Methoden voor de bepaling van elementen

De volgende analysemethoden kunnen gebruikt worden voor het bepalen van elementen in water.

Voor de conservering en behandeling van watermonsters wordt verwezen naar WAC/I/A/010.

Voor drink- en grondwater dient geen ontsluiting te worden uitgevoerd.

Voor afval- en oppervlaktewater dient een ontsluiting te worden uitgevoerd conform WAC/III/B/001 of WAC/III/B/002. Indien specifiek het gehalte aan totaal Ti (incl. TiO_2) en/of Sn (incl. SnO_2) wordt aangevraagd, wordt de speciale ontsluitingsmethode zoals beschreven in WAC/III/B/002 bijlage E toegepast. Op het analyseverslag dient duidelijk vermeld te worden welke ontsluitingsmethode werd toegepast.

aluminium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • ISO 12020: 1997 Water quality – Determination of aluminium – Atomic absorption spectrometric methods • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
antimoon	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • NEN 6433:1993 Water – Bepaling van het gehalte aan antimoon met behulp van atomaire absorptiespectrometrie (hydridegeneratietechniek). Ontsluiting met salpeterzuur en zoutzuur (WAC/III/B/012) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
arseen	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 11969: 1996 Water quality – Determination of arsenic – Atomic absorption spectrometric method (hydride technique) (WAC/III/B/012) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • NEN 6432:1993 Water – Bepaling van het gehalte aan arseen met behulp van atomaire absorptiespectrometrie (hydridegeneratietechniek). Ontsluiting met salpeterzuur en zoutzuur. • EN ISO 15586:2003 Water quality – Determination of trace elements using

	atomic absorption spectrometry with graphite furnace
barium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011)
boor	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011)
cadmium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 5961: 1994 Water quality: Determination of cadmium by atomic absorption spectrometry • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
calcium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • ISO 14911:1998 Water quality - Determination of dissolved Li^+, Na^+, NH_4^+, K^+, Mn^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+} and Ba^{2+} using ion chromatography - Method for water and waste water
chroom	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • EN 1233: 1996 Water quality – Determination of chromium – Atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled

	plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
ijzer	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
fosfor	• Zie WAC/III/D in functie van het matrixtype
kalium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • ISO 14911:1998 Water quality - Determination of dissolved Li^+, Na^+, NH_4^+, K^+, Mn^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+} and Ba^{2+} using ion chromatography - Method for water and waste water
kobalt	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
koper	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace

lood	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
magnesium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • ISO 14911:1998 Water quality - Determination of dissolved Li^+, Na^+, NH_4^+, K^+, Mn^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+} and Ba^{2+} using ion chromatography - Method for water and waste water
mangaan	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
molybdeen	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
natrium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements

	(WAC/III/B/011) • ISO 14911:1998 Water quality - Determination of dissolved Li^+, Na^+, NH_4^+, K^+, Mn^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+} and Ba^{2+} using ion chromatography - Method for water and waste water
nikkel	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
seleen	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • NEN 6434:1993 Water – Bepaling van het gehalte aan seleen met behulp van atomaire absorptiespectrometrie (hydridegeneratietechniek). Ontsluiting met salpeterzuur en zoutzuur (WAC/III/B/012) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
tin	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011)
titanium	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011)
zilver	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines

	• ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace
zink	• ISO 11885:2007 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (WAC/III/B/010) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • ISO 17294-1: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines • ISO 17294-2: 2003 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (WAC/III/B/011) • EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace

Voor de bepaling van **kwik** is het toepassen van een ontsluiting afhankelijk van de conserverings- en bepalingstechniek en het type water.

Voor de conservering en behandeling van watermonsters wordt verwezen naar WAC/I/A/010.

Bij de bepaling van kwik met CV-AAS en CV-AFS (WAC/III/B/014) en BrCl als conservering reagens dient voor drink- en grondwater geen ontsluiting te worden uitgevoerd. Voor afval- en oppervlaktewater dient een ontsluiting te worden uitgevoerd, tenzij de nodige gegevens beschikbaar zijn die aantonen dat het type afvalwater dat door het laboratorium wordt geanalyseerd gelijkwaardige resultaten geeft zonder ontsluiting bij verhoogde temperatuur.
Volgende ontsluitingsmethoden kunnen worden toegepast:

- WAC/III/B/001 Ontsluiting voor de bepaling van geselecteerde elementen in water – salpeterzuurontsluiting
- WAC/III/B/002 Ontsluiting voor de bepaling van geselecteerde elementen in water – aqua regia ontsluiting
- Ontsluiting met BrCl oplossing bij kamertemperatuur gedurende min. 24 u volgens ISO12846:2012 § 7.4 (kT)
- Ontsluiting met BrCl-reagens bij verhoogde temperatuur, BrCl (hT)[1]

Bij de bepaling van kwik met CV-AAS en CV-AFS (WAC/III/B/014) en kaliumdichromaat als conservering reagens dient zowel drink-, grond-, afval- en oppervlaktewater ontsloten te worden.
Volgende ontsluitingsmethoden kunnen worden toegepast:

- WAC/III/B/002 Ontsluiting voor de bepaling van geselecteerde elementen in water – aqua regia ontsluiting
- Ontsluitingsmethode met kalium permanganaat/ kalium peroxodisulfaat
  Breng 100 ml monster geconserveerd met HNO_3 en $K_2Cr_2O_7$ (0.05%), in een ontsluitingsrecipiënt
  Voeg 15 ml kalium permanganaat oplossing (50 g $KMnO_4$/liter), 1 ml HNO_3 en 1 ml H_2SO_4 toe.

[1] Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, August 2002.

Laat de oplossing 15 min. staan, en voeg 10 ml kalium peroxodisulfaat oplossing (40 g $K_2S_2O_6$/liter) toe
Plaats het recipiënt in een verwarmingstoestel (bv. verwarmingsblok of waterbad) bij 95°C gedurende 2uur
Indien nodig, voeg bijkomend kalium permanganaat oplossing toe
Laten afkoelen, en aanlengen tot gewenst volume.

- Ontsluiting met BrCl oplossing bij kamertemperatuur gedurende min. 24 u volgens ISO 12846:2012 § 7.4 (kT)
- Ontsluiting met BrCl-reagens bij verhoogde temperatuur, BrCl (hT)[1]

Bij de bepaling van Hg met ICP-MS dient onafhankelijk van de conservering voor drink- en grondwater geen ontsluiting te worden uitgevoerd. Bijkomend dient bij de analyse $AuCl_3$ te worden toegevoegd aan zowel standaarden als monsters om geheugeneffecten in de verstuiverkamer te minimaliseren[2]. Voor afval- en oppervlaktewater dient een ontsluiting te worden uitgevoerd.
Volgende ontsluitingsmethoden kunnen worden toegepast:

- WAC/III/B/001 Ontsluiting voor de bepaling van geselecteerde elementen in water – salpeterzuurontsluiting
- WAC/III/B/002 Ontsluiting voor de bepaling van geselecteerde elementen in water – aqua regia ontsluiting

De volgende analysemethoden kunnen gebruikt worden voor de bepaling van kwik in water.

Kwik	• ISO 12846:2012 Water quality : Determination of mercury - Method using atomic absorption spectrometry (AAS) with and without enrichment • ISO 17852:2006 Water quality : Determination of mercury - Method using atomic fluorescence spectrometry • EN 12338: 1998 Water quality: Determination of mercury – enrichment methods by amalgamation • EPA 200.8 Determination of trace elements in waters and wastes by inductively coupled plasma- mass spectrometry. • WAC/III/B/011 Bepaling van elementen met inductief gekoppeld plasma massa spectrometrie (ICP-MS) • ISO 5666: 1999 Water quality: Determination of mercury • EN 1483: 2007 Water quality – Determination of mercury

[2] B.T. Sturman, *Comment on 'Determination of mercury in potable water by ICP-MS using gold as stabilising agent*, J. Anal. At. Spectrom., 2000, **15**, 1512.