

Methoden voor bepaling van elementen

Deze procedure vervangt de procedure CMA/2/I/B van oktober 2018.

Voor de conservering en bewaring van watermonsters worden verwezen naar CMA/1/B.

MATRICES: GRONDWATER, ELUATEN, DESTRUCTIEVLOEISTOFFEN

ELEMENTEN

Voor grondwater en eluaten dient geen ontsluiting te worden uitgevoerd. De analyses worden uitgevoerd op de gefiltreerde (0.45 µm) monsters. Enkel indien een neerslag wordt waargenomen, dient een ontsluiting te worden uitgevoerd conform CMA/2/I/A.6.1 of CMA/2/I/A.6.3.

Voor bodem, vaste en pasteuze afvalstoffen dient een destructie te worden uitgevoerd conform CMA/2/II/A.3.

Voor materialen die als meststof/bodemverbeterend middel worden aangewend, dient de destructie te worden uitgevoerd conform CMA/2/IV/6 met uitzondering van vloeibare monsters met een droge stofgehalte < 2%. Deze worden behandeld als een afvalwater en ontsloten conform WAC/III/B/002.

Voor olie dient een destructie te worden uitgevoerd conform CMA/2/III/F.

De volgende analysetechnieken kunnen gebruikt worden voor de bepaling van de elementen in grondwater, eluaten, destructievloeistoffen:

antimoon	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • CMA/2/I/B.6 Bepaling van antimoon, arseen en seleen met hydride-atomaire absorptie spectrometrie • ISO 17378-1:2014 Water quality - Determination of arsenic and antimony - Part 1: Method using hydride generation atomic fluorescence spectrometry (HG-AFS) • ISO 17378-2:2014 Water quality - Determination of arsenic and antimony - Part 2: Method using hydride generation atomic absorption spectrometry (HG-AAS) • ISO 20280:2007 Soil quality -- Determination of arsenic, antimony and selenium in aqua regia soil extracts with electrothermal or hydride-
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	generation atomic absorption spectrometry
arsen	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • CMA/2/I/B.6 Bepaling van antimoon, arsen en seleen met hydride-atomaire absorptie spectrometrie • ISO 17378-1:2014 Water quality - Determination of arsenic and antimony - Part 1: Method using hydride generation atomic fluorescence spectrometry (HG-AFS) • ISO 17378-2:2014 Water quality - Determination of arsenic and antimony - Part 2: Method using hydride generation atomic absorption spectrometry (HG-AAS) • NEN 6432:1993 Water – Bepaling van het gehalte aan arsen met behulp van atomaire absorptiespectrometrie (hydridegeneratie-techniek). Ontsluiting met salpeterzuur en zoutzuur. • ISO 20280:2007 Soil quality -- Determination of arsenic, antimony and selenium in aqua regia soil extracts with electrothermal or hydride-generation atomic absorption spectrometry
barium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
cadmium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of

	selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • 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
calcium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
chromium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • NBN EN 1233: 1996 Water quality – Determination of chromium – Atomic absorption spectrometric methods • CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
fosfor	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 6878: 2004 Water quality – Determination of phosphorus – Ammonium molybdate spectrometric method (ISO 6778:2004) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • NBN EN ISO 15681-1:2005 Water quality – Determination of orthophosphate and total phosphorus contents by flow analysis (FIA)

	and CFA) – Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003) • NBN EN ISO 15681-2:2005 Water quality – Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) – Part 2: Method by continuous flow analysis (CFA) (ISO 15681-2:2003)
kalium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
kobalt	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
koper	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper,

	zinc, cadmium and lead – Flame atomic absorption spectrometric methods • CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
lood	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods
magnesium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
mangaan	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
molybdeen	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry

	(ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
nikkel	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods • CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
seleen	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) • CMA/2/I/B.6 Bepaling van antimoon, arseen en seleen met hydride-atomaire absorptie spectrometrie • ISO/TS 17379-1:2013 Water quality - Determination of selenium - Part 1: Method using hydride generation atomic fluorescence spectrometry (HG-AFS) • ISO/TS 17379-2:2013 Water quality - Determination of selenium - Part

	2: Method using hydride generation atomic absorption spectrometry (HG-AAS) • ISO 20280:2007 Soil quality -- Determination of arsenic, antimony and selenium in aqua regia soil extracts with electrothermal or hydride-generation atomic absorption spectrometry
thallium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
tin	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
vanadium	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) • NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5)
zink	• NBN EN ISO 11885:2009 Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885:2007) (CMA/2/I/B.1) • NBN EN ISO 15586:2003 Water quality – Determination of trace elements using atomic absorption spectrometry with graphite furnace (ISO 15586:2003) (CMA/2/I/B.2) • NBN EN ISO 17294-1:2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General

Kwik ¹	- guidelines (ISO 17294-1:2004) - NBN EN ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2: Determination of selected elements including uranium isotopes (ISO 17294-2:2016) (CMA/2/I/B.5) - ISO 8288: 1986 Water quality – Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods - CEN/TS 16188:2012 Sludge, treated biowaste and soil – Determinations of elements in aqua regia and nitric acid digests – Flame atomic absorption spectrometry method (FAAS)
	- NBN EN ISO 12846:2012 Water quality : Determination of mercury - Method using atomic absorption spectrometry (AAS) with and without enrichment (ISO 12846:2012) (CMA/2/I/B.3) - NBN EN ISO 17852:2008 Water quality -- Determination of mercury -- Method using atomic fluorescence spectrometry (ISO 17852:2006) (CMA/2/I/B.3) - NBN EN ISO 17294-1: 2006 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 1: General guidelines (ISO 17294-1:2004) - NBN EN ISO 17294-2: 2004 Water quality – Application of inductively coupled plasma mass spectrometry (ICP-MS) – Part 2: Determination of 62 elements (ISO 17294-2:2003) (CMA/2/I/B.5) - EPA 200.8:2007 Determination of trace elements in waters and wastes by inductively coupled plasma- mass spectrometry. - EPA 7473:1998 Mercury in solids and solutions by thermal decomposition, amalgamation, and atomic absorption spectrophotometry

¹ C. Vanhoof, F. Beutels, K. Duyssens, J. De Wit, K. Tirez en J. Annys (VMM), *Bepaling van Hg met ICP-MS*, VITO rapport 2018/SCT/R/1586, mei 2018, <https://esites.vito.be/sites/reflabos/onderzoekrapporten/Online%20documenten/2017%20Rapport%20bepaling%20van%20Hg%20ICP-MS-finaal2.pdf>