groundWork

The Cement Kiln Portal

All around the world communities are fighting cement kilns. With the current drive to reduce CO_2 emissions, save on the cost of fuel and get rid of all kinds of waste, many cement companies are burning, or considering burning, what are politely called "alternative fuels" but should really be called waste. This site aims to consolidate information pertaining to cement kilns, especially those burning waste, and the communities that are opposing this practice.

General

Overview

Concrete, a vital element of which is cement, is the second most consumed substance in the world. Only water is used in greater quantities (ref). Apparently, almost one ton of concrete is used for each person in the world each year (ref). The amount of concrete used in construction around the world is more than double that of the total of all other building materials, including wood, steel, plastic and aluminium (ref).

Currently, production of cement is in the region of 1.5 billion tons per annum (ref), with a projected 2 billion tonnes (2000 megatonnes) production by 2010 (ref). This should be of grave concern to all, as the manufacturing of cement is intrinsically unsustainable, and has serious environmental impacts.

At the moment sixteen cement companies, which together represent more than 50 percent of the cement manufacturing capacity outside of China, have formed the Cement Sustainability Initiative (CSI), a member sponsored program of the World Business Council for Sustainable Development (WBCDSD). Core members of the CSI are Holcim and Lafarge.

The Cement Sustainability Initiative has put out a great many documents
CSI Documents:
- The Cement Sustainability Initiative (Brochure)
- Agenda for Action
- Toward a Sustainable Cement Industry (Executive Summary)
- Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process (Draft)(443 kb)

- Formation and Release of POPs in the Cement Industry (2nd Edition)
- Safety in the cement industry: Guidelines for measuring and reporting
- The Cement CO2 Protocol: CO2 Accounting and Reporting Standard for the Cement Industry (Guidance Document)
- The Cement Sustainability Initiative: Progress report
- The Cement CO2 Protocol: CO2 Accounting and Reporting Standard for the Cement Industry (Spreadsheet)
- Environmental and social impact assessment (ESIA) guidelines
- Guidelines for Emissions Monitoring and Reporting in the Cement Industry
- Health & safety in the cement industry: Examples of good practice

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all of which avoid the central truth – that cement can never be sustainably produced. While the industry is fond of saying that cement is the glue which holds society together, it generally neglects to point out that the industry is also responsible for a disproportionate volume of CO2 and other green house gas emissions, for massive fossil fuel consumption, for the creation of huge volumes of particulate matter, for the emission of large amounts of mercury and for environmental impacts through the mining of quarries and so on. While, in fairness, the industry is making some genuine environmental adjustments, we should not lose sight of the fact that a more honest approach to sustainability would be to make real investments in research into sustainable alternatives to cement, and to building methods which do not require concrete or cement, and which are less harmful to the environment.

An area where the cement industry is particularly focussed at present is the use of what they term "alternative fuels", which translates to the use of waste as a fuel. We must also not allow the industry's current attempts to paint the use of "alternative" fuels and waste materials green to go unchallenged – in the end, the use of waste in the cement industry is no more sustainable than current practices, and potentially brings with it a number of new problems.

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Manufacturing Process

Cement is essentially a binding agent which is used in concrete, mortar and plaster. It consists of four elements, calcium, silica, alumina and iron, which are found in limestone, clay and sand. To manufacture cement, four main processes are followed.

Firstly, raw materials are quarried and transported to a cement facility. These materials would include lime, shells or chalk, silica or fly ash from coal combustion, alumina from clay or shale or fly ash from coal combustion and iron oxide from iron ore or from iron containing by-products.

Next, these raw materials are milled into a fine powder and are mixed thoroughly. This mixing may be done using water or compressed air.

The next step is to heat the elements at very high temperatures (between 1400° and 1500°C), in a cement kiln. What is placed in the kiln can be either wet or dry. In the dry process, raw materials are in a fine dust form, and in the wet process in a slurry form. Generally, wet kilns are older and dry kilns are more modern and fuel efficient.

The kiln is an enormous sloped cylinder which slowly rotates. Temperatures increase over the length of the cylinder to very high temperatures – around about 1500°C - and the fuel is fed directly into the kiln, meaning that the fuel residues are incorporated into the final product. The temperature has to remain regulated, because if it is too low the product will not become sintered (i.e. the small particles of the raw materials will not adhere to one another correctly) and if it is too high the particles will melt and fuse into large glass-like lumps.

There are four thermal zones through which the raw materials travel in the kiln. The first is known as the Calcining zone, and it is here that limestone undergoes a chemical conversion to become lime. This occurs at about 900°C and the liberation of a CO2 molecule from the limestone (calcium carbonate - CaCO3) to form lime (calcium oxide - CaO) is known as calcination. The second zone is known as the Upper-transition zone, and here the temperature of the materials is increased to about 1200°C. In the third zone, the Sintering or Burning zone, the temperature is increased to about 1450°C, and it is at this point that the clinker, grey, glass-hard pellets, is formed. The last few meters of the kiln form the fourth zone, the Cooling or Lower-transition zone, and here the clinker is cooled to around 1250°C. The clinker then drops into a cooler and is taken for storage, where it can be kept for a number of years before being used.
In the final step of cement manufacture, about two percent gypsum (calcium sulphate), along with various other materials, is added to the clinker to improve the cement's setting and handling qualities, and everything is then finely ground into a powder which will react to the addition of water.

Find out more...

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Environmental Problems with Cement Manufacture

Energy and Fuel

Because the process of turning limestone into clinker requires high temperatures, the cement industry is one of the most energy intensive industries, consuming about 10 times more energy than the average required by industry in general. Modern dry-process kilns, however, require far less energy than the older, wet-process kilns (ref), and the use of pre-burners and the re-use of air from the clinker coolers can further reduce the amount of energy required. However, in the US in 2003, 25 kilns at 14 plants used hazardous waste as a fuel and most of these used the older, wet process [Commission for Environmental Cooperation, p. 36].

Historically, fuels used to fire cement kilns include pulverised coal, petroleum coke, which is a by-product of oil refining, and natural gas. More recently, "alternative fuels" such as used solvents, spent tyres, waste oil, paint residue, biomass such as wood chips, treated wood and paper, and sewerage sludge have also been used [ibid, p. 36].

The burning of hazardous and non-hazardous waste is also euphemistically known as co-processing, secondary materials co-processing or energy recycling. Waste fuels are very attractive to the industry as energy makes up the major cost in the manufacture of cement and such fuels are generally cheaper than the traditional fuels. Tyres and used industrial solvents are particularly attractive as they have calorific (energy) values similar to that of coal. Sometimes, waste can have an added benefit in that the kiln operator may, in fact, be paid for incinerating the waste. In certain countries, because the use of waste fuels reduces the use of oil and gas, carbon dioxide emission credits can be claimed [ibid, p. 36].

The cement industry suggests that the use of tyres as a fuel is beneficial to all. They try to convince us that a tyre will be completely destroyed in six seconds, and we are led to believe that virtually nothing will be emitted as a result. Research performed by Carrasco et al. indicated, however, that while there were improvements in some areas, the emission of some pollutants was exacerbated by the inclusion of tyres. The following table comes from the report Gaseous Contaminant Emissions as Affected by Burning Scrap Tyres in Cement Manufacturing.

Pollutants before and after tyre valorisation

	Coal			Coal and tyres		
Pollutant†	**Kilns**	**Cooling units**	**Total**	**Kilns**	**Cooling units**	**Total**
PM, mg/kg	166.4	86.5	252.9	177.4	112.4	289.8
Metals, µg/kg						
Fe	1464.6	1309.2	2773.8	2741.3	1717.4	4458.7
Al	1250.2	1422.5	2672.7	1950.1	1612.8	3562.9
Zn	310.5	91.6	402.1	2245.8	114.2	2360.0
Pb	202.7	21.7	224.4	477.6	31.0	508.7
Cr	80.5	22.0	102.5	422.5	28.0	450.5
Hg	92.4	0.85	93.3	71.2	1.5	72.7
Mn	46.1	39.4	85.5	122.9	48.6	171.5

Cu	6.6	5.9	12.5	15.9	5.8	21.7
Gases, mg/kg						
NOx	2943.4	–	2943.4	2628.3	–	2628.3
SO2	1169.0	–	1169.0	1446.7	–	1446.7
CO	260.7	–	260.7	356.0	–	356.0
HCl	16.4	–	16.4	24.4	–	24.4
Organics, µg/kg						
PAH	143.0	–	143.0	123.6	–	123.6
Naphtalene	130.7	–	130.7	120.4	–	120.4
Chlorobenzene	2.9	–	2.9	1.9	–	1.9
Dioxins and furans	0.0017	–	0.0017	0.00094	–	0.00094

† PM = particulate matter; PAH = polycyclic aromatic hydrocarbons

Clearly, emissions from a kiln will vary with exactly what is being burned, and there would never be a standard emission pattern for all kilns, or even for one kiln at all times.

The industry generally characterises the burning of waste in cement kilns as “an internationally accepted practice”. But, in 2003 in Mexico less than five percent of fuel used was alternative fuel, even though all cement kilns in Mexico are licensed to burn waste, while alternative fuels accounted for eight percent in Canada and nine percent in the United States [Commission for Environmental Cooperation, p. 36]. Should the practice, in fact, be “accepted”, then it is unlikely that there would be as many organisations militating against the use of such fuels as there are .

Greenhouse gas emissions

According to the cement industry itself, it is responsible for about 3% of the world’s total greenhouse gas emissions and for 5% of CO2 emissions [Humphreys and Mahasenan, p. 2]. This equates to about 1.4 Gt (1 Gt = 1 gigatonne = 109 metric tonnes = 100 000 000 tonnes (ref)). These emissions come from the burning of fossil fuels in kilns (40%), transport of raw materials (5%), fossil fuels required for electricity (5%) and the conversion of limestone (CaCO3) to calcium oxide (CaO) (50%). These are estimates, however, as the cement industry does not collect this data in a systematic manner [Humphreys and Mahasenan, p. 4].

Japan has managed to reduce their CO_2 emissions to .73kg CO_2 for each kilogram of cement produced, the best CO_2 emission record for cement kilns in the world but, having made great improvements with their early efforts, have been unable to further reduce them. Similarly, cement factories in Britain showed sharp improvement when first addressing the problem in the 1990s, but a levelling off in 2003 and 2004. It is felt that only fundamental technology breakthroughs or changes in market incentives will allow for further meaningful reductions in emissions [Humphreys and Mahasenan, p. 4].

The industry uses the potential reduction of CO_2 emissions as a reason for the use of waste derived fuels. However, given that half of the CO_2 emissions result from the calcification of limestone, changes in fuel will have no impact on these particular emissions, and even if the industry were to be able to reduce their fuel related emissions of CO_2 to nothing, they would still be responsible for more than 2.5% of the world's total CO_2 emissions – or round about 84 million tonnes every year.

Mercury emissions

Mercury is classified as a persistent, bioaccumulative toxic (PBT) chemical. It can cause neurological and developmental problems, particularly in children.

In a letter to the United States Environmental Protection Agency, protesting the fact that the EPA had elected not to place limits on the mercury emissions of cement kilns, the group Physicians for Social Responsibility explain the effects of mercury pollution.

In Northern America in 2003, cement kilns, which represent less than one percent of industries reporting, reported about nine percent of the total mercury released in air emissions [Commission for Environmental Cooperation, p. 56] in North America. This equates to approximately 5.75 tons of mercury and mercury compounds, about 5.23 tons of which were emitted to the air.

In view of the high and unregulated emissions, Physicians for Social Responsibility calls on the EPA to more stringently monitor cement kiln stacks. The letter also suggests that the reporting methods used by the cement kilns are flawed, and that the actual emissions from these kilns may be significantly higher. A recent report appears to confirm this.

Controlling mercury emissions from cement kilns is particularly troublesome as the high temperature of the kilns makes it impossible to use the bag houses used in other industries. A bag house traps dust from the boiler and an activated carbon injection system is used to extract the mercury. The bags would melt in a cement kiln environment, and carbon injection is not effective where there is a lot of dust. Luc Robitaille of Holcim cement says that there is no technology that exists in the cement industry to control mercury emissions [Shapley, 16 July 2006].

Dioxins, Furans and Products of Incomplete Combustion

Dioxins and Furans are inadvertently created through combustion and industrial activities and are considered to be persistent, bio-accumulative toxic compounds. Some are carcinogenic and are suspected to be neurological, developmental and reproductive toxicants or endocrine disruptors. They may be produced when exhaust gases cool, and cooling these gases quickly through the critical temperature range of 450 to 200°C has been demonstrated to reduce dioxin and furan formation in cement kilns [Commission for Environmental Cooperation, p. 60].

Combustion upsets are par for the course in any kind of kiln or incinerator. Because of the very hot raw mix, a cement kiln must run through each combustion upset or process malfunction. This means that it is possible for the cement kiln to contain products of incomplete combustion (PICs), even though they may be required by regulations to stop feeding new matter into the kiln should there be an upset [p13]. This presents a real risk to surrounding communities as upset emissions have been shown to be more toxic than the original waste being burned through the creation of harmful products of incomplete combustion [Neil Carmen, 23 April 2004].

In 1995, at an EPA workshop, it was indicated that the cement industry was responsible for 17% of all dioxin emissions in the United States, and that those kilns burning hazardous waste were responsible for 99% of the cement industry's dioxin emissions (ref), and in 1998, in their report "The inventory of Sources of Dioxin the United States", they say that kilns that burn hazardous waste have 80 times higher dioxin emissions in the stack gases than those which use only conventional fuels [USEPA, p. 5]. In addition, USEPA also reports that dioxins are found in the Cement Kiln Dust (CKD) of both kilns which burn conventional fuel and those that burn hazardous waste, but that concentrations of dioxins in the CKD of those burning hazardous waste are almost 100 times greater than those not doing so.

A more recent study, Use of Continuous Isokinetic Samplers for the Measurement of Dioxins and Furans in Emissions to Atmosphere shows that continuous sampling shows higher levels of dioxin emissions than certified manual sampling. This study, however, shows low levels of dioxin emissions. You may also wish to read comment on the report.

Ozone

Ozone (O3) is "good" when it is high up in the atmosphere, in the region known as the stratosphere, but "bad" when found close to the earth in the troposphere (ref). Too much ozone can cause respiratory problems in humans. The electrostatic precipitator (ESP) is a particulate collection device that removes particles from air or flowing gas through the force of an induced electrostatic charge, and which tends to create ozone (ref). A study showed that maintenance workers who suffered from respiratory and eye irritations when working in a cement kiln were being affected by the ozone being generated by the ESP (ref). In 2004, two activist groups, Downwinders and Blue Skies, Midlothian citizens groups which have long been fighting the three enormous cement factories in Texas, sued the US Environmental Protection Agency (USEPA) "to do its job", and force the cement factories to reduce their emissions, especially ozone which is thought to be causing the extremely high incidence of asthma in the areas downwind from the plants (ref). A settlement was reached in 2005 whereby a cement kiln study would be conducted. This study concluded that emissions, including ozone, could be considerably reduced through the installation of new technology known as selective catalytic reduction (SCR). This is, however, quite expensive and the cement industry, who generally deny that their plants are any sort of problem at all, are resisting the installation of SCRs.

Cement Kiln Dust and Particle Emissions

Dust emissions are one of the primary problems faced by the cement industry. However, according to industry, these emissions "have been reduced considerably in the last 20 years, and state-of-the-art abatement techniques now available (electrostatic precipitators, bag filters) result in stack emissions which are insignificant in a modern and well managed cement plant" [CSI, January 2006, p. 47]. This statement not withstanding, a continuous monitoring system run by the NGO Emission-Watch, at Castle Cement's brand-new plant at Padeswood in Flintshire, North Wales, indicates frequent upsets where particulate matter exceeds the regulatory limit of 50ug/m3 (ref).

Most materials which are burned at very high temperatures will vaporise. However, when this vapour is cooled, the aerosols could have changed from the original materials to a previously unknown compound, which might have unpredictable consequences for people's health and for the environment. Even materials that are generally considered to be chemically inert may become reactive and electrically charged when they are changed into small particles and at times these particles may be of a novel configuration (ref).

Large amounts of fine material are given off during the cement making process. This material is carried out of the kiln by the flow of hot gas generated inside the kiln, and is not incorporated into the clinker as the raw materials have not been fully processed. This dust, CKD, therefore becomes a waste by-product (ref). In many cases, CKD is recycled back into the kiln and is ultimately incorporated into the clinker. The problem with this is that heavy metals can become concentrated in the CKD as some of it will pass through the kiln many times (ref). Where it is not recycled, it is stored in piles at the facility, and ultimately transferred to landfill. There have been allegations that this dust has contaminated both surface and ground water.

Off-gassing

It is currently unknown what the effects of incorporating the combusted waste matter will have. Conceivably some of these, too, may off-gas. And certainly, when the cement is used, or the concrete or mortar for which it has been used is later broken up, it is more than possible that contaminants will be "set free".

Products

As the residues from the fuel which is used to fire the kiln are ultimately incorporated into the clinker, the clinker and cement produced from the clinker will obviously contain the same types of metals and organic compounds which are found in the CKD and in the air emissions (ref).

Concern has been expressed as to whether cement produced by kilns which burn alternative fuels will contain unacceptable levels of metals. It is possible that, should metals be present in great enough quantities, the integrity of the cement could be threatened. It is also possible that these materials could leach out from the finished cement, or could be released when the cement is later broken up for whatever reason.

While researching their Cement Kiln Dust Report, the EPA found that some clinker samples from waste burning kilns contained certain materials in quantities which exceeded the Land Disposal Restrictions for hazardous waste. This means that this clinker could technically be considered hazardous waste. Other research, however, has indicated that there is very little difference between the concentrations of metal in cement produced by kilns burning hazardous waste and those not doing so (ref). It should be remembered, however, that what is being burned at any one time will impact on what is incorporated into the cement.

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Conclusion

While the industry has spent a great deal of time, energy, money and imagination on putting a positive spin on the production of cement, there are a number of issues which pose serious problems for the industry, for the people who live near the manufacturing plants and the people who ultimately use, or are surrounded by, cement products.

Even without the introduction of alternative fuels to the scenario, industry emissions are problematic and, while there is as yet little firm data to back this up, it is probable that the burning of hazardous waste will introduce additional concerns.

Through burning waste, cement kilns become simply incinerators in disguise. Even though this is so, cement kilns are generally not subject to the same stringent emission standards that waste incinerators are. This is clearly an unreasonable situation as it not only means that cement kilns are in a position to pollute the community with relative freedom, but also that they have an unfair competitive advantage over the incinerators which, no matter how we may view them, are at least required to remain within certain standards.

The use of waste in kilns represents for the industry the kind of operating savings which can make an appreciable difference to their bottom line – assuming that they do not intend to pass these savings on to the consumer – or to their ability to be competitive in the market. The key elements of the industry argument are that it is better to burn waste in a cement kiln than in a conventional incinerator as they burn hotter and for longer, they exist already, and the energy from the waste is “recycled”. These are fallacious but, are likely to carry weight with both communities and government.

Ideally, the making of cement should be phased out altogether, although this is clearly a long-term option and would require a great deal of innovation and imagination from the industry and from society in general. In the short-term, however, communities should be pushing for more stringent standards to be imposed upon the industry, and for the burning of waste to be disallowed completely.

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Alternative Fuels & Raw Materials (AFRs)

Overview

The term "Alternative Fuels" is generally a euphemism for waste. The waste that is most often considered as fuel for cement kilns includes used tyres, rubber, paper waste, waste oils, waste wood, paper sludge, sewage sludge, plastics and spent solvents and spent potliners.

Arguments that the cement industry use to justify the use of waste as a fuel are pretty standard. They generally include:

Conservation of a non-renewable resource
The industry points out that substituting coal with unwanted materials that need to be disposed of would save coal, a non-renewable resource.
This implies that waste is a renewable resource, which it certainly should not be. Any process which relies on a constant (and in the case of cement kilns, large) stream of waste is intrinsically unsustainable and can only encourage an increase in waste generation rather than any attempts to reduce it.

Energy recovery from waste materials
As all the energy is used directly in the kiln for clinker production, the use of alternative fuels maximises the recovery of energy from waste. The recovery of the non-combustible parts of the waste is also maximised as the inorganic part is a substitute for raw materials in the cement and the need for disposal of slag or ash is eliminated.
If we accept that there is no option but to both generate and burn waste, then this argument holds true. The incorporation of heavy metals and other toxins in the cement should, however, be a cause for concern rather than celebration.

Increased environmental performance
Because of high temperatures, long residence times, high turbulence, a high PH environment, termal stability and the elimination of ash residues, cement kilns are more efficient and have a lower environmental impact than traditional incinerators.
Once again, the premise is that waste is a given, and that it must be burned is a given. It is true that if, indeed, there is no alternative to producing waste and burning it, it is better that it be burned at very high temperatures, leaving little residue. It must be remembered, however, that the waste burned contains heavy metals and toxins, and that these don't just simply disappear. Instead they either go up the stack or are incorporated into the cement.

Overall greenhouse gas emissions will be reduced
After considering the emissions from incinerators and landfills, there is an overall decrease in greenhouse gas production if waste is co-processed in cement kilns, because the kilns take these emissions over and no new emissions are generated.
Once again, this argument is based on the idea that waste is inevitable and must be burned, so it might as well be burned in cement kilns.

There is a reduced risk of soil and groundwater contamination"
By burning waste in cement kilns there is a reduced requirement for landfills and potentially hazardous waste will be incinerated and incorporated into the cement instead of being sent to landfills either as is or in the form of ash from a traditional incinerator.
We are led to believe that there are no alternatives to waste or what could be done to it, and it is better to have the waste residues trapped in the cement and its products than elsewhere.

The use of AFRs will not significantly change emissions
If the basic rules of secondary and raw material usage are followed (for example, feeding via the correct firing path, storing the waste correctly, sourcing it from trustworthy sources and setting limits on the quality) there should be no significant change in emissions from the cement kiln.
There is evidence to suggest that, under perfect operating conditions, emissions are largely limited. Unfortunately, however, perfect conditions rarely persist and during start-up and shut-down situations, as well as upsets during normal operation, emissions have been shown to be problematic.

An industry view can be found in Alternative Fuels in Cement Manufacture - Technical and environmental review.

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Tyres

Waste tyres are a popular fuel for cement kilns. They are a real problem in waste terms, and are attractive to kilns because they have a high energy content. In many instances tyres are the only "alternative" fuel that a kiln might use.

Some cement kilns can accept whole tyres, while others require that the tyres first be chipped.

A Friends of the Earth report, Gone to Blazes reports that tests of tyre burning at four California kilns showed the following emission increases when compared to coal:

Emission	% Increase	Number of Tests
Dioxins	53% - 100%	4/4
PAHs*	296% - 2230%	3/4
Lead	59% - 475%	3/4
Chromium	727%	1/3

*PAHs = Polycyclic Aromatic Hydrocarbons - many are carcinogenic

A significant increase of zinc and lead input to the kiln, and between a two to five times increase in dioxin emissions were found in a German study of a Belgian kiln burning tyres.

There is plenty of tyre burning information here. A report, Options for the use and disposal of waste tyres, examines both the problems with burning tyres and alternative uses for waste tyres in the South African context.

Although about a test burn case at a paper mill facility, the note International paper and a boiler full of tyres has some interesting legal perspectives on test burns of tyres.

Although about a dedicated tyre incinerator, a letter to the Dixie County Advocate newspaper summarises very nicely a community's concerns about tyre burning.

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Blended and Processed Fuels

Blending plants take waste a create fuel products from them. They are given fancy names like Cemfuel, Climafuel and Profuel to make them sound green and to disguise the fact that they are actually just waste, often hazardous, in a different form. Manufacturers of such fuels claim that they are helping to recycle waste that otherwise cannot be recycled.

Some of these products are known as SLFs (Secondary Liquid Fuels). SLFs are a blend of organic and solvent wastes. Materials used in such fuels include Oils, Non Halogenated Solvents, Halogenated Solvents, Organic Acids. Glycols, Distillation Residues, Solvent Based Inks, Paints and Adhesives, Aqueous/Organic Mixtures, Viscous Organic Liquids, Toxic Solvents, Organic Sludges and Amines/Alkali. Such fuels can replace up to 40% of the traditional fuels used in the kilns. They are used by injecting them into the kiln burner.

One of the best known SLFs is Cemfuel, produced by a Castle Cement affiliate company in Britain. Castle had hoped that, once waste had been turned into Cemfuel, it would be classed as a fuel and would therefore no longer be seen to be waste. This would mean that it would not be subject to the trade restrictions imposed upon waste through mechanisms such as the Basel Convention. This hope was, however, for the moment at least, dashed in a court case where the judge deemed that Cemfuel remained waste until such time as it was burned and the energy recovered.

Fuels such as Climafuel and Profuel are made from cardboard, paper, plastics, textiles, carpet and other fibrous wastes that are expensive or difficult to recycle and would, says the industry, otherwise be disposed of in landfill sites. The materials are shredded and ground to pieces of about 20mm in size, and then mixed.

Meat and Bone Meal (MBM) products are produced at animal rendering plants through the high temperature processing of animal remains, largely waste from abattoirs. The fuel is the granular solid residue that is left after the tallow (fat) has been rendered out.

Processed Sewerage Pellets (PSP) are made from the sludge from sewerage works. The sludge is treated by drying and then the application of heat to produce a sterile, glassy, pelletised material.

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Communities

All around the world communities are opposing cement kilns. This site is intended to bring those communities together and any additional information regarding groups that are working against cement kilns would be gratefully received. Please e-mail team@groundwork.org.za with any information that you might have.

South Africa
United Kingdom
United States

This section last checked or updated: 17 July 2008

Abstracts

Usage of cement kiln dust in cement products

Maslehuddin, M., O. S. B. Al-Amoudi, et al. (2008). Usage of cement kiln dust in cement products - Research review and preliminary investigations. Construction and Building Materials 22(12): 2369-2375.

Abstract: Large quantity of dust, commonly known as cement kiln dust (CKD), is produced during the production of Portland cement. In order to meet environmental requirements, CKD is disposed off in land fills. Recently, there has been a trend of utilizing it for soil stabilization, treatment of sewage, etc. Also, attempts were made at using it in cement products. This paper reviews the work conducted on the latter aspect and reports results of tests conducted by the authors to investigate the properties of cement-CKD combination. Results indicate that CKD does not adversely affect the properties of cement mortar.

However, the implication of high chloride concentration and alkalinity of CKD on concrete durability needs to be studied.

Taiwan: dioxin emission factors during start-up and normal operations of MSW incinerator

Chen et al., 2008. Polychlorinated dibenzo-p-dioxins/dibenzofuran mass distribution in both start-up and normal condition in the whole municipal solid waste incinerator. Journal of Hazardous Materials. Article in Press. doi: 10.1016/j.jhazmat.2008.02.077

Abstract: Although many researches focused on the polychlorinated dibenzo-p-dioxins/ dibenzofuran (PCDD/F) emissions from stack, in the bottom ash and in the surrounding environment, researches focused on PCDD/F mass distributions in the whole incineration plant have seldom been addressed. This study determined PCDD/F emissions in the whole plant. A high-resolution gas chromatograph/high-resolution mass spectrometer was utilized for analyzing 17 PCDD/F species. Experimental results displayed that PCDD/Fs were formed during fly ash from super heater (SH), economizer (EC), semi-dryer absorber (SDA) and fabric filter (FF) was transferred to fly ash pit. Mass distribution ratios of PCDD/Fs in g I-TEQ (Toxicity Equivalency Quantity) per week from stack, SH, EC, SDA, FF, generation and bottom residue (BR) in start-up operations were 14.6%, 0.1%, 8.3%, 1.0%, 41.7%, 33.4% and 0.9%, respectively. Above results indicated that main PCDD/F source in the MSWI was from fly ash. However, the fly ash is easily controlled and PCDD/F emitted from stack flue gases will be difficult to be handled. Therefore, we should pay more attention on PCDD/F emission from flue gases especially from start-up procedure. Besides, fly ash should be controlled by sodium hypophosphite before being landfilled. MSWI did require further detoxification treatments for the solid residues and flue gases.

[from body of text]: The stack samples and ash samples were collected from KS MSWI, located in southern Taiwan. There are four incinerators, each of which includes own heat recovery systems (350 degrees C), selective non-catalytic reduction, dry scrubber (250–230 degrees C), activated carbon injection, fabric filter (180–160 degrees C) and stack. The treatment processes are the most common ones in Taiwan, which are recognized as the most effective technique for PCDD/F emission control.

Operation of the KS MSWI began in 2000 and its total capacity is 1800 ton/day with lower heating value of 2500 kcal/kg-waste

Experimental results displayed that the averaged PCDD/F equivalent concentration was 0.0511 ng I-TEQNm-3. The averaged PCDD/F contents for ash samples from the bottom residue, super heater, economizer, semi-dryer absorber, fabric filter and fly ash pit were measured to be: 17.2, 37.9, 4180, 620, 5020 and 6410 ng I-TEQ kg-1, respectively. The total PCDD/Fs emission factors were stack (8.47mg ton-waste-1; 0.454mg I-TEQ ton waste-1), BR (58.2 mg ton-waste-1; 3.54 mg I-TEQ ton-waste-1), SH (4.40 mg ton-waste-1; 0.306 mg I- TEQ ton-waste-1), EC (961 mg ton-waste-1; 31.9 mg I-TEQ ton-waste-1), SDA (100 mg ton- waste-1; 3.66 mg I-TEQ ton-waste-1), FF (1870 mg ton-waste-1; 160 mg I-TEQ ton-waste-1) and FAP (3610 mg ton-waste-1; 323 mg I-TEQ ton-waste-1), respectively. Theoretically the PCDD/F emission factor in FAP should be equal to summation of that in SH, EC, SDA and FF because fly ash from SH, EC, SDA and FF were transferred to fly ash pit. In other words, the PCDD/Fs might be formed (674 mg ton-waste-1; 128 mg I-TEQ ton-waste-1). As a result, the temperature of transmission system should be maintained at a level of 105–110 degrees C to prevent formation of PCDD/Fs and save energy as well. Recently, several studies have focused on the high PCDD/F emission during the start-up of incinerators. Therefore, the total emission amount of PCDD/Fs from stack, BR, SH, EC, SDA, FF and generation were 0.596, 0.0377, 0.00326, 0.340, 0.0390, 1.70 and 1.36 g I-TEQ week-1 with considering the start-up operations, respectively. Mass distribution ratios of PCDD/Fs in g I-TEQ week-1 from stack, SH, EC, SDA, FF, generation and BR in start-up operations were 14.6%, 0.1%, 8.3%, 1.0%, 41.7%, 33.4% and 0.9%, respectively. It could be seen that the main PCDD/F source in the MSWI was from fly ash although start-up procedure can generate 60% of the PCDD/F emissions from stacks for one whole year of normal operations.

Specific emergy of cement&concrete

Pulselli et al., 2008. Specific emergy of cement and concrete: An energy-based appraisal of building materials and their transport. Ecological Indicators 8: 647 – 656.

Abstract: Use and production of building materials, such as cement and concrete, is a major cause of global ecological problems with special reference to the overexploitation of non-renewable natural resources due to high temperature production processes, fossil fuels combustion, extraction of raw materials and non-recycling. In this paper, an environmental accounting method was applied to the production of cement and concrete in order to evaluate its dependence on natural resources even non-renewable and heavily relied on external inflows. The main steps of the production process (1) cement production, (2) transport of materials and (3) concrete mixing, were assessed by the emergy analysis (spelled with an ''m''). This was performed to measure the amount of environmental resource use in terms of equivalent solar energy, extending the energy hierarchy principle to building materials. The resulting unit emergy values of cement and concrete were compared with previous emergy assessments in order to highlight how emergy analysis is sensitive to local context and reference system's boundaries. An Emergy Investment Ratio (EIR) was assessed and presented as a synthetic indicator of sustainability. Results showed a high dependence of cement and concrete production on external resource flows. Furthermore, the high value of EIR suggested a weak competitive capacity due to a high sensitivity to external instabilities.

[from body of text]: In this paper, an evaluation of building materials sustainability was presented through an emergy evaluation. The specific emergy of cement and concrete are 3.04 x 10 to the 9 sej/g and 1.81 x 10 to the 9 sej/g, respectively, in the Italian context. The emergy analysis of cement and concrete production takes into account various steps in the process. More than procedures for materials production, the results highlight the impact of the use of quarry materials. These are seen as mineral resources with high specific emergy provided by natural sedimentary cycles and accounted in sej. In the case of cement, materials (limestone, chalk, shale, clay and sand) are about 84% of the total emergy, while emergy for the blast furnace is about 15%. In the case of concrete, materials (sand, gravel, crushed stone, cement) are about 97% of the total emergy. Thus emergy highlights the critical role of overuse of non-renewable resources in the building industry, since it accounts for the work of nature (sedimentary cycle), not only human work for quarrying (the only process accounted in economic analysis). The dominant contribution of mineral resources underlines the un-sustainability of the building industry. Non-renewable and non-recyclable materials such as cement and concrete are undergoing depletion.

Burning RDF in cement kilns

Genon, G. and E. Brizio (2008). "Perspectives and limits for cement kilns as a destination for RDF." Waste Management 28(11): 2375-2385
a: Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
b: A.R.P.A. Piemonte, Via Vecchia di Borgo 11, 12100 Cuneo, Italy

Abstract: RDF, the high calorific value fraction of MSW obtained by conventional separation systems, can be employed in technological plants (mainly cement kilns) in order to obtain a useful energy recovery. It is interesting and important to evaluate this possibility within the general framework of waste-to-energy solutions. The solution must be assessed on the basis of different aspects, namely: technological features and clinker characteristics; local atmospheric pollution; the effects of RDF used in cement kilns on the generation of greenhouse gases; the economics of conventional solid fuels substitution and planning perspectives, from the point of view of the destination of RDF and optimal cement kiln policy. The different experiences of this issue throughout Europe are reviewed, and some applications within Italy are also been considered. The main findings of the study are that the use of RDF in cement kilns instead of coal or coke offers environmental benefits in terms of greenhouse gases, while the format ion of conventional gaseous pollutants is not a critical aspect. Indeed, the generation of nitrogen oxides can probably be lower because of lower flame temperatures or lower air excess. The presence of chlorinated micro-pollutants is not influenced by the presence of RDF in fuel, whereas depending on the quality of the RDF, some problems could arise compared to the substituted fuel as far as heavy metals are concerned, chiefly the more volatile ones.

[from body of text]: Some studies reported 1.8 million t/y of secondary fuels co-incinerated in cement kilns in Europe in 1997, which is expected to increase by 15% by 2003. The related strategy for the cement industry is to rely on alternative fuels to reduce its high energy bill (energy costs typically represent 30–40% of manufacturing costs of Portland cement), as well as for sustainable development. This is also an important consideration from the point of view of carbon dioxide emissions and the consequent possibility to benefit from carbon emission credits.

Hazardous wastes (1 million t/y) and tyres (550,000 t/y) are the most frequently used secondary fuels. However, future attention should be switched to biomass-based fuels including wastepaper and sewage sludge for carbon emission credits.

Table 1
Quantities of RDF co-incinerated in the cement industry in Europe ($\times 10^3$ t/y)

Secondary fuels	AT	BE	DK	FI	FR	DE	GR	IR	IT	LU	NL	PO	ES	SE	UK	Total
Tyres	30	25		8	200[c]	240				[i]	–	6.5	13		25	550
Waste oil	30	[b,i]			520[b,e]	180							9	6	120	1000
Solvent	7.5					25					10					
Sewage sludge		15	7.5								30					50
Plastics/paper	25	[i]	10			290										350
Bone meal/animal fat	10	220			100				[i]							350
Wood			>0.5			80							2+5[g]			100
Other	40[a]	[c,i]	22[d]			115					>5[f]		10		[h,i]	200
Total	142.5	NI	40	8	820	930	0	0	(NI)	(NI)	>45	6.5	39	6	(>55)	2600
Substitution rate (%)	26	40	7		24	23			1.5	5–10			1.2	13		

Notes:
Figures in brackets are quantities which have been reported incomplete.
[a] Paper fibre residues.
[b] Mainly reconstituted fuel mixed with sawdust or other absorbent matter.
[c] Including automative shredder residues and carpet/textile pellets.
[d] Including waste textiles and unspecified non-hazardous wastes.
[e] Estimates.
[f] Including paper sludge and waste rubber.
[g] Sawdust.
[h] Profuel derived from a variety of sources including paper, plastics and carpet cut-offs.
[i] Quantities were not available.

On the contrary, an increase in chlorine (0.3–0.5% in RDF, very low values less than 0.1% in coke) can lead to some problems arising from reactions between alkali and chlorine, the volatilisation of chlorides and recycling with dust, and the necessity to operate a bypass (extraction of part of the flue-gas) in order to limit the chlorides in the final clinker (Kurdowski, 1983).

The presence of heavy metals in secondary fuels can lead to a transfer in the produced clinker

… A final important aspect for the proposed substitution of secondary fuels is the low density of this material in comparison with conventional fuels. Taking into account the transport and storage costs, the cost of substituted fuels per unit of heat produced is higher than the cost of coke or coal.

… The use of RDF in cement manufacturing kilns seems to be positive, as the combustion of RDF allows for a reduction of about 1.61 kg of CO2 per kg of utilised RDF compared to conventional combustible materials (coal). This is due to the chemical composition of the combustible material. When RDF is used in specifically set up combustion systems with energetic recovery, taking into consideration the energetic mix for the production of electric energy and the efficiency of the electric production, the substitution of the combustible material involves an increase in the production of CO2 of about 0.15 kg per kg of RDF.

… The negative impact of the emission of atmospheric pollutants from the raw composition of burned RDF consists of the possible transfer of substances contained in the waste to the atmosphere or the produced clinker.

Table 3
Transfer factors to waste gas for RDF contaminants, in the case of incineration and co-combustion in cement kilns

	Transfer factors (TF) for RDF		Transfer factors (TF) for waste solvents
	TF to waste gas for incinerators (%)	TF to waste gas for cement kilns (%)	TF to waste gas for cement kilns (%)
Chlorine	0.08	3.4	—
Sulphur	0.1	3.1	—
Cadmium	0.5	1.873	4.32
Thallium	0.065	0.875	2.81
Mercury	5	49	24.96
Antimony	0.004	0.042	—
Arsenic	0.001	0.020	0.01
Lead	0.005	1.015	0.21
Chromium	0.005	0.018	0.01
Cobalt	0.005	0.014	—
Copper	0.005	0.040	0.01
Manganese	0.005	0.010	—
Nickel	0.005	0.019	0.001
Vanadium	0.005	0.050	—
Tin	0.005	0.043	—
Zinc	No data	0.437	0.18

In any case, it is evident that the use of RDF instead of traditional fuels in a cement kiln could be dangerous in terms of the presence of larger amounts of heavy metals in the waste gas, so the quality and the quantity of RDF

… It is important to underscore that the transfer factors can change according to the composition of the fuel (for example, which molecules mercury forms around), to the presence of halogens (for example, Pb, Ag, Ni are much more volatile as chlorides) and to the occurrence of a reducing or oxidising atmosphere.

… As far as the possible formation of dioxin is concerned, a complete study has been conducted on the emissions from the co-combustion system (SINTEF, 2004). The main results of this study are as follows:

- there is no correlation between dioxin emissions and the type of alternative combustible material used (Fig. 4);
- the formation of dioxins can occur in a thermal window between 200 and 450 _C, zones that are encountered in fume cooling systems before the final separator of the fumes;
- potential precursors released by combustible material introduced into the pre-calcination zone can react with the chlorine not retained by the alkaline matrix of the clinker, in the presence of metallic catalysts present in the transported powders, giving rise to emissions of dioxin where de-novo synthesis occurs;
- while the dioxin concentrations are, in most cases, lower than 0.1 ng/Nm3, concentrations of PCB at least a thousand times higher are possible. In this sense, they constitute a significant source of

precursors that are able to generate micro-pollutants where the aforementioned kinetic conditions allow this to happen.

Based on our experience, some problems can arise for cement kilns when using secondary raw materials containing micro pollutants or precursors (PCB, PAH).

Read Full Report

This section last checked or updated: 1 October 2008

Jargon

Term	Definition
AFR	Alternative Fuels & Resources
Alternative Fuels	Waste
CKD	Cement Kiln Dust
Co-processing	Burning waste along with coal or other fuels
CSI	Cement Sustainability Initiative
CV	Calorific Value
EIA	Environmental Impact Assessment
Emergy	The energy of one kind, usually solar energy, which is required to make a service or product
ESP	Electrostatic Precipitator
MBM	Meat and Bone Meal
MBT	Mechanically and Biologically Treated

MSW	Municipal Solid Waste
OPC	Ordinary Portland Cement
PFA	Pulverised Fuel Ash
PAH	Polycylclic Aromatic Hydrocarbon
PIC	Product of Incomplete Combustion
Product of Incomplete Combustion	Organic compounds formed by combustion at too low a temperature
PSP	Processed Sewerage Pellets
RDF	Refuse Derived Fuels
Refuse Derived Fuels	Waste
RFO	Recovered Fuel Oil
RHC	Rapid Hardening Cement
RoD	Record of Decision
SCR	Selective Catalytic Reduction
Secondary materials	Waste
SLF	Secondary Liquid Fuel
SRF	Solid Recovered Fuel

TDF	Tyre Derived Fuel
WLF	Waste Liquid Fuel

In the News

Cement Manufacturer to Pay $1.4 Million for Clean Air Act Violations

WASHINGTON – The U.S. Environmental Protection Agency (EPA) and the U.S. Justice Department announced today that Cemex, Inc., one of the largest producers of Portland cement in the United States, has agreed to pay a $1.4 million penalty for Clean Air Act violations at its cement plant in Fairborn, Ohio. In addition to the penalty, Cemex will spend an estimated $2 million on pollution controls that will reduce harmful emissions of nitrogen oxides (NOx) and sulfur dioxide (SO_2), pollutants that can lead to childhood asthma, acid rain, and smog.
Read more...

Argentina: Heavy metal pollution in topsoil's near cement plant

In Yocsina, Argentina, Bermudez et al. (2010) studied heavy metal pollution in topsoils near a cement plant burning 75% gas and 25% alternative fuels that are said to include industrial solid wastes. They found that cesium (Cs), europium (Eu), lanthanum (La), lutetium (Lu), rubidium (Rb), scandium (Sc), samarium (Sm), terbium (Tb), thorium (Th), and ytterbium (Yb) were associated with cement production, as higher concentrations were found downwind (predominant NE and NNE winds) to the cement plant. Barium (Ba) was related to distance from the cement plant and the mean total concentration was above residential and agricultural land use limits stated in national and international legislation and was related to the distance to the cement plant. The concentrations of HCl-extracted heavy metals – copper (Cu), lead (Pb) and zinc (Zn) – could be predicted by the organic matter percentage and the distance to the cement plant. According to soil quality guidelines for environmental health, the human and wildlife populations in Yocsina might be experiencing toxic barium and chromium effects.

Source: Bermudez et al., 2010. Heavy metal pollution in topsoils near a cement plant: The role of organic matter and distance to the source to predict total and HCl-extracted heavy metal concentrations. Chemosphere 78: 375–381

Over 3000 people against waste burning in Cemex and the expansion of the landfill

No to waste burning in cement kilns and no to the expansion of the landfill. Over 3000 people, mainly from Alicante and San Vicente, support the campaign against the issuance of environmental license to Cemex to burn waste and build and new cell in the landfill in Fontcalent. Read more ...

Cement Kiln fined for emissions caused by Pet Coke

DEP, EPA Settle National Air Quality Action Against LaFarge Cement.
The Department of Environmental Protection has joined the U.S. Environmental Protection Agency in a settlement with Lafarge of North America for air quality violations at its cement manufacturing plants in 12 states, including one in Whitehall Township, Lehigh County.
Read more....

US News: Cement industry says new EPA regulations would cost jobs, environmental groups respond

Wednesday Feb. 17, 2010 by Mike Lee

A day after Texas sued the federal government over global warming, the U.S. cement industry kicked off a campaign against tighter environmental regulations, releasing a study on the economic impact of regulations and dropping hints about filing a lawsuit. Read more...

Cement kiln incineration of hazardous waste: A critique by Kleppinger (1990)

Read the report on waste incineration in cement kilns by Dr. Edward Kleppinger.

New Portland Cement Rules

6 May 2009
The American EPA has published its proposed portland cement rule to revise requirements for hazardous air pollutants from this industry.

The new rules are titled: National Emission Standards for Hazardous Air Pollutants: Portland Cement Manufacturing Industry, 21136–21192 [E9–10206].

Read the rules.

Cement Makers Decry Emissions Rules

27 April 2009 - Jeremy Miller
New curbs on mercury and other emissions are too onerous, cement makers claim.

Cement industry representatives say that proposed federal air emissions regulations announced last week will lead to closure of American plants and outsourcing of cement production to countries with lax environmental regulations.

Last week, the Environmental Protection Agency announced proposed rule changes that would require significant reductions in emissions from cement plants. The new rules call for an 81 percent reduction in mercury by 2013, as well as steep cuts in sulfur dioxide, particulates and other pollutants.

Read the full article.

RDF Plant battles to get enough good quality waste

19 February 2009
Here is an interesting news report about the RDF plant built in Chandigarh, India, to produce pellets for a cement kiln. This plant is partially funded by the Clean Development Mechanism of the UN, for its supposed climate benefits.

Neil Tangri of GAIA comments: The article, despite its clear anti-poor bias, makes it very clear that the incinerator is in conflict with recycling systems. It blames the wastepickers for recycling materials which the incinerator needs to burn, in order to maintain a high calorific value of the waste. Instead, the writers should have asked why a facility was built which is inappropriate for the post-wastepicker stream. In fact, the answer to that question is: because then we wouldn't need an incinerator. Composting would be a much better solution for the wet, organic waste. Instead, the plant has imported expensive machinery (and no doubt, very energy-intensive machinery) to dry the food waste so that it will burn. Ridiculous!

Read the article.

Spanish groups unite against waste burning in cement kilns

Citizen´s movements from Spain are taking big steps against waste burning in cement kilns. The groups working on this issue agreed to create a national network against waste burning in cement kilns, and they will hold their first meeting on 5 June in Bierzo, province of Leon (home of one of the major grassroots "Plataforma Bierzo Aire Limpio"). They have also been working with the party Izquierda Unida, who has introduced a bill that requests the national government to submit a report on the compliance and monitoring of the regulations related to co-incineration in cement kilns. It also requests the Autonomous Communities (groups of provinces) to reject proposals to burn waste in cement kilns and to provide economic incentives to tyre recycling and reuse companies.

Cleaner air for region

New regulations in the state of New York will result in the tougher regulation of mercury emissions from the three Portland cement kilns in the state. (17 January 2009)
Read article...

Cemex faces major changes after court ruling

In addition to paying a $2 million fine, experts say CEMEX will have to make significant changes to its Victorville cement plant to meet the terms of a recent court ruling. (16 January 2009)
Read article...

Ravena plant is N.Y.state's No. 2 mercury source

The Lafarge cement plant is second only to New York state's largest coal-fired power plant in emitting mercury pollution. (6 January 2009)
Read article...

Polluters must pay

Polluters can be successfully sued for emitting annoying odours, dust or noise - even if they are in compliance with government regulations, the Supreme Court of Canada ruled in November 2008. (21 November 2008)
Read article...

Cemex says that dust cloud was not harmful to people or the environment

On Tuesday, 12 August 2008, a large, thick cloud of smoke was clearly visible over the Cemex cement factory in Kastel Sucurac. The incident occurred because a part of the heat exchanger became blocked. In a press release, the Head of Department for Public Relations of the cement kiln, Mr Mozar, stated that during the accident there was uncontrolled release of fine dust in the area. He said that discharge of materials lasted on 15 to 20 seconds which, while sufficient to make a visible dust cloud, had no significant impact on the environment.

He said "released material was in the form of fine particles from raw materials and there was no impact for the people or the environment, except for the usual dust respiratory impacts". Visitors to the local web page www.kastela.org said that such statements have become routine for citizens of Kastela in the Republic of Croatia.

More pictures...

Call for continuous monitoring of major polluters

In at effort to stop the world's largest tire incinerator, the Energy Justice Network is in the process of convincing the city of Erie, Pennsylvania to follow through with an effort to develop a local air pollution law requiring major polluters to continuously monitor many toxic pollutants, such as heavy metals, acid gases and even dioxins.

Read more...

Major victory for Lafarge neighbours

Undated but circa 20 June 2008

The Ontario Divisional Court has given a resounding victory to the Environmental Review Tribunal and to neighbours who oppose tire burning at the Lafarge cement plant in Bath.

Read more...

Cancer-causing chemical in the air

10:00 PM PDT on Monday, May 5, 2008 - CASSIE MACDUFF

The cancer-causing chemical found in dust blowing from the TXI Riverside Cement plant in Rubidoux isn't just a concern for people living in northwest Riverside County.

Prevailing winds carried hexavalent chromium-laden dust into south Colton and south Rialto, testing by the South Coast Air Quality Management District found earlier this year.

Higher than average levels of the toxic chemical were found in dust near La Cadena Drive and Rancho Avenue, Pepper Avenue and Interstate 10, and Riverside Avenue and I-10.

Hexavalent chromium is the chemical made famous by Erin Brockovich after it contaminated water in Hinkley. Residents there won more than $300 million from Pacific Gas & Electric for heart, respiratory and reproductive problems they blamed on the chemical.

Read more...

Riverside cement plant cited twice more over levels of dust from its property

via Environmental Health News
10:00 PM PDT on Saturday, April 26, 2008 By DAVID DANELSKI, The Press-Enterprise

Regional air pollution regulators have again cited TXI Riverside Cement for allowing plumes of potentially harmful dust to escape its century-old plant north of Riverside.

"Riverside Cement will continue to get notices of violations until they solve their dust problem," Sam Atwood, spokesman for South Coast Air Quality Management District, said Saturday.

A recent air district investigation found that dust from the plant contains hexavalent chromium, a cancer-causing substance that is a byproduct of cement-making. The plant, located just south of the border between Riverside and San Bernardino counties, was cited for producing dust clouds longer than 100 feet and for allowing dust to cross its property line, according to a memorandum written late Friday by Barry Wallerstein, the air district's executive officer. The agency regulates air pollution in Orange County and the most populated areas of Riverside, San Bernardino and Los Angeles counties.

The district also cited the company Friday for failing to use the best available technologies to control dust.

Read more...

Cement plant mercury emissions spur concern

By Bob Green, Special to the Freeman, 03/25/2008

STUYVESANT - After federal data recently showed that Lafarge Cement's plant across the Hudson River in Ravena was the state's largest source of mercury emissions in the state in 2006, the Stuyvesant Town Board moved at its March meeting to send a letter to the state highlighting its concerns.

Environmental groups, citing data from the federal Environmental Protection Agency, say that the Lafarge plant emitted over 400 pounds of mercury in 2006, although in 2003, the company said it produced a tenth of that amount, or 40 pounds. Mercury can cause health problems in humans and animals. It also can lead to birth defects.

The plant's output of toxic mercury was nearly a third of the state's total mercury pollution, equivalent to four of the state's largest coal- fired power plants, according to one published estimate.

Read more...

Industry scrambles to find a 'greener' concrete

It takes a lot of energy to make it, and the world is using billions of tons of it. Makers are finding better ways to do it.

By Tony Azios **|** *Correspondent of The Christian Science Monitor*
from the March 12, 2008 edition

We drive our cars on it, we build skyscrapers with it.

But concrete, one of the most common building materials in the world, has an ugly secret: It's a major source of carbon dioxide (CO_2) emissions, which contribute to global warming.

Roughly 5 to 10 percent of global CO_2 emissions are related to the manufacture and transportation of cement, a major ingredient of concrete.

With cement production expected to grow exponentially in coming decades, the industry is trying to address its environmental challenges.

"There is not one single cement company on this planet that is not thinking about how to [reduce emissions]," says Franz-Josef Ulm, a professor of civil engineering who researches concrete at the Massachusetts Institute of Technology in Cambridge, Mass. Read more...

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Cement Kilns

Burning waste in cement kilns is another form of incineration, and it wastes resources and results in emissions that are harmful to people's health.

In order to make cement, high temperature kilns (reaching temperatures of up to 1500°C) are needed to produce the clinker that is ultimately ground up and made into cement. Traditionally, coal is used in these kilns, but in the past two decades many "alternative fuels" have been used. The term "alternative fuel" has often been used to disguise the fact that this "fuel" is actually waste.

Cement kilns are neither properly designed for this purpose, nor are they held to the same regulatory standard as other incinerators.

The types of waste that cement companies try to burn include used solvents, spent tires, waste oil, paint residue, biomass such as wood chips, treated wood and paper, municipal solid waste, medical waste, and sewage sludge. These are added, along with coal, to the kilns. The cement industry uses these materials because they are generally cheaper than coal, and in some instances the kilns are actually paid for using them or can claim carbon credits because they are not using fossil fuels.

While it is claimed that the very high temperatures and long residency times within cement kilns result in high incineration efficiency and low emissions, cement kilns are simply not designed for burning waste. And because they are not regarded as incinerators, they generally avoid having to meet incinerator emissions regulations.

One of the biggest problems with using cement kilns as makeshift incinerators is periodic operating upsets, where the temperature can be reduced and emissions of dioxins dramatically increase. Studies have shown that emissions of some substances are reduced but that others increase substantially. It should also be noted that the residue of the fuel is incorporated into the cement, along with any heavy metals and other contaminants.

GAIA member groundWork has designed a web-based clearinghouse of information on the environmental and public health impacts of cement kilns burning waste. This site provides a meeting point for communities around the world facing similar challenges to exchange information and ideas, and provides a database of sustainable alternatives for waste streams currently being incinerated

http://www.no-burn.org/section.php?id=87

The Cement Kiln Portal

All around the world communities are fighting cement kilns. With the current drive to reduce CO_2 emissions, save on the cost of fuel and get rid of all kinds of waste, many cement companies are burning, or considering burning, what are politely called "alternative fuels" but should really be called waste. This site aims to consolidate information pertaining to cement kilns, especially those burning waste, and the communities that are opposing this practice.

http://www.groundwork.org.za/Cement/Cement.html

General

Concrete, a vital element of which is cement, is the second most consumed substance in the world. Only water is used in greater quantities. Apparently, almost one ton of concrete is used for each person in the world each year. The amount of concrete used in construction around the world is more than double that of the total of all other building materials, including wood, steel, plastic and aluminium. **(WBCSD Cement Sustainability Initiative report)**. Currently, production of cement is in the region of 1.5 billion tons per annum, with a projected 2 billion tonnes (2000 megatonnes) production by 2010 **(www.ecosmartconcrete.com/enviro_cement.cfm)**. This should be of grave concern to all, as the manufacturing of cement is intrinsically unsustainable, and has serious environmental impacts.

At the moment sixteen cement companies, which together represent more than 50 percent of the cement manufacturing capacity outside of China, have formed the **Cement Sustainability Initiative (CSI)**, a member sponsored program of the **World Business Council for Sustainable Development (WBCDSD)**. Core members of the CSI are **Holcim** and **Lafarge**.

The Cement Sustainability Initiative has put out a great many documents:

CSI Documents:
Documents:

- The Cement Sustainability Initiative (Brochure)
- Agenda for Action
- Toward a Sustainable Cement Industry (Executive Summary)
- Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process (Draft)(443 kb)
- Formation and Release of POPs in the Cement Industry (2nd Edition)
- Safety in the cement industry: Guidelines for measuring and reporting-
- The Cement CO2 Protocol: CO2 Accounting and Reporting Standard for the Cement Industry (Guidance Document)
- The Cement Sustainability Initiative: Progress report
- The Cement CO2 Protocol: CO2 Accounting and Reporting Standard for the Cement Industry (Spreadsheet)
- Environmental and social impact assessment (ESIA) guidelines
- Guidelines for Emissions Monitoring and Reporting in the Cement Industry
- Health & safety in the cement industry: Examples of good practice

Go to the CSI Document Page...

All these documents avoid the central truth – that **cement can never be sustainably produced**. While the industry is fond of saying that cement is the glue which holds society together**, it generally neglects to point out that the industry is also responsible for a disproportionate volume of CO2 and other green house gas emissions, for massive fossil**

fuel consumption, for the creation of huge volumes of particulate matter, for the emission of large amounts of mercury and for environmental impacts through the mining of quarries and so on. While, in fairness, the industry is making some genuine environmental adjustments, we should not lose sight of the fact that a more honest approach to sustainability would be to make real investments in research into sustainable alternatives to cement, and to building methods which do not require concrete or cement, and which are less harmful to the environment.

An area where the cement industry is particularly focussed at present is the use of what they term “alternative fuels”, which translates to the use of waste as a fuel. We must also not allow the industry’s current attempts to paint the use of “alternative” fuels and waste materials green to go unchallenged **– in the end, the use of waste in the cement industry is no more sustainable than current practices, and potentially brings with it a number of new problems.**

Manufacturing Process

Cement is essentially a binding agent which is used in concrete, mortar and plaster. It consists of four elements, calcium, silica, alumina and iron, which are found in limestone, clay and sand. To manufacture cement, four main processes are followed.

Firstly, raw materials are quarried and transported to a cement facility. These materials would include lime, shells or chalk, silica or fly ash from coal combustion, alumina from clay or shale or fly ash from coal combustion and iron oxide from iron ore or from iron containing by-products.

Next, these raw materials are milled into a fine powder and are mixed thoroughly. This mixing may be done using water or compressed air.

The next step is to heat the elements at very high temperatures (between 1400° and 1500°C), in a cement kiln. What is placed in the kiln can be either wet or dry. In the dry process, raw materials are in a fine dust form, and in the wet process in a slurry form. Generally, wet kilns are older and dry kilns are more modern and fuel efficient.

The kiln is an enormous sloped cylinder which slowly rotates. Temperatures increase over the length of the cylinder to very high temperatures – around about 1500°C - and the fuel is fed directly into the kiln, meaning that the **fuel residues are incorporated into the final product**. The temperature has to remain regulated, because if it is too low the product will not become sintered (i.e. the small particles of the raw materials will not adhere to one another correctly) and if it is too high the particles will melt and fuse into large glass-like lumps.

There are four thermal zones through which the raw materials travel in the kiln. The first is known as the **Calcining zone**, and it is here that limestone undergoes a chemical conversion to become lime. This occurs at about 900°C and the liberation of a CO_2 molecule from the limestone (calcium carbonate - $CaCO_3$) to form lime (calcium oxide - CaO) is known as calcination. The second zone is known as the **Upper-transition zone**, and here the temperature of the materials is increased to about 1200°C. In the third zone, the Sintering or Burning zone, the temperature is increased to about 1450°C, and it is at this point that the **clinker,** grey, glass-hard pellets, is formed. The last few meters of the kiln form the fourth zone, the Cooling or **Lower-transition zone**, and here the clinker is cooled to around 1250°C. The clinker then drops into a cooler and is taken for storage, where it can be kept for a number of years before being used.

In the final step of cement manufacture, about two percent gypsum (calcium sulphate), along with various other materials, is added to the clinker to improve the cement's setting and handling qualities, and everything is then finely ground into a powder which will react to the addition of water.

http://www.groundwork.org.za/Cement.html