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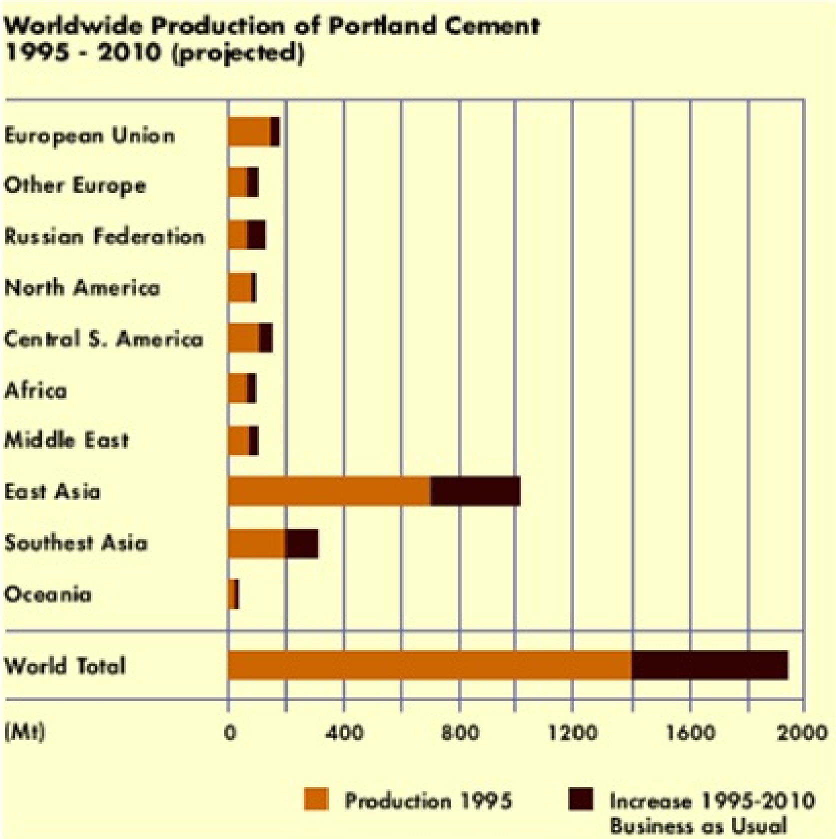
Thematic Focus: Resource Efficiency, Harmful Substances and Hazardous Waste, and Climate Change

Greening Cement Production has a Big Role to Play in Reducing Greenhouse Gas Emissions

Why is this issue important?

Next to water, concrete is the second-most consumed substance on earth; on average, each person uses nearly three tonnes a year. Portland cement, the major component of concrete, is used to bind the materials that make up concrete. The concrete industry uses about 1.6 billion tonnes of portland cement and produces some 12 billion tonnes of concrete a year.

The industry has a large ecological footprint: it uses significant amounts of natural resources such as limestone and sand, and depending on the variety and process, requires 60-130 kg of fuel oil and 110 kWh of electricity to produce each tonne of cement. In addition, the cement industry is second only to power generation in the production of CO_2. Producing one tonne of portland cement releases roughly one tonne of CO_2 to the atmosphere, and sometimes much more, and the cement industry accounts for 7-8 per cent of the planet's human-produced CO_2 emissions. Half of it comes from producing clinker (the incombustible remains of coal combustion), 40 per cent from burning fuel and 10 per cent from electricity use and transportation (Mahasenan and others 2003, WBCSD 2005).



Source: EcoSmart™ Foundation Inc. (n.d.)

Although cement making has become more efficient and the amount of greenhouse gas the industry emits has declined, further reductions will be diffi cult since processing limestone produces CO_2 and demand is increasing—within the next 30 years, worldwide demand for concrete is expected to double. Thus, it is critical that ways are found to reduce the concrete industry's environmental impact, especially its large contribution to global warming.

What are the findings and implications?

Much recent research has been conducted to investigate the potential for reducing greenhouse gas (GHG) emissions from the cement industry. Most of it has focused on using alternative materials to replace the maximum amount of cement used in concrete production, which would create a more sustainable process and product. Some of the most commonly used alternatives are waste products from industrial processes, such as fly ash, a by-product of coal-fired power plants; cement-kiln dust; volcanic ash; ground, granulated blast-furnace slag; rice-husk ash; and silica fume. Studies have shown that when blended in the right proportion and activated properly, using supplementary cementing materials can reduce emissions, energy use and resource consumption while still producing cement with robust strength and performance. In addition, there is the environmental benefit of waste reduction (Shah and others 2004).

The addition of such alternative materials to concrete often gives the product other benefits: they are recyclable, durable and need less maintenance and the product is often more economical and has reduced permeability and increased strength.

Another promising technique to reduce the industry's GHG emissions involves capturing the CO_2 used in the cement-making process to make other products, such as carbonates, bicarbonates, solids and liquids that capture the CO_2 molecule. One example is sending the CO_2 emissions through seawater to create a carbonate material that can be used to create concrete, thereby securing the gas permanently inside the building material (Biello 2007). Emerging technologies that reduce the environmental impact of cement production have a significant role to play in mitigating climate change. UNEP’s Sustainable Buildings and Climate Initiative recognizes this and supports the wide adoption of sustainable building practices (UNEPSBCI 2010). More policy and market incentives to support research and development of supplementary cementing materials and carbon capture and storage in concrete are needed.

References

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