GRS Complex Claims SOLUTIONS

Low Carbon Cement

Introduction

Concrete is the second most consumed material in the world after water. The production of Ordinary Portland Cement (OPC) generates 8% of all global carbon emissions. To put that into context, if the concrete industry was a country, it would be the world's third worst polluter, behind only the USA and China. So, it's not surprising that there is a drive to look to alternate materials and processes. Michael Clayton, Divisional Director at GRS' Construction and Engineering looks at how the concrete industry is shaping up to the challenges ahead.

Picture courtesy Castle Cement

The significant emissions produced during the manufacture of concrete cannot be ignored. The construction industry is looking to embrace a more sustainable approach and one of the challenges is to reduce carbon emissions.

The construction industry is already exploring the use of sustainable structural materials, such as utilising CLT (Cross Laminated Timber) which can provide a solution to structural designs and also has a certain aesthetic charm. It has its own limitations though, with limits on heights imposed by both design and, occasionally, underwriters. It is unlikely that the utilisation of materials such as CLT will be the panacea to the problem.

So, what of the inevitable consumption of concrete? The challenge to reduce emissions is already being embraced by the GCCA (Global Cement and Concrete Association). They have published the GCCA 2050 Net Zero Roadmap and Accelerator Programme as a template for countries to look to reduce their own emissions. The target is net zero by 2050, with an interim target of halving of emissions by 2030. But how are they going to do this, what is the strategy? Not surprisingly, the GCCA propose a multifaceted approach to the challenge, some of a technical nature and some, perhaps less so.

One solution is the use of "Low Carbon Concrete" which is now making its mark on the construction industry as designers and contractors look to fulfil both corporate and statutory obligations to reduce greenhouse gas emissions produced during construction.

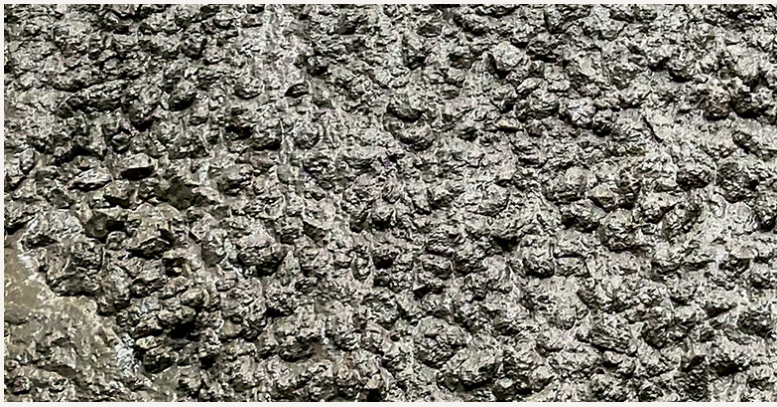
These low carbon products tend to fall into two strands of definition.

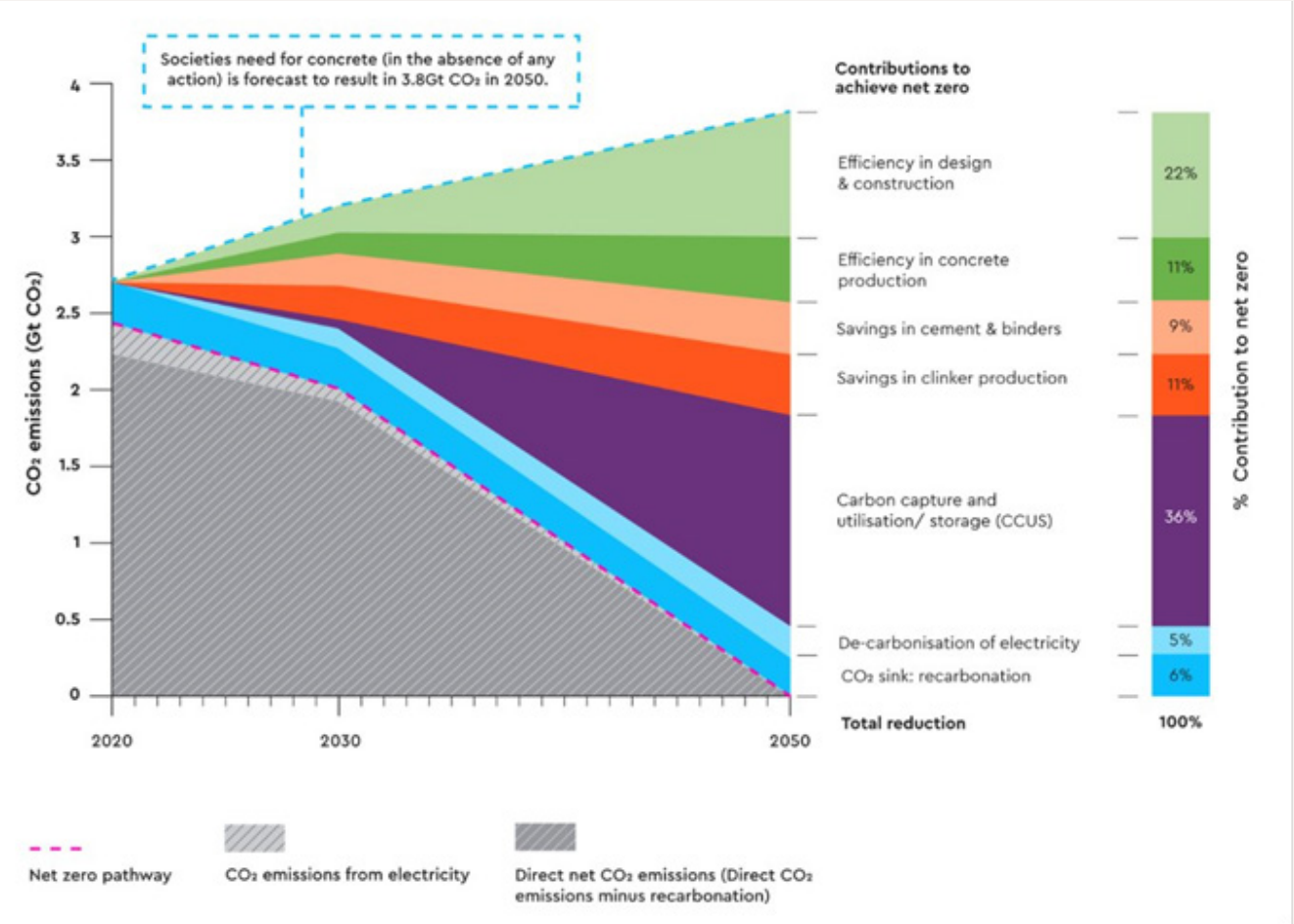
Firstly, manufacturers are looking to produce "traditional" concrete, with the same mined materials, but using green energy to fuel the kiln burn, a major contributor to carbon emission in cement production. This can be sourced from renewable energy or consumption of non-recyclable waste derived fuels. Technologies such as carbon capture can also reduce the carbon emissions intrinsic with the traditional production process.

An advancement in material science is leading technologists down the second type of solution and reducing the need for OPC and, instead, introducing novel materials in the sand, ballast and water mix to invoke chemical reactions to produce the material. These are classified as "Supplementary Cementitious Material" and, perhaps fortuitously, are often by-products of other industries, typically blast furnace slag from steel production and fly and bottom ash from coal-fired power plants. The utilisation of SCMs is not a new technology with one of the earliest recorded uses of any significance was substitution of OPC with Ground Granular Blast Furnace Slag to construct the Paris Metro in 1889. UK standards have been slow to catch up with the technology and the lack of accreditation thwarted an attempt to utilise low carbon concrete in the Crossrail project. Had that project been contemplated now, then it may well have been given the green light as the 2019 revision to BS8500 included standards for the inclusion of SCM in concrete products and with the 2023 revision, this scope has widened further, encouraging the reduction in OPC in concrete products and we see already built projects, such as 20 Fenchurch Street in the City of London, affectionally know as the "Walkie Talkie", utilising 50% by volume of SCM.

Utilisation of by-products in this way inevitably leads to concerns about performance. The provenance of such materials is not as easily established as virgin material. Inclusion of SCM can lead to longer setting times, delaying the striking of formwork. It can increase vulnerability to freeze-thaw damage and increase the rate of carbonation. There may be supply chain restrictions, and the SCM materials may become valued commodities as their availability reduces. Inclusion of SCM can have advantages however, with an increase in resistance to Sulphite and Chloride attacks and reduction in the risk of thermal cracking during curing and it can lead to greater ultimate strength being achieved. Clearly, such pros and cons need to be carefully considered by designers when contemplating specifying and utilising such materials.

However, it is unlikely that the use of SCMs alone will be the solution to achieving net zero. Indeed, the GCCA roadmap suggests that by 2050, savings in cement and binders will only contribute 9% to achieving net zero. There is also the problem that SCMs derive from existing "dirty" industries that themselves are being phased out as a result of environmental concerns, such as the closure of the two blast furnaces recently announced in Port Talbot. So where do the GCCA plan to make the main savings? Controversially to some, the greatest carbon reduction strategy is planned to be being achieved through carbon capture and storage, with this contributing 36%, by far and away the largest part of the overall strategy. A cynical view might be that it's not solving the problem, just hiding it and Carbon Capture and utilisation is, in itself, a developing technology. The next saving strategy, well that is to simply use less concrete in any given structure, with carbon savings of 22% aimed for through design refinement and construction.





Source: GCCA

As might be expected from the GCCA, there is no reference to other materials such as CLT being the solution or contributing to net zero. However, there are other technologies emerging, and research is underway to produce building materials grown with bacteria, not only avoiding carbon emissions, but absorbing carbon in the process. Such prototype materials are already in use in limited applications and are unlikely to figure in the GCCA plans for 2050, but such technologies could result in not only net zero being achieved, but the construction industry becoming carbon negative, removing more carbon from the air than it produces. That would surely be the utopia for the construction industry.

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