1st INTERNATIONAL CONFERENCE ON
INNOVATION IN LOW-CARBON CEMENT & CONCRETE TECHNOLOGY
LONDON 24-26 JUNE 2019

The Cement Industry and its Relation to Energy and Carbon Dioxide

Fredrik Glasser

ABSTRACT

Portland cement manufacture is an energy- intensive process and is associated with high specific carbon dioxide emissions. Although the benefits of Portland cement construction arguably outweigh the intensity of its CO_2 emissions, we strive to lower the emissions associated with its production and use while, at the same time, seeking to improve its performance.

I concentrate on an example taken partly from my work with colleagues over past decades: Portland cement-calcium carbonate blended cements. Adding ground natural limestone to Portland cement is not new and specifications for Portland -limestone blended cements have existed for decades. What is relatively new is (i) the freedom to market a product fitting the legal requirements for Portland cement but containing up to 5% limestone, and (ii) the move to circularity resulting from the potential availability of synthetic $CaCO_3$ made from captured CO_2

In assessing the action of limestone and of $CaCO_3$ in Portland cement blends, it is important to take a holistic view: the added carbonate /limestone has both physical and chemical impacts. The finer particles have a physical influence on cement performance, particularly on fresh mixes , but chemical reactions also occur.: $CaCO_3$ is not simply an inert diluent but reacts with Portland cement during the hydration process affecting the mineralogical evolution, strength gain and physical qualities of the hardened product, such as strength and permeability.

In these respects $CaCO_3$ differs from other cement admixes such as aluminosilicate fly ash and calcined clay because $CaCO_3$., has less impact on the high pH of cements than many other blending agents and this, in turn, enhances the durability of steel reinforced concrete in aggressive environments. By understanding and controlling the balance between physical and chemical reactions between cement and calcium carbonate, it may be possible to increase $CaCO_3$ contents without sacrifice of engineering properties and moreover, give scope for greatly enhanced reduction of net CO_2 emissions. The capture and conversion process and its implementation is described briefly.as initially operated. The process will scrub CO_2 from a coal-fired utility but the technology is readily transferrable to cement making.

It is proposed that in the decade ahead, an international effort be made to develop and exploit low- CO_2 versions of Portland cement. Many approaches have been proposed and there may be no “magic bullet”. The industry has to coordinate internationally so standards can be developed and consumer protection assured. A serious and sustained effort will certainly achieve substantial environmental benefit and I predict with confidence that Portland cement will still be a preeminent construction material In the century ahead.