

**Kalt vatn á Rangárvöllum. Efnasamsetning
vatns á nokkrum stöðum**

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KALT VATN Á RANGÁRVÖLLUM Efnasamsetning vatns á nokkrum stöðum

Þann 12. janúar 1994 tók undirritaður starfsmaður Orkustofnunar sýni af köldu vatni á 10 stöðum á Rangárvöllum. Sýnataka þessi fór fram að beiðni Ómars Bjarka Smárásonar (Stapi - Jarðfræðistofa) og er liður í rannsókn á grunnvatni á neðanverðum Rangárvöllum í tengslum við hugsanlegan sorpurðunarstað við Strönd. Fjögur sýnanna voru svokölluð heilsýni þar sem öll aðalefni eru greind auk margra snefilefna, en á sex stöðum var einungis mælt sýrustig og karbónat. Samhliða sýnatöku tók starfsmaður frá Stapa - Jarðfræðistofu sýni til gerlamælinga, mælinga á lífrænum efnum, mældi leiðni o. fl.

Sýni voru tekin á eftirtöldum stöðum:

Staður	Lýsing	Gerð sýnis	Númer
Strönd hola 1	dæling	heilsýni	94-9005
Strönd hola 2	dæling	heilsýni	94-9003
Lambhagi	mjólkurhús	heilsýni	94-9004
Langekra	gamalt mjólkurhús	heilsýni	94-9006
Hjarðarbrekka I	eldhús	hlutsýni	94-9010
Hjarðarbrekka II	eldhús	hlutsýni	94-9011
Oddi	gestasalerni	hlutsýni	94-9008
Vindás	þvottahús	hlutsýni	94-9009
Sólvellir	eldhús	hlutsýni	94-9007
Selalækur II	þvottahús	hlutsýni	94-9012

Í meðfylgjandi töflu eru greint frá niðurstöðum allra mælinga sem gerðar voru á Orkustofnun. Meðhöndlun sýna við sýnatöku, efnagreiningaraðferðum og greiningarmörkum er lýst á meðfylgjandi fylgiplaggi, dagsett 21.12.1993. Einnig fylgir með tafla sem sýnir viðmiðunarmörk fyrir drykkjarvatn.

Hér verður ekki farið út í ítarlega túlkun á niðurstöðum efnagreininganna, en þó bent á nokkur áhugaverð atriði. Í fyrstu er rétt að taka eftir þeim mun sem kemur fram á efnasamsetningu vatns úr holum 1 og 2 annars vegar og frá t.d. Lambhaga og Langekru hins vegar. Styrkur allra aðalefna mælist umtalsvert hærrí í Lambhaga og Langekru en í vatni úr holunum. Sýrustig mælist hærrí í vatni úr holunum. Allt þetta bendir til einhverskonar umhverfismengunar t.d. frá áburði. Styrkur járn mælist hærrí í vatni úr holunum sem gæti stafað af háum járnstyrk í glerkenndum sandinum sem holurnar skera. Aftur á móti er trúlegt að hærrí styrkur sínks í Langekru en á hinu stöðunum geti stafað frá uppleysingu á galvanhúð í vatnslögn.

Einnig er rétt að benda á lágt sýrustig á nokkrum stöðum, einkum í Odda, en lágt sýrustig bendir til að vatnið sé mengað af yfirborðsvatni. Lágt sýrustig veldur því einnig að vatnið er tær-
andi fyrir járnlagfir.

Tafla. Efnasamsetning vatns (mg/l)

Staður	Strönd Hóla 1 94-9005	Strönd Hóla 2 94-9003	Lambhagi Mjólkurhús 94-9004	Langekra Gamalt mjólkurhús 94-9006	Hjarðarbrekka I Eldhús 94-9010	Hjarðarbrekka II Eldhús 94-9011	Oddi Gestasalemi 94-9008	Vindás Þvottahús 94-9009	Sólvellir Eldhús 94-9007	Selalækur II Þvottahús 94-9012
Númer										
Hiti (°C)	4,8	4,9	5,1	7,4	-	5,0	5,2	4,9	7,0	-
Leiðni (µS/cm)	143	120	344	304	-	191	402	379	383	-
Sýrustig (pH/°C)	8,2/23	8,1/23	7,4/22	7,2/23	6,8/23	7,6/23	6,5/23	7,2/23	7,0/23	8,0/24
Súrefni (O ₂)	10	9	8	9	-	-	-	-	-	-
Natríum (Na)	11,5	11,4	19,6	17,4	-	-	-	-	-	-
Kalíum (K)	0,99	0,86	2,53	7,43	-	-	-	-	-	-
Kalsíum (Ca)	8,33	6,14	26,6	21,8	-	-	-	-	-	-
Magnesium (Mg)	4,91	3,58	14,3	11,0	-	-	-	-	-	-
Kísill (SiO ₂)	19,3	19,3	27,9	31,2	-	-	-	-	-	-
Karbónat (CO ₂)(t)	32,4	19,6	111	100	≈83	≈47	≈156	≈108	≈135	≈80
Klóríd (Cl)	14,6	14,4	19,1	18,5	-	-	-	-	-	-
Flúoríd (F)	0,12	0,11	0,19	0,16	-	-	-	-	-	-
Súlfat (SO ₄)	3,06	3,17	5,08	4,73	-	-	-	-	-	-
Nítrat (NO ₃)	0,68	0,41	19,2	9,85	-	-	-	-	-	-
Járn (Fe)	0,013	0,027	0,004	0,005	-	-	-	-	-	-
Fosfór (P)	0,05	0,06	0,08	0,04	-	-	-	-	-	-
Arsen (As)	<0,0001	<0,0001	<0,0001	<0,0001	-	-	-	-	-	-
Kvikasilfur (Hg)	<0,000005	<0,000005	<0,000005	<0,000005	-	-	-	-	-	-
Bly (Pb)	<0,0005	<0,0005	<0,0005	<0,0005	-	-	-	-	-	-
Kadmíum (Cd)	<0,00005	<0,00005	<0,00005	<0,00005	-	-	-	-	-	-
Kopar (Cu)	0,0022	0,0003	0,0023	0,0056	-	-	-	-	-	-
Nikkel (Ni)	0,0006	<0,0005	0,0006	<0,0005	-	-	-	-	-	-
Krómi (Cr)	0,0003	0,0003	0,0004	0,0003	-	-	-	-	-	-
Sínk (Zn)	0,0015	0,0025	0,0077	0,033	-	-	-	-	-	-
Al (Al)	-	0,0096	0,0025	-	-	-	-	-	-	-

- : Ekki mælt

Parameters measured in water samples

Samples for measurement of pH, total sulphide and total carbonate are collected in a gas collection bulb and analyzed at room temperature within 24 hours.

Gas samples are collected in a gas collection bulb and analysed by gas chromatography.

Parameter	Method	Detection Limit in mg/l
pH	is measured by a pH-meter with a glass electrode	
Total sulphide as H ₂ S	is measured by titration with 0.001 M mercuric acetate with dithizone as indicator	0.02
Total carbonate as CO ₂	is measured by titration with 0.1N HCl using a pH-meter	1.0
Conductivity	is measured with a conductivity meter	-
Total dissolved solids	is determined gravimetrically after drying at 180°C and 260°C	2.5
Sodium (Na)	is measured by atomic emission spectrophotometry of a filtered and acidified sample	0.001
Potassium (K)	is measured by atomic emission spectrophotometry of a filtered and acidified sample	0.001
Calcium (Ca)	is measured by atomic absorption spectrophotometry in a graphite furnace of a filtered and acidified sample	0.001
Magnesium (Mg)	is measured by atomic absorption spectrophotometry in a graphite furnace of a filtered and acidified sample	0.0001
Silica (SiO ₂)	is measured spectrophotometrically as (yellow) silicomolybdate complex in a sample of raw water	0.5
Barium (Ba)	is measured by atomic absorption spectrophotometry in a graphite furnace in a filtered and acidified sample	0.005
Iron (Fe)	is measured by atomic absorption spectrophotometry in a graphite furnace in a filtered and acidified sample	0.0001
Manganese (Mn)	is measured by atomic absorption spectrophotometry in a graphite furnace in a filtered and acidified sample	0.0001
Aluminium (Al)	is measured by atomic absorption spectrophotometry in a graphite furnace in a filtered and acidified sample	0.001
Antimony (Sb)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace or by hydride generation	0.002
Molybdenum (Mo)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.002
Arsenic (As)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry by hydride generation	0.001
Selenium (Se)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry by hydride generation	0.004
Chromium (Cr)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0001
Copper (Cu)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0001

Parameter	Method	Detection Limit in mg/l
Lead (Pb)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0005
Nickel (Ni)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.001
Zinc (Zn)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0001
Lithium (Li)	is measured in a filtered and acidified sample by atomic emission spectrophotometry	0.0005
Strontium (Sr)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0001
Cobalt (Co)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.0002
Cadmium (Cd)	is measured in a filtered and acidified sample by atomic absorption spectrophotometry in a graphite furnace	0.00005
Mercury (Hg)	is collected into KMnO_4 solution and measured by amalgamation flameless atomic absorption spectrophotometry	0.000002
Chloride (Cl)	is measured by ion chromatography of a filtered sample	0.025
Sulphate (SO_4)	is measured by ion chromatography of a filtered sample	0.020
Fluoride (F)	is measured by ion chromatography of a filtered sample	0.002
Iodide (I)	is measured by ion chromatography of a filtered sample	0.0002
Cyanide (CN)	is measured by ion chromatography of a filtered sample	0.002
Bromide (Br)	is measured by ion chromatography in a filtered sample	0.005
Nitrite (NO_2)	in a raw sample is measured by an azodyecolorimetric method in autoanalyser	0.005
Nitrate (NO_3)	in a raw sample is transformed to nitrite by Cu-Cd reduction and analyzed by an azodyecolorimetric method in autoanalyser	0.005
Ammonium (NH_3)	is measured in a raw sample by indophenolblue in autoanalyser	0.001
Boron (B)	is complexed with azomethine-H and measured spectrophotometrically in a filtered sample	0.005
Phosphate (PO_4)	is measured by an automated ascorbic acid reduction method in autoanalyser	0.002

Description of the analytical methods for most elements are found in:

Methods for Chemical Analysis of Water and Wastewater, EPA/600/4-79/020, March 1983.
and

Standard Methods. For the Examination of Water and Wastewater, American Public Health Association, Washington, DC 20005, 1134.

The method for boron analysis is described in: Chemical Analysis and Sampling Techniques for geothermal Fluids and gases at the Fenton Hill Laboratory. Los Alamos National Laboratory, La-11006-MS, UC-66b, June 1987, 83pp.

**VIÐMIÐUNARMÖRK FYRIR DRYKKJAVATN,
VATN TIL VÖKVUNAR OG FISKELDIS**
Byggt á gögnum frá EC, WHO og FAO (mg/l)

	Einkenni	EC Drykkjarvatn		WHO Drykkjarvatn	FAO Vökvun	FAO Fiskeldi
		Viðmiðunarmörk (VM)	Mesta leyfilegt magn (MLM)	Viðmiðunarmörk (VM)	Viðmiðunarmörk (VM)	Viðmiðunarmörk (VM)
Litur		1 (Pt/Co skali)	20 (Pt/Co skali)	15 (TCU)		
Leiðni ($\mu\text{S}/\text{cm}$)/25°C		400			750	3000
Harka (CaCO_3)				500		
Hiti (°C)		12	25			max. 23-34
Uppleyst súrefni (DO)			Metun >75%			min. 5.0
Sýrustig (pH)	bragð, tæring	6.5 - 8.5	9.5	6.5-8.5	7.0-8.5	6.5-8.5
Uppleyst efni (TDS)	bragð		1500	1000	450-2000	2000
Kalsíum (Ca)	útfelling	100				
Magnesium (Mg)	bragð, útfelling	30	50			
Kalíum (K)		10	12			
Natríum (Na)	bragð, eitrun	20	150	200	70-200	
Klóríð (Cl)	bragð, tæring	25	200	250	100-350	
Flúoríð (F)	eitrun		1,5 (við 12°C)	1,5	1,0	1,5
Súlfat (SO_4)	eitrun	25	250	400	200	
Brennisteinsvetni (H_2S)	bragð, lykt	0,05 - 0,1	0,2			0,5
Bíkarbónat (HCO_3)	skaðlegt				100-500	
Fjálst kolefnisdíoxíð (CO_2)			ekki tærandi			1,0
Nítrat ($\text{NO}_3\text{-N}$)	eitrun	25	50	10	5-30	
Nítrít ($\text{NO}_2\text{-N}$)	eitrun		0,1			
Ammóníak ($\text{NH}_3\text{-N}$)		0,05	0,5			0,5
Ál (Al)	bragð	0,05	0,2	0,2	5,0	
Antímon (Sb)			0,01			
Arsen (As)	eitrun		0,05	0,05	0,1	1,0
Baríum (Ba)	eitrun	0,1				5,0
Beryllíum (Be)					0,1	
Bór (B)		1,0			0,5	
Kadmíum (Cd)	eitrun		0,005	0,005	0,01	0,01
Krómi (Cr)	eitrun		0,05	0,05	0,1	0,05
Kopar (Cu)		0,1	3,0	1,0	0,2	0,02
Kóbalt (Co)					0,05	
Sýaníð (CN^-)	eitrun		0,05	0,1		0,02
Blý (Pb)	eitrun		0,05	0,05		0,1
Lípíum (Li)					2,5	
Járn (Fe)	bragð, bakteríur	0,05	0,2	0,3	5,0	
Mangan (Mn)	bragð, útfellingar	0,02	0,05	0,1	0,2	
Kvikasilfur (Hg)	eitrun		0,001	0,001		0,01
Molybden (Mo)					0,01	
Nikkel (Ni)			0,05		0,2	0,05
Palladíum (Pd)					5,0	
Fosfat (P_2O_5)		0,4	5,0			
Seleníum (Se)	eitrun		0,01	0,01	0,02	
Silfur (Ag)			0,01			0,01
Vanadíum (V)					0,1	
Sink (Zn)	bragð, útfelling	0,1	5,0	5,0	2,0	0,1

EC: Official Journal of the European Communities, nr. L 229/24, Council Directive 15 July 1980

WHO: World Health Organization, 1984

FAO: From *The Water Encyclopedia* by van der Leeden et al., 1990