

Parameter “chlorine demand” no longer used for the hygienic assessment of organic materials in contact with drinking water

1 The parameter “chlorine demand”

Chlorine demand was a test parameter included in the KTW Recommendations which the former Federal Health Office issued between 1977 and 1986¹ for the hygienic assessment of plastics and other non-metal materials in contact with drinking water. Until 31 December 2007, the parameter “chlorine demand” was part of the basic requirements in the Federal Environment Agency’s guidelines for the hygienic assessment of different organic materials in contact with drinking water², which gradually replaced the KTW Recommendations.

The chlorine demand test determines the decrease in the concentration of free chlorine in test water following contact with an organic material intended to come into contact with drinking water. The test method has been published as European standard DIN EN14718 and is limited to the testing of organic materials. Free chlorine can react with the contact surface or with substances leaching from the material into drinking water, whereby the substances are chlorinated or oxidised and the concentration of free chlorine decreases. According to DIN EN 14718, chlorine demand is calculated from the difference of the concentrations of free chlorine at the start of the test and after contact with the material, the volume of test water and the contact material surface, and the contact time. The chlorine demand of a material is expressed as mg chlorine/dm²/d.

2 Development of requirements

The KTW Recommendations of the former Federal Health Office contained requirements for the composition of relevant organic materials. In those days, the additional analysis of migration waters was limited to summary parameters. These included the parameters clarity, colour, foaming, odour and flavor, total organic carbon (TOC) content, chlorine demand, and microbial content which collectively were designated as basic requirements. For some materials, additional requirements were set in the form of the determination of a few polymer-specific summary parameters, e.g. primary aromatic amines, formaldehyde and phenols.

Starting in 2003, the KTW Recommendations were refined and gradually replaced by the guidelines published by the Federal Environment Agency (Umweltbundesamt, UBA). In the positive lists, the limitation of the quantities used in formulations was abandoned and replaced

¹ Bundesgesundheitsamt, Gesundheitliche Beurteilung von Kunststoffen und anderen nichtmetallischen Werkstoffen im Rahmen des LMBG für den Trinkwasserbereich, 1-6. Mitteilung, Bundesgesundheitsblatt 1977, 20 pp.10-13, 124-129; 1979, 22 pp. 213-215, 264-265, 1985, 28 pp. 371-374; 1987, 30 p. 178.

² <http://www.umweltbundesamt.de/themen/wasser/trinkwasser/trinkwasser-verteilen/bewertungsgrundlagen-leitlinien>

by migration-based restrictions. Advances in analytical techniques made it possible to formulate requirements for the migration of individual substances harmful to health. As a result of this development, it was possible to abandon the determination of chlorine demand as a test parameter of the UBA guidelines as from 1 January 2008.

3 Reasons for deleting chlorine demand as a test parameter

3.1 Chlorine demand as summary parameter

Chlorine demand is a measure of the reactivity of a material surface and migrating substances with chlorine. For certain organic materials, high chlorine demands have been found. This very unspecific summary parameter does not allow a differentiation between chlorine reacting on the material surface and with migrating substances. Determination of total organic carbon (TOC) in migration water is a more specific summary parameter for migrating substances than is chlorine demand, and captures the actual migration of organic substances. TOC analysis is much more precise today than analysis of chlorine demand. The UBA guidelines additionally provide for tests to determine the migration of relevant individual substances used for the manufacture of the material concerned. The associated requirements have significantly increased certainty in the assessment of materials in contact with drinking water, which made it possible to dispense with the unspecific parameter chlorine demand as summary parameter for migrating substances.

Another reason for deleting this parameter is that chlorine demand testing according to DIN EN 14718 is often difficult to reproduce in the case of high surface/volume ratios, which limits the suitability of the parameter for the assessment of materials.

3.2 Chlorine demand in disinfection

Chlorine is added to drinking water as disinfectant in certain cases, particularly when it has been produced from surface water. In drinking water disinfection, the concentration is chosen so as to ensure that a residual concentration of chlorine remains in drinking water during its distribution in order to prevent bacterial contamination of the water in the distribution system.

Contrary to what is widely assumed, the parameter chlorine demand according to DIN EN 14718 is not suitable for assessing a material with regard to whether it would, during drinking water distribution, significantly deplete the chlorine that might have been added as disinfectant, and thus compromise disinfection. This test standard has not been designed to that end: The contact time it calls for is too long (3 days) and the required surface to test water volume ratios are too high to fulfil this testing purpose. Metals and cement-bonded materials induce a much higher chlorine demand than most organic materials. The testing of these materials according to DIN EN 14718 results in the complete depletion of chlorine, so that in their case a chlorine depletion rate cannot be determined with this test method. These materials are nevertheless suitable for chlorine-treated drinking water, since on contact with them the water will still exhibit a residual chlorine content for stagnation periods of up to 12 hours.

Chlorine can also be used to disinfect drinking water installations, at concentrations much higher than those applied in regular drinking water disinfection. Such highly chlorinated water

will always be flushed out before the installation is put back into service. Therefore, the problem here is not consumer exposure to reaction products but the fact that such high concentrations can lead to the corrosion of installed materials. Determination of chlorine demand according to DIN EN 14718 is also unsuitable for assessing materials with respect to their resistance to chlorine from disinfection measures, since the chlorine concentrations applied in this test are too low to do that.

3.3 Conclusion

The chlorine demand test according to DIN EN 14718 does not provide additional safety in the hygienic assessment of organic materials in contact with drinking water. This parameter was therefore deleted from the UBA guidelines.

To assess the chlorine resistance of materials in contact with drinking water, a different test method must be developed which determines the technical suitability of the materials for disinfection.