

## Chemical composition of geothermal water and heated groundwater for space heating from geothermal power plants in the Hengill area

Typical concentrations ( $\mu\text{g/L}$ ) of several trace elements in geothermal water (separated and condensed water) and heated groundwater (for space heating) from the Hellisheidi and Nesjavellir geothermal power plants and their maximum permissible concentrations ( $\mu\text{g/L}$ ) for potable water. When the chemical content of separated water is compared to potable water standards, one can see that in separated water from the Hellisheidi geothermal power plant, the concentration of arsenic exceeds double the amount of permissible levels for potable water. The concentration of other substances in separated water is lower than the given limits for potable water. Concentrations of trace elements in condensate and heated groundwater from both power plants is lower than the given limits for potable water.

Element	Unit	Max. recommended value for potable water	HELLISHEIDI			NESJAVELLIR		
			Separated water	Condensate water	Heated groundwater	Separated water	Condensate water	Heated groundwater
Arsenic (As)	$\mu\text{g/L}$	10	22.50	<0.05	0.05	5.25	0.09	2.18
Barium (Ba)	$\mu\text{g/L}$	700	0.51	0.03	0.63	0.33	0.07	0.61
Cadmium (Cd)	$\mu\text{g/L}$	5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt (Co)	$\mu\text{g/L}$	*	0.02	0.01	0.02	0.01	0.05	<0.005
Chrome (Cr)	$\mu\text{g/L}$	50	0.35	0.10	0.09	0.14	3.87	0.37
Copper (Cu)	$\mu\text{g/L}$	2,000	0.30	<0.1	<0.1	0.12	<0.1	0.30
Mercury (Hg)	$\mu\text{g/L}$	1	<0.002	<0.002	<0.002	0.004	0.013	<0.002
Manganese (Mn)	$\mu\text{g/L}$	50	1.11	0.23	0.32	2.55	1.73	0.28
Molybdenum (Mo)	$\mu\text{g/L}$	*	2.95	<0.05	0.17	0.17	<0.05	0.54
Nickel (Ni)	$\mu\text{g/L}$	20	0.27	0.74	0.48	0.99	4.47	0.13
Phosphorus (P)	$\mu\text{g/L}$	5000	1.06	<1	41.10	1.03	<1	44.40
Lead (Pb)	$\mu\text{g/L}$	10	0.02	0.03	0.02	0.10	0.03	0.01
Titanium (Ti)	$\mu\text{g/L}$	*	0.52	0.02	0.20	0.08	0.03	0.74
Antimony (Sb)	$\mu\text{g/L}$	5	0.83	2.35	<0.01	0.06	0.03	0.05
Selenium (Se)	$\mu\text{g/L}$	10	8.72	<0.5	<0.5	0.60	<0.5	1.29
Strontium (Sr)	$\mu\text{g/L}$	*	3.37	0.06	10.80	2.76	0.10	18.80
Vanadium (V)	$\mu\text{g/L}$	*	3.02	0.02	6.62	2.15	0.05	21.00
Zinc (Zn)	$\mu\text{g/L}$	3,000	7.28	1.58	3.94	15.17	2.39	2.17

\*Maximum limits not specified in the potable water regulation

Chemical composition of geothermal water (separated and condensed water) and heated groundwater (for space heating) from the Hellisheidi and Nesjavellir Geothermal Power Plants and their maximum permissible concentrations (mg/kg) for potable water. When the chemical content of separated water is compared to potable water standards, one can see that in separated water from the Hellisheidi Geothermal Power Plant, the concentration of aluminium is about nine times higher and the concentration of potassium is about three times higher than permissible levels for potable water. The concentrations of sodium and fluoride in the separated water from Hellisheidi also exceed the limit and the concentration of aluminium is almost nine times as high as the permissible level for potable water. In separated water from the Nesjavellir Geothermal Power Plant, the concentration of aluminium is about nine times higher, the concentration of potassium is about three times the permissible levels for potable water. Iron content of condensate water from Nesjavellir also exceeds the limit. Concentrations of other chemicals in condensate and heated groundwater from both power plants is lower than the given limits for potable water.

Chemical- and physiological factors	Unit	Max. recommended value for potable water	HELLISHEIDI			NESJAVELLIR		
			Separated water	Condensate water	Heated groundwater	Separated water	Condensate water	Heated groundwater
Acidity	pH		9.74	6.9	7.79	9.04	5.1	7.42
T (pH)	°C		22.6	13	20.4	22.3	28	22.7
Carbon dioxide (CO <sub>2</sub> )	mg/kg	*	19.4	2.0	24.6	22.9	20.9	47.5
Hydrogen sulphide (H <sub>2</sub> S)	mg/kg	*	25.4	1.0	0.22	78.3	98.3	0.62
Silica (SiO <sub>2</sub> )	mg/kg	*	737.5	<0.06	23.1	767.8	0.23	40.29
Sodium (Na)	mg/kg	200	203.8	<0.1	6.37	169.4	<0.1	18.4
Potassium (K)	mg/kg	12	38.6	<0.4	0.88	33.4	<0.4	2.69
Calcium (Ca)	mg/kg	100	1.84	<0.1	4.90	0.56	<0.1	9.24
Magnesium (Mg)	mg/kg	50	0.15	<0.09	2.71	<0.1	<0.09	4.5
Iron (Fe)	mg/kg	0.2	<0.05	0.01	0.01	<0.05	0.06	0.01
Aluminium (Al)	mg/kg	0.2	1.73	0.39	0.002	1.80	0.004	0.04
Sulphate (SO <sub>4</sub> )	mg/kg	200	29.9	1.0	9.47	12.91	3.91	12.55
Chloride (Cl)	mg/kg	*	190.0	0.10	6.89	156.9	1.0	12.93
Fluoride (F)	mg/kg	1.5	1.64	<0.005	0.12	1.37	0.01	0.14

\*Maximum limits not specified in the potable water regulation