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UTILISING THE INHERENT CO_2-BINDING CAPACITY OF CONCRETE – SUSTAINABLE INITIATIVES TOWARDS CIRCULAR ECONOMY

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Abstract

The binding of CO_2 by concrete carbonation is an on-going natural process. Many estimates have been given over the past decades and the last 5-10 year the knowledge has increased significantly regarding the capability to estimate the binding of CO_2 by concrete carbonation. This included better insight of the carbonation mechanisms, increased quantity of field data, and developments of models that calculate the CO_2-binding by concrete in service life and in the recovery phase. These developments have been the basis for EN 16757[i] published in 2017. This standard specifies the product category rules (PCR) on how CO_2-binding can be included in environmental product declarations for concrete and concrete elements.

Carbonation of concrete normally occurs when air or water-borne CO_2 dissolves in the concrete pore water and react with Ca^{2+} to form stable polymorphs of $CaCO_3$, which are precipitated in the pore system. Upon carbonation, the pH of the concrete pore water is decreased to around 9. Although it is a well-known naturally occurring ageing process for concrete, the carbonation phenomena is quite complex as it involves a series of chemical reactions and physical processes. Thus, it is difficult to give a complete physico-chemical description of all processes involved. However, in the natural process of carbonation it is indisputable that CO_2 is bound to concrete and thereby reduces the net CO_2 footprint of cement and concrete. Furthermore, the concrete exposure (i.e. user scenario) largely determines the speed of carbonation and thus the quantity of bound CO_2.

Hence, new initiatives has started In Norway on specific user applications with favorable exposure conditions where CO_2-binding can be maximized. The initiatives include the use of recycled aggregates from crushed concrete in new concrete (increasing the inherent CO_2-binding capacity) and the use as unbound aggregates (utilizing the unused remaining CO_2-binding capacity). In addition, laboratory and field measurements are conducted to scientifically support the calculated CO_2 uptake.

Keywords: carbonation, CO_2-binding capacity, greenhouse gas**,** recycled aggregates, road construction

[i] EN 16757:2017 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements.