We take for granted the inherent strength of structures like the Humber Bridge (pictured). The fabric of our world depends upon traditional Portland cement. But it comes at a cost to the environment because the huge heat and chemical change that are essential in making cement also results in carbon emissions. The industry is working hard to reduce them - but are there any long-term alternatives?

IT is hard to think of cement as anything other than basic. While the contribution it makes to our world is far from ordinary, the product that makes it all possible remains (for most of us) a nondescript grey powder.

The prospect of "novel" cements may then be a little hard to take seriously. Until that is, you explore the work underway within the industry and beyond to advance the cause you explore the work underway within the industry and beyond to advance the cause

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In the meantime, the industry has already taken great strides in developing second generation cements that are more sustainable. They involve use of Portland cement as an activator for mineral additions such as fly ash from power stations and slag from the steel industry, both of which would otherwise be landfilled.

Added to that is the increasing use of alternative waste-derived fuels instead of finite fossil fuels, plus heavy investment in new energy-efficient technology. As a result, MPA Cement members in the UK managed to achieve CO2 emissions in 2009 that were 7.7 million tonnes lower than in 1990. The question now is whether a further generation of novel cements can do still better.

To put the quest for low-carbon cements into perspective you need to appreciate that the industry worldwide is responsible for five per cent of all CO2 emissions (two per cent in the UK). The 10 million tonne annual cement output from the UK’s 14 plants is but a tiny fraction of the three billion tonnes manufactured worldwide. With growth in China and India both spiralling, the prediction is for global output nearer five billion tonnes by 2020 with obvious CO2 consequences.

Cements have been around since Roman times, but while the technology has changed greatly, the process still relies on the same basic raw materials and on volcanic heat (around 1,450°C) to bring about the fundamental chemical change. Therein lies the CO2 problem.

On the plus side, this traditional cement is made from abundant natural raw materials and is relatively low cost per tonne produced. But a tiny fraction of the three billion tonnes manufactured worldwide. With growth in China and India both spiralling, the prediction is for global output nearer five billion tonnes by 2020 with obvious CO2 consequences.

Most importantly, concrete made from it is highly durable – it literally puts the backbone into our built environment.

The big question is therefore can science give us a new generation of cements that use less, or no limestone, and less energy? And when can we expect to see them? The short answer is that they are already here, but don’t hold your breath on when you can expect to see them in everyday use. Research is still largely confidential but is well underway.

Dr Pal Chana, executive director of MPA Cement, is cautious. “Some of these novel cements are showing early potential but it is important to remember that they have yet to be produced in the sort of volumes needed for the global construction industry,” he says.

“Next generation?”

The challenge of identifying novel cements with genuine long-term commercial potential is being taken up worldwide. Alternatives are being investigated in Australia, China, Japan and the Netherlands.

The UK is, however, amongst the front runners with Novacem, a project led by engineers at Imperial College that uses magnesium silicates rather than calcium carbonate as its main feedstock. Magnesium silicates provide the main component in talcum powder.

Without getting into the details of the chemical process, the crucial factor is that the heat required is relatively low, which means that biomass fuels can do the job. Wherias manufacturing a tonne of conventional cement emits 0.8 tonnes of carbon, the equivalent for Novacem is claimed to be minus 0.11 tonnes. An industrial sized pilot plant should be operational in 2011.

Other novel cements at varying stages of development include:

■ CALIX – produced in a reactor by rapid calcination of dolomitic rock in superheated steam.

■ GEPOLYMER CEMENT uses wastes from power stations and the steel industry plus concrete waste to make alkali-activated cements.

“...but not as we know it”