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We need to talk about cement

The Australian, Australia

Professor Jay Sanjayan is the director of the Centre for Smart Infrastructure and Digital Construction at Swinburne University in Melbourne

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We need to talk about *cement*

Concrete is essential to modern life, but it's no friend to the planet. The rush is on to find a way to make concrete without CO_2

Story by **Max Maddison** Photography by **Aaron Francis**

Jay Sanjayan talks about concrete like most people talk about their family or friends.

The "depth and complexity" of the material fascinates him, the passion for his work is palpable. Rightly so: he is at the forefront of global research efforts to develop an industrial-scale, sustainable concrete.

His passion has taken him a long way — from the streets of Jaffna in Sri Lanka, where as a 10-year-old he used bags of concrete to construct fish tanks and furniture, through to Monash University in 1984, where his obsession really took hold.

"Modern civilisation is built on concrete," says Sanjayan. "A developing world infrastructure boom is coming in the next 20 years and concrete is the material that people are planning to use."

It's already the most commonly used material on the planet — and a big problem for the environment.

Concrete production is the third highest emitter of carbon, slightly behind global agriculture, and it adds up to 8 per cent of global emissions. If the concrete industry were a country, it would produce more carbon emissions than any other nation besides China and the US.

Along with several researchers across Australia, Sanjayan, who is based at the Swinburne University of Technology, is leading the global effort to develop a large-scale alternative production method for concrete. The task isn't easy; the method effectively has remained unchanged since its creation in 1824.

For all the talk of concrete, the real culprit is cement, which works as a binder or glue that holds together the other ingredients of concrete.

The process involves heating limestone at high temperatures, which produces what's called clinker and releases CO_2. About one tonne of CO_2 is released in manufacturing one tonne of cement. About half comes from the clinker production process, and the rest from the energy used to produce it.

"You can remove the latter by introducing renewable energy sources into the grid, but you can't get rid of the other half," says Stephen Foster, head of civil and environmental engineering at the University of NSW.

He and Sanjayan — who are working on different projects — are among those trying to find a way to get rid of the other half.

Their solution? An alternative concrete called geopolymer concrete, which is made from a waste product from coal power stations (fly ash) and the by-product of steel plants (slag).

Several projects across Australia are already on board. Queensland-based Wagners constructed part of Toowoomba Airport using sustainable concrete, and last year the City of Sydney, in partnership with UNSW, paved 15m of Wyndham Street in the Sydney suburb of Alexandria, with geopolymer to trial the long-term durability of the material.

Although the world has a glut of fly ash and slags, there are significant hurdles to the widespread use of geopolymer concrete. What's missing is the long-term data showing it has the longevity of traditional concrete.

Cement Concrete and Aggregates Australia chief executive Ken Slattery says that while the industry is on the "cusp of some quite significant change", a balancing act is required.

"The important thing for us is making sure that concrete behaves like concrete does, that it's performance isn't diminished while using some of these other materials and diminishing it's environmental impact," Slattery says. "It's one of the reasons why driving all of the emissions out of concrete is actually going to be a slow and relatively difficult process."

For all the environmental issues posed by concrete, its qualities as a building material are many. It's cheap, abundant and durable.

Sanjayan is sceptical of suggestions that recycled, reinforced timber could replace concrete: "We currently use 30 billion tonnes of concrete per year, regrowth timber can only replace less than 1 per cent of the requirement and regrowth takes 20 years."

Evidently, a large-scale solution to the concrete problem is needed — and fast. Standing in the way, says Slattery, is a conservative construction industry resistant to the next step in sustainability.

"In Canada, nearly all of the cement supplied now contains up to 15 per cent finely ground limestone, which performs the same way as conventional cement does but reduces emissions by about 7 or 8 per cent," he says. "We have been able to convince people to get to 7.5 per cent, but we haven't been able to convince them to make the next step despite the fact there's a whole body of evidence that these products work in exactly the same way."

Infrastructure Sustainability Council of Australia chief executive Ainsley Simpson says the industry is changing. She believes carbon neutrality for the industry can be achieved by 2050.

"We're seeing a major shift in how projects are being procured," Simpson says. "There is an increasing appetite for shared risk around innovation. That can only be a positive thing. It's perhaps just not happening fast enough."

At Lendlease, environmental and sustainability managers Ann Austin and Darryl Stuckey believe the company can be part of the answer. Later this year, they'll set out to discover what barriers are stopping their supply-chain partners from achieving lower emissions.

The goal is to induce a conservative industry into initially being more transparent about their emissions, then figuring out what the pressure points are to switch to less carbon-intensive materials.

Says Austin: "We need to be as bold as we can." **D**