



Practical test: Efficacy of chromate reduction with KROnoCHROME in ready-mixed concrete

Depending on the origin of the raw materials used and the production conditions, cement contains up to 100 mg/kg hexavalent chromium (chromate).

In this water-soluble form, chromium is capable of penetrating the human skin and can cause an allergic reaction known as chromate dermatitis, depending on the intensity and duration of exposure.

Regulation (EC) No. 1907/2006 includes the following stipulations regarding the production, marketing and use of cement and cement-containing preparations:

Cement and cement-containing preparations shall not be produced, placed on the market or used, if they contain more than 0.0002% (2 ppm) soluble chromium(VI). Possible exceptions to this are automated processes or uses in which there is no possibility of contact with the skin.

By adding a reducing agent, such as ferrous sulphate, the hexavalent, water-soluble chromate can be converted into a hardly soluble, trivalent form that can no longer penetrate the skin. The reducing agent is customarily already added to the dry cement during cement production. This can be done in various technological ways (e.g. during or after grinding).

Since the chemical reaction between the chromium(VI) and the reducing agent only starts when the mixing water is added, it must be ensured that the reducing agent demonstrates sufficient efficacy, storage stability and homogeneous distribution.

The ferrous sulphate monohydrate **KROnoCHROME** can be added to the cement as a reducing agent during or after grinding, and its characteristics include the high thermal stability required in this context. In addition, its low residual moisture content (approx. 0.5%) offers significant handling advantages in connection with storage and conveying.



Planning and procedure of the practical test

Complete effectiveness of the reducing agent, and thus of the conversion of water-soluble chromium(VI) into harmless chromium(III), is also partly dependent on the intensity of mixing of the cement with water and mineral aggregate. The aim of the practical test was to investigate whether the intensity of mixing achieved during concrete production at the ready-mix plant and subsequent transport is comparable to that of the extraction method according to DIN EN 196-10 and sufficient for complete conversion of chromium(VI) into chromium(III).

To ensure unequivocal comparability, a dry sample of cement grade CEM I 42.5 R was taken during unloading into the bin at the concrete plant, the content of water-soluble chromium(VI) being determined according to DIN EN 196-10. A quantity of 0.4% **KRONOCHROME** ferrous sulphate monohydrate had already been incorporated into the cement supplied during its production at the cement works, where it was added between the cement mill and the separator. Without reducing agent, the content of water-soluble chromium(VI) in this cement grade is usually in the region of 8 ppm. The mixing plant used the same cement delivery to prepare the ready-mixed concrete, which was then transported to a building site in a truck mixer, where the second sample was taken.

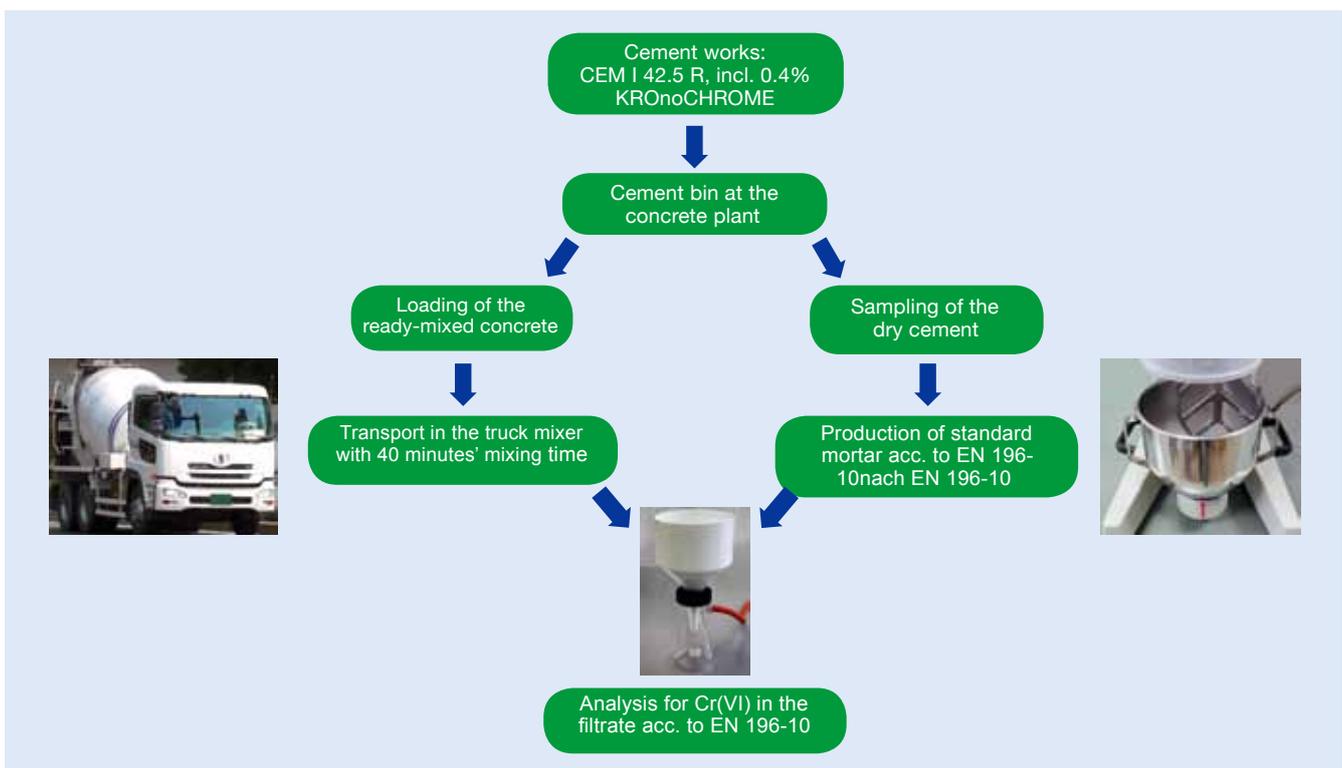
Result

Transport in the truck mixer took 40 minutes before a sample of the fresh concrete was taken at the building site. After a further 20 minutes at rest in the sampling vessel (transport from the building site to the laboratory), the sample of ready-mixed concrete was then filtered in accordance with the EN specification, the clear filtrate obtained in this way subsequently being tested for its chromium(VI) content.

Water-soluble chromium(VI) could not be detected either in the cement or in the ready-mixed concrete produced with it. The quantity of ferrous sulphate monohydrate already added to the cement, and the mixing parameters, were sufficient for reliable chromate reduction - both in the cement tested according to EN 196-10 and in ready-mixed concrete in practice.

Properties of the ready-mixed concrete:

Strength class	C25/30
Exposure classes	XC4, XF1, XA1
Moisture class	WA
Consistency	F3
Grain size	16 mm
Cement	CEM I 42.5 R
Water/cement ratio	0.58



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