

Reduction of greenhouse gases from cement production through combustion optimization in Romania

Cimus – Holcim Cimpulung, Romania

Summary

Having a duration of twelve months, this project was financed within ECOLINKS, an USAID funded program. The implementing organisation is a cement factory from Cimpulung Muscel, Romania, which now belongs to the Holcim Group. The Romanian Partner assisting the American one have undertaken a series of tests using various mixtures of natural gas and heavy oil to fire the kilns. The results show that the best solution is to burn more natural gas than heavy oil in order to improve the combustion efficiency and reduce the carbon dioxide emissions.

End-user area	Target Audience	Technical
<input type="checkbox"/> New buildings	<input type="checkbox"/> Citizens	<input checked="" type="checkbox"/> Energy efficiency
<input type="checkbox"/> Refurbishment of buildings	<input type="checkbox"/> Households	<input type="checkbox"/> Heating
<input type="checkbox"/> Transport and mobility	<input type="checkbox"/> Property owners	<input type="checkbox"/> Cooling
<input type="checkbox"/> Financial instruments	<input type="checkbox"/> Schools and universities	<input type="checkbox"/> Appliances
<input checked="" type="checkbox"/> Industry	<input type="checkbox"/> Decision makers	<input type="checkbox"/> Lighting
<input type="checkbox"/> Legal initiatives (municipal regulations, directives, etc)	<input type="checkbox"/> Local and regional authorities	<input type="checkbox"/> CHP
<input type="checkbox"/> Planning issues	<input type="checkbox"/> Transport companies	<input type="checkbox"/> District Heating
<input type="checkbox"/> Sustainable communities	<input type="checkbox"/> Utilities	<input type="checkbox"/> Solar energy
<input type="checkbox"/> User behaviour	<input type="checkbox"/> ESCOs	<input type="checkbox"/> Biomass
<input type="checkbox"/> Education	<input type="checkbox"/> Architects and engineers	<input type="checkbox"/> Wind
<input type="checkbox"/> Other	<input type="checkbox"/> Financial institutions	<input type="checkbox"/> Geothermal
	<input checked="" type="checkbox"/> Other	<input type="checkbox"/> Hydro power
		<input type="checkbox"/> Other

Context

Holcim Group owns three cement factories in Romania. With a net sales figure of over € 80 millions, the group accounts for 30 % of the Romanian market. Over € 15 millions were already invested in environmental protection activities. The group has over 1900 employees, and the investment plan for the next 3 years exceeds € 80 millions.

Cimus operates a cement manufacturing facility with an annual production of 750,000 metric tons from three rotary kilns. The kilns can be fired with three different auxiliary fuels (natural gas, heavy oil, and waste oil) individual or in a combination with one another. A total of approximately 29,5 millions kcal/h (net) of auxiliary fuel is required to produce 800 MT/day of cement clinker in a single rotary kiln. Cimus factory is located in Cimpulung Muscel, at around 200 km west from Bucharest.

The hot cement clinker is discharged from the lower end of the kiln at 1440 C° and cooled to about 65 C° by heat exchange with forced ambient air in a grate-type cooler. The hot air exhaust from the

cooler is used as secondary combustion air for the auxiliary fuel used by the kiln. Approximately 90 % of the total air required for combustion is preheated.

Objectives

The overall goal of the project is to reduce the greenhouse gas emissions at cement plant firing kilns by improving the combustion process. First, a detailed investigation of present emissions and fuel efficiency will be conducted to determine the performance of two kilns. A study will be conducted to assess different options of process optimization such as changes in the fuel and air supply. The study will make recommendations on process and technology to minimize fuel consumption and air emissions.

Process

The project started on January 11th 2000 and ended on January 21st 2001.

Oxygen, Carbon monoxide and carbon dioxide readings are normally taken between the cyclones and the electrostatic filter. A CO analyser is used in order to ensure that CO level is maintained below the explosive limit of 0.6 % CO by volume.

For the purpose of the study, kiln exhaust measurements were made at the upper (feed) end of the kiln. All gas measurements were made on a wet volumetric basis using instrumentation and manpower provided by GASTAR. Although the hot and dirty gas conditions prevent continuous analysis of the exhaust at this location, an accurate assessment of kiln exhaust gas composition and combustion efficiency can be made with periodic checks.

Heat and material balances, based upon recorded meal feed rate, various process temperatures, fuel combustion rates, and measured gas composition, were performed to calculate the volume of kiln exhaust prior to dilution with infiltrated air.

Daily average concentrations for each kiln were between 1.38 % and 2.78 % for Oxygen and 23.81 % to 29.59 % for CO₂.

The tests have shown that:

Mass rate of carbon monoxide decreases with increasing oxygen concentration;

Mass rate of nitrogen dioxide does not show any correlation with oxygen concentration

Mass rate of carbon dioxide at the exit of kiln decreases with increasing percent of oxygen

Two different proportions of natural gas and heavy oil were used during the testing

During the project implementation period various burning compositions were tested. Various mixtures of natural gas and used oils were tested. The project had revealed that a mixture of natural gas at 1700 Nmc/h and heavy oil at 1750 kg/h is the most efficient.

Financial resources and partners

Project costs amounted to € 50,000 external financing and € 16,700 co-financing.

The project was undertaken with the support of two partners Chavond-Barry Engineering corp. USA and Gastar Romania.

Results

The project team had tested various burning mixtures analyzing the optimum composition in terms of percentage of natural gases and used oils. Burning natural gas instead of oil the fuel consumption can reduce by 8 % the energy consumption, with a reduction in CO₂ emissions by 60 to 75Mt per kiln per day.

The major environmental benefits are related to the reduction of gases emissions. Using the improved combustion process the CO₂ emission was reduced with more than 25,000 T/year and per kiln.

The tests have shown that lower carbon dioxide emissions are favored by burning more natural gas than heavy oil. More complete calcinations of the feed material in the feed preheat system, is capable of improving the overall process efficiency, and consequently reduce carbon dioxide attributable to fuel combustion

Lessons learned and repeatability

The positive aspects of project implementation is that testing various mixture of fuel increased the kiln efficiency resulting in reduced carbon dioxide emissions.

One problem that the team faced was measuring the exhaust gas parameters in difficult conditions of dust suspensions and high temperature. Gastar had to test a range of analyser and realising that a continuous monitoring is not possible, they decided to do regular checks and measurements (few times per shift).

The system can be easily replicated in all cement factories along Europe that use rotary kilns with h h precalcinaters. However, MgO kilns could also benefit from the use of gases an analyzers and other instrumentation, and energy audits to optimize combustion efficiency

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