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ABSTRACT

Literature Study on the Leaching Kinetics of Cementitious Building Materials

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A database was built in this research project. Leaching data of the tank test from numerous literature sources were collected and analyzed. The releases of most trace elements from cementitious building materials are very low, except for chromium, copper, thallium, and vanadium, which can be relevant to the environment.

For defining the leaching kinetics, the leaching rates were plotted over time in double logarithmic scale (lgJ – lgt diagram) and the slops were determined. For a diffusion controlled leaching with constant diffusion coefficient, the slope is theoretically -0.5. Because of the ongoing hydration during the experiment, the pore structure of concrete becomes denser. Therefore, the diffusion coefficient decreases, which leads to a faster decrease of the leaching rates of the environmentally relevant substances. Alkalis, which are weakly bound to hydration products, show a leaching behaviour that is controlled by diffusion. The average slopes of their lgJ – lgt diagrams were -0.65. The slopes of a number of trace elements were also around -0.65. Some heavy metals showed a different behaviour. The slops of Vanadium were less steep, sometimes the leaching rates increased at the end of the tank test. Obviously the release of this parameter is not controlled by diffusion. Further investigations over longer periods are needed. The slopes of lead, molybdenum and zinc were steeper than -0.65.

Besides compilation of the database, the current DIBt evaluation concept /1/ was explained. The reasons for the chosen conventions were also given. In the existing concept, a diffusion equation with a temporally constant diffusion coefficient is selected. In this research project, the realistic leaching rates of the database were used for the simulation. The modeling was performed for chromate. The equation, which was derived from the concept (admissible E_{56d} = insignificance threshold / 0.97), was also valid when using the realistic leaching kinetics. When using this equation for other parameters, it should be noticed, that the conversion factor for the input of the simulation depends on the observed parameter and possibly also on the tested materials. For a more accurate evaluation concept, more laboratory tests are required.

Apart from the illumination and verification of the German evaluation concept the Dutch evaluation concept is presented. In this concept the total release or rather the immission is the criterion. It is pointed out that the German assessment is much stricter than the Dutch for most of the parameters.

/1/ Deutsches Institut für Bautechnik (DIBt): Principles for evaluation the effects of building materials on soil and groundwater - Part II - Evaluation concepts for specific building materials, chapter "concrete raw materials and concrete" (Grundsätze zur Bewertung der Auswirkungen von Bauprodukten auf Boden und Grundwasser – Teil II – Bewertungskonzepte für spezielle Bauprodukte, Kapitel „Betonausgangsstoffe und Beton“): Deutsches Institut für Bautechnik, 2011

/2/ The State Secretary for Housing, Planning and the Environment , the Minister for Agriculture, Nature and Food Quality and the State Secretary for Transport, Public Works and Water Management: Soil Quality Decree (Netherlands), 2007