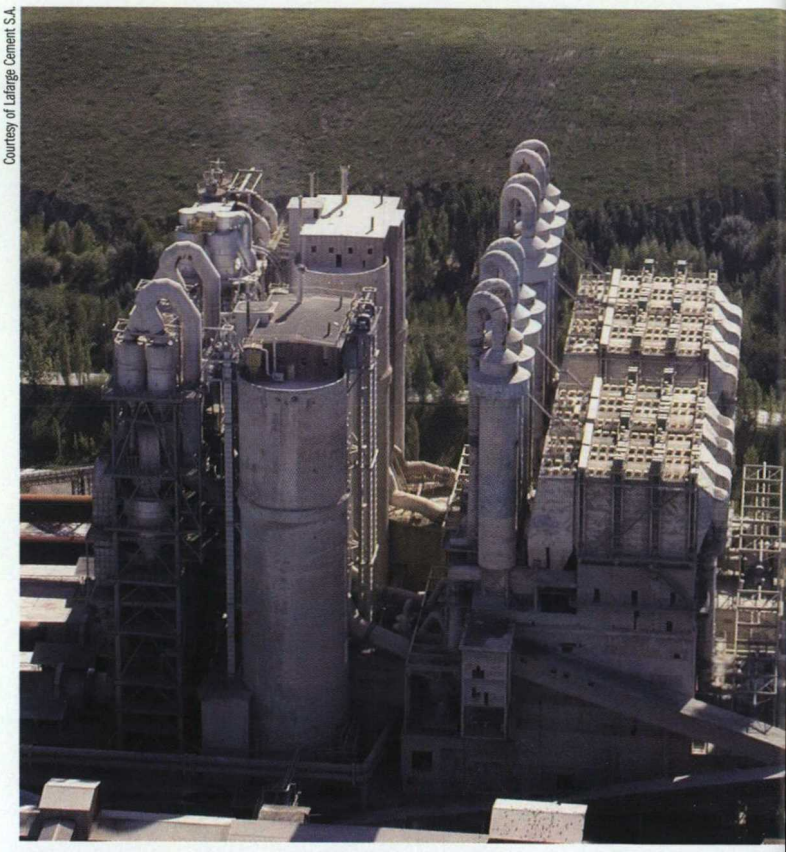
## Halfway down the road

There are several technological methods of making cement: dry, semi dry, wet and semi wet. Only two of them are used in Poland: the dry method (accounting for 98% of clinker production in 2003) and the wet method (2% in 2003). In each of them, the process consists of three stages: the preparation of raw material, clinker burning, and the milling of clinker with additives. This requires a lot of energy, especially when using the wet method. The specific heat consumption for clinker burning, on average for the whole industry, is approximately 3770 kJ/kg. Thus it is reasonable to search for new ways of obtaining this energy.

Alternative fuels have been used in the cement industry since the 1980s. Prior to the recent wave of accession, there were 250 cement plants in the European Union producing 170 million tons of cement per year. In Poland there are 12 full-production-cycle cement plants, 6 cement milling plants and one white cement plant. Poland produced 11.009 million tons of cement in 2003.

According to 2002 data from CEMBUREAU, the greatest usage of alternative fuels in European countries is to

Courtesy of Lafarge Cement S.A.



**Cement production in Małogoszcz plant is an environment-friendly process as a result of alternative fuel use**

be found in Holland (72%), Switzerland (34%), Germany (30%), and Belgium (30%). Waste fuels are not yet widely used in Poland, but this is changing. Only six cement plants currently have alternative fuel co-combustion installations, but the percentage of waste fuel usage has risen from 4.0% in 2002 to 6.5% in 2003.

The combustion of alternative fuels in cement kilns offers a safe method of waste utilization, which is both environmentally-friendly and profitable to the cement industry and society. More than twenty years of experience has shown that such use of waste is both ecologically and economically justified. ■

**Further reading:**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*Climate Change, Cement and the UE. The European cement industry contribution to CO2 emission reduction by choosing the best policies for Europe. Positive action by CEMBUREAU Members.* Cembureau, Brussels 1998.