

Cement, cementitious products and drinking water

Introduction

Cement¹ is used widely in construction works, including in the UK's drinking water infrastructure. Concrete and pipe-lining mortars are used in water treatment works, major ring-mains, service reservoirs, water towers and the connecting pipe-lines. Given the importance of the safety and quality of drinking water, cement-containing products (referred to as *cementitious* products by the UK water sector) in contact with drinking water are subject to regulation to minimize any potential detrimental effects to public health.

This Fact Sheet describes the position of cement and cementitious products under the current (2014) legislative/regulatory framework established in the UK. This limits water suppliers (public supply) and contractors/other stakeholders (premises of all types receiving water) to use only products and substances which meet the requirements of the relevant regulations, including official approval, or authorization, where required by the relevant authority.

In addition, regulatory developments within the European Union (EU) and European Economic Area (EEA), and an initiative underway in four EU Member States including the UK (4 MS regulatory proposals), are mentioned.

1) Cement, cementitious products and the drinking water infrastructure

Cement is placed on the market as a dry powder and, in that form, never comes into direct contact with drinking water. Consequently it is regarded as a *substance*, i.e. a constituent of other products, as opposed to an 'end-use product' in its own right. However, in its hydrated hardened cement paste state it is the matrix of any number of cementitious products where it is in contact with drinking water. Such products include: concrete, pipe-lining mortars and repair mortars used within the public supply and on premises, of all types, which receive water from the public supply.

The public supply ends at property boundaries, as does the remit of its related regulations. Within a property boundary, i.e. on premises, any product which will carry or receive water from the public supply must comply with a different set of regulations. Within both sets of regulations there is provision for products and substances to be pre-qualified or pre-tested for regulatory approval prior to installation. The requirements are complex and will only be outlined here, but the implications for cement and cementitious products are dealt with more comprehensively.

2) LEGISLATIVE/REGULATORY REGIMES IN UK

In UK, the legal framework that safeguards the safety and quality of drinking water is addressed within two sets of regulations, one which addresses water in the public supply and the other

¹ Any cement based on Portland cement clinker

which deals with water on premises. The implications of both for cement and cementitious products are described below.

2.1) PUBLIC SUPPLY IN UK

The regulations that apply to the approval, or authorization, of substances and products used in the provision of public water supplies within the United Kingdom, are: Regulation 31 (England² and Wales³), Regulation 27 (Scotland⁴) and Regulation 30 (Northern Ireland⁵) of the Water Supply (Water Quality) Regulations. Under these regulations water suppliers must not apply or introduce any product or substance into the public supply unless it meets the requirements of the relevant regulations. Where there is a requirement for the product or substance to be approved by the Secretary of State (DEFRA) or Welsh Ministers or Northern Ireland Assembly or Scottish Ministers, lists^{6,7} of all the products/substances approved or refused, and of all approvals revoked or modified, have to be published at least once a year.

In order to ensure that the requirements of the regulations are met, the relevant authorities have established independent bodies, e.g. the Drinking Water Inspectorate⁸ (DWI) for England and Wales, which operate product approval schemes on their behalf.

NOTE. The infrastructural scope of the public supply, and of the DWI Approval Scheme, is as follows:

Within scope: - raw water storage reservoirs; raw water pipelines; water treatment works; service reservoirs; water towers; water supply pipes up to property boundaries.

Outside scope: supply pipes, and plumbing systems, on premises.

DWI Approval Scheme, and authorization, for cementitious products

Approval of a product or substance is based on whether its use might create a risk to the health of consumers or adversely affect the quality of the water supplied. General 'fitness for purpose' is outside the scheme and is the responsibility of the end-user, generally a water supplier.

In the case of cementitious products, and associated substances, a risk assessment carried out by the DWI and other UK Authorities (in the 1990s), with assistance from industry representatives for the cement, concrete and chemical admixture sectors, produced a set of regulatory principles that were graduated as a function of:

- the ratio of the 'surface area of the product' to 'volume of conveyed drinking water' (S/V ratio) for the product in use, and;
- the presence, or otherwise, of organic substances (toxicological and hygienic considerations) in a cementitious end-use product.

The DWI Approval Scheme, which includes a concept called *authorization*, that covers cement and cementitious products was codified within DWI 'Guidance documents', 'Regulation Letters', 'Laboratory Test Protocols' and, in particular, 'Advice Sheets'. The broad principles and implications of the Scheme for generic categories of cementitious product are described below. However, where detailed information is required, the relevant approval body should be contacted via one of the following e-mail addresses:

² http://www.dwi.gov.uk/stakeholders/legislation/ws_wqregs2000.pdf

³ <http://www.opsi.gov.uk/legislation/wales/wsi2001/20013911.htm>

⁴ <http://www.opsi.gov.uk/legislation/scotland/ssi2001/20010207.htm>

⁵ http://www.opsi.gov.uk/sr/sr2009/nisr_20090246_en_1

⁶ <http://dwi.defra.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf>

⁷ <http://www.scotland.gov.uk/Publications/Recent>

⁸ <http://dwi.defra.gov.uk/>

Country	Approval body/regulator	E-mail contact
England	Drinking Water Inspectorate (DWI)	reg31.enquiries@defra.gsi.gov.uk
Wales		and dwi.enquiries@defra.gsi.gov.uk
Scotland	Drinking Water Quality Regulator For Scotland (DWQR)	regulator@dwqr.org.uk
Northern Ireland	Drinking Water Inspectorate - Northern Ireland (DWINI)	dwi@doeni.gov.uk

Authorization of cement and approval of cementitious products for use in the public supply

CEMENT

Cement that conforms to its harmonized European product standard (typically BS EN 197-1⁹) and also conforms to clause 47 of Annex XVII¹⁰ of the REACH Regulation [Cr (VI) limit], whether for use in concrete water-retaining structures, concrete/mortar-lined pipe-systems or repair products, complies with the DWI's Approval via an *authorization* without any testing or listing on its Approved List¹¹ being required.

See DWI Advice Sheet 7¹².

NOTE 1. The DWI applies the term *authorization* (not approval) to the constituents of concrete/mortar.

NOTE 2. The 'Approved List' is a short-hand for... *List of Approved Products for use in Public Water Supply in the United Kingdom* published by the DWI.

Cement complies with the DWI Approval Scheme without any testing, or listing on its Approved List, being required.

NOTE. For the qualifying conditions which must be met, see DWI Advice Sheet 7.

CONCRETE for use in water-retaining structures

Concrete for use in water-retaining structures, whether ready-mixed, site-mixed or as a precast element, presents a small S/V ratio condition - i.e. a relatively large quantity of water is in contact with a small surface area of concrete. In consequence, providing a set of qualifying conditions is met, concrete complies with the DWI's Approval Scheme for construction products without any testing being required.

See DWI Advice Sheet 7.

Concrete for use in water-retaining structures, whether ready-mixed, site-mixed or precast, complies with the DWI Approval Scheme without any testing or listing on its Approved List being required.

NOTE. For the qualifying conditions which must be met, see DWI Advice Sheet 7.

The qualifying conditions are described in detail in DWI Advice Sheet 7 but cover requirements for water suppliers which must be met before concrete can be used in a water-retaining structure, in particular:

⁹ BS EN 197-1 Cement. Composition, specifications and conformity criteria for common cements

¹⁰ Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

¹¹ <http://dwi.defra.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf>

¹² <http://dwi.defra.gov.uk/drinking-water-products/advice-and-approval/Advicesheet7.pdf>

- structural design must conform to BS EN 1992-3¹³;
- the chemical identity of any admixtures must be listed in Section 2.4 *List of Authorized Cement Admixture Components* of Appendix 2 of the Approved List;
- any admixture must be used within the manufacturer's recommended dosage range;
- a declaration must be obtained for any admixture to be used. It must confirm that the admixture contains no chemicals other than those in the *List of Authorized Cement Admixture Components* and that the admixture conforms to its European standard. Where no admixtures are used, confirmation is required in writing;
- all other constituents of concrete must conform to their European product standards. In addition cement and concrete must conform to clause 47 of Annex XVII of the REACH Regulation [Cr (VI) limit].

CONCRETE PIPES and MORTAR LININGS for metallic pipes (factory-lined or lined in situ)

Concrete pipes (pressure and non-pressure) and mortar linings to metallic pipes (ductile/cast iron or steel) present a high S/V ratio condition - i.e. a relatively small volume of water is in contact with a large surface area of material. In consequence, cementitious construction products intended for use in pipe-lines in the public supply have to be officially approved under the DWI Approval Scheme on a case-by-case basis in the form in which they will come into contact with drinking water (and/or raw water i.e. untreated water).

See DWI's Advice and Approval web-page¹⁴ and, in particular, DWI Advice Sheet 1¹⁵.

Concrete pipes and mortar-lined metallic pipes have, on an individual (i.e. brand) basis, to be tested for approval under the DWI Approval Scheme before they can be used in the public supply.

DWI's Advice Sheet 1 *Overview of the application process and general requirements* provides generic guidance on how producers apply for an individual approval for a construction product intended for use in the public supply. It describes, amongst other things, the minimum compositional information required in an application together with results from relevant testing in accordance with BS 6920¹⁶ or evidence of a listing by the Water Regulations Advisory Scheme (WRAS)¹⁷ in its web-based Water Fittings and Materials Directory. Additional release or leaching tests and chemical/toxicological screening may be required by the DWI during the administrative process depending on whether organic substances might be present e.g. resin-based, semi-porous seal coats are generally used to minimize leaching from factory-made mortar lined pipes.

The approval process and fulfillment of the administrative application requirements can be highly complex and for that reason the DWI advises applicants to seek independent, qualified assistance, pointing to its *designated test laboratories*¹⁸ as a potential source.

Cementitious repair products

Cementitious products used to repair water retaining structures and pipeline products usually contain organic substances. They are regarded by the DWI as potential high risk materials. Therefore these products also require a full approval on a case-by-case basis.

¹³ BS EN 1992-3 Eurocode 2. Design of concrete structures. Liquid retaining and containing structures

¹⁴ <http://dwi.defra.gov.uk/drinking-water-products/advice-and-approval/index.htm>

¹⁵ <http://dwi.defra.gov.uk/drinking-water-products/advice-and-approval/Advicesheet1.pdf>

¹⁶ BS 6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water

¹⁷ <http://www.wras.co.uk/>

¹⁸ <http://dwi.defra.gov.uk/drinking-water-products/advice-and-approval/labinfo.pdf>

2.2) PREMISES IN UK

The regulations that apply to the use and approval of plumbing systems and water fittings intended for use in contact with drinking water on premises in the UK, are: the Water Supply (Water Fittings) Regulations (England and Wales)¹⁹; Water Byelaws (Scotland²⁰) and Water Supply (Water Fittings) Regulations (Northern Ireland²¹). They impose national requirements for the design, installation and maintenance of plumbing systems, water fittings and water-using appliances. Their purpose is to prevent misuse, waste, undue consumption or erroneous measurement of water and, most importantly, to prevent contamination of drinking water beyond the public supply. Owners/occupiers of premises and anyone who installs plumbing systems or water fittings has a legal duty to ensure that the systems satisfy the regulations.

There are various means for demonstrating compliance but the best way is to engage voluntarily with the Water Regulations Advisory Scheme (WRAS)²² Approval process.

WRAS (Water Regulations Advisory Scheme)

The WRAS is funded by, and represents, all the water suppliers in UK providing an advisory service and approval process in support of the Water Fittings Regulations. Engaging voluntarily with WRAS, and/or a suitably accredited test facility²³ is the surest way to determine if an approval is indicated for compliance for a product/substance, and if so, the process involved in obtaining one. A copy of its Water Regulations Guide is available on request²⁴. WRAS also produces a Water Fittings and Materials Directory²⁵ which is a unique reference to the fittings, materials and appliances approved for compliance.

Obtaining a WRAS Approval has not, however, been solely associated with its role as a route to compliance with the Water Fittings Regulations. A WRAS approval can also confer a commercially beneficial status on a product or material and provides authoritative BS 6920²⁶ test results for use in any application for a DWI Approval for a product in regard to use in the public supply. A WRAS Approval remains valid for five years.

The process of assessment of cement, cementitious and associated products, and materials, for use on premises is already established within WRAS.

Cement and cementitious products for use on premises

The focus of the Regulations is on plumbing systems/fittings but, where appropriate, also covers the non-metallic materials and substances of which the fittings comprise and, additionally, many non-metallic products/materials for various uses e.g. repair.

CEMENT

Cement that conforms to its harmonized European product standard (typically, BS EN 197-1²⁷) and also conforms to clause 47 of Annex XVII²⁸ of the REACH Regulation [Cr (VI) limit], when used as a constituent material of other end-use cementitious products for use in contact with

¹⁹ <http://www.legislation.gov.uk/uksi/1999/1148/contents/made>

²⁰ <http://www.scottishwater.co.uk/business/our-services/compliance/water-byelaws/water-byelaws-documents>

²¹ <http://www.legislation.gov.uk/nisr/2009/255/contents/made>

²² <http://www.wras.co.uk/>

²³ http://www.wras.co.uk/pdf_files/approval/Material%20laboratories%20V4%20March%202014.pdf

²⁴ http://www.wras.co.uk/Regulations_guide.htm

²⁵ <http://www.wras.co.uk/Directory/>

²⁶ BS 6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water (many Parts/Sections)

²⁷ BS EN 197-1 Cement. Composition, specifications and conformity criteria for common cements

²⁸ Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

drinking water on premises is 'deemed to satisfy' the requirements of the Water Fittings Regulations without testing for approval being required.

Cement is deemed to satisfy the requirements of the Water Fittings Regulations without testing for approval being required

CONCRETE for use in water-retaining structures

Concrete, whether ready-mixed, site-mixed or as a precast element, is rarely intended for use in water-retaining structures on premises. Where, however, concrete is to be used for that purpose it may be that compliance with the requirements of DWI Advice Sheet 7 (see earlier) will be all that is required to demonstrate compliance with the Water Fittings Regulations. However, the potential need for testing in accordance with relevant parts of BS 6920 cannot be discounted and advice should be sought from WRAS.

CONCRETE PIPES and MORTAR LININGS for metallic pipes (factory-lined or lined in situ)

Concrete pipes

Concrete pipes, due to their large dimensions, are rarely used in contact with drinking water on premises but where they are to be used, advice should be sought from WRAS.

Mortar linings/lined pipes

Smaller diameter mortar lined pipes are used in contact with drinking water on premises and where used will need to demonstrate compliance with the regulations on a case-by-case basis. Where a WRAS Approval is sought, appropriate testing to BS 6920 will be invoked and this will include some product-specific aspects. For example, in the case of a factory-lined product, the tests will be carried out on samples representative of the finished product, whereas in the case of a metallic pipe to be lined in situ, samples of the mortar will have to be applied to specified substrates prior to testing. The complex procedural detail is described in BS 6920-2.1²⁹ with references to other sections of BS 6920 for the methods of determination for release of substances (e.g. trace metals) and effects (e.g. odour and flavour).

NOTE. Mortar linings are also applied internally to boilers and these also need to demonstrate compliance; testing at elevated temperature is included in BS 6920.

Cementitious repair products

In common with use in the public supply, cementitious repair products (which generally contain organic substances) need to demonstrate compliance with the Water Fittings Regulations on a case-by-case basis. UK water suppliers expect manufacturers to follow the WRAS Approval route with testing in accordance with relevant sections of BS 6920.

3) CESWI (Civil Engineering Specification for the Water Industry)

Unlike the previous subject matter, the Civil Engineering Specification for the UK Water Industry (CESWI) is not a regulation but an industry specification published by WRC³⁰. This is the specification for use in all civil engineering contracts let by water suppliers in the UK. In its clause 2.1, it highlights the need for compliance with the regulatory requirements for materials intended for use in contact with drinking water, as follows:

²⁹ BS 6920-2.1 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Methods of test. Samples for testing

³⁰ <http://ceswi.wrcplc.co.uk/index.php/news/71-ceswi-7-now-available>

CESWI: Clause 2.1 Materials in contact with potable water

All materials, substances and products in contact with potable water shall comply in all respects, for England with the Water Supply (Water Quality) Regulations and they shall be listed on the Approved List published by the Drinking Water Inspectorate; for Scotland, with the Water Supply (Water Quality) (Scotland) Regulations; for Northern Ireland, with the Water Supply (Water Quality) Regulations (NI); and for Wales, with the Water Supply (Water Quality) Regulations (Wales).

However, the requirement in CESWI clause 2.1 for all materials, substances and products in contact with potable water to be listed on the DWI's Approved List may well have given rise to the misconception that cement, itself, has to be listed. Cement cannot be listed in the Approved List because its status is that of *authorization* (not approval) and the qualifying conditions for its successful *authorization* are as described in a preceding section in this Fact Sheet.

4) Legislative/regulatory regime in the EU (position in 2014)

Products and materials for use in contact with drinking water in the EU and EEA are regulated under various European and national instruments:

- Article 10 of the EU Drinking Water Directive³¹ (DWD) - this regulates the generic safety and quality of drinking water;
- the EU Member States' national drinking water regulations - these establish and regulate the levels of safety and quality of national drinking water;
- the Basic Requirement for Construction Works 3 (BRCW 3)³² of the Construction Products Regulation³³ (CPR) - this defines the regulatory information - *declarations of performance and CE marking* - that has to be provided with construction products.

Just how the CPR's BRCW 3 requirement for drinking water-related information is to translate into provisions within European harmonized product standards, and associated test methods, has been under review since 1998 and has yet to be finalized. CEN/TC164³⁴ has developed many test method standards and, from time-to-time, the European Commission (EC) has introduced regulatory guidance into the process. But the multi-faceted nature of MS's notified national regulations and product approval schemes is still - after a 'false start' with the European Acceptance Scheme (EAS) - proving difficult to translate into CE marking provisions in relevant, harmonized product standards. In consequence, it will be some years yet before a coherent pan-European system emerges and in the interim, four EU Member States (4MS) have engaged in a 'mutual recognition' initiative.

5) Legislative/regulatory proposals in four EU Member States (4 MS)

In 2007, frustrated by the slow progress in Europe, four EU Member States, France, Germany, The Netherlands and UK, agreed to collaborate on the harmonization of tests for the hygienic suitability of products in contact with drinking-water.

³¹ Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

³² BRCW 3 - Hygiene, health and the environment, Annex I of the CPR

³³ Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

³⁴ CEN/TC164 Water Supply

Documentation describing the *4MS Common Approach* can be found on UBA's (the German Federal Environment Agency) website³⁵ together with a draft procedure for assessing cementitious products³⁶. The assessment will comprise four distinct parts:

- Part A: Control of primary substances;
- Part B: Accepted generic constituents;
- Part C: Approval of manufacturers' constituent products;
- Part D: Final product testing and approval.

If adopted by the 4MS, the UK will need to make consequential changes to its national regulations, and related policies and practices, which currently authorize cement and approve cementitious products for use in the public supply. All changes will need to be notified by the UK authorities (and the other 3MS) to the European Commission, in order to have an effect on relevant, harmonized European product standards already mandated under the Construction Products Regulation (CPR).

It is too early to speculate on what the effects might be for cement and cementitious products for use in contact with drinking water in UK.

Where can I find out more?

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³⁵ <https://www.umweltbundesamt.de/en/topics/water/drinking-water/drinking-water-distribution-guidelines-evaluation/approval-harmonization-4ms-initiative>

³⁶ http://www.umweltbundesamt.de/sites/default/files/medien/419/dokumente/4ms_assessment_of_cementitious_products_in_contact_with_drinking_water_2.pdf