

Aquaporin Inside®



DWRO™ × Heavy metals

A report on the Aquaporin Inside® DWRO™
membranes' rejection of various heavy metals.

Many believe water is just water. At Aquaporin, we take water seriously. We develop the best drinking water membranes using nature's own water filters – the aquaporin proteins. This is the basis of our Aquaporin Inside® technology. This report shares our knowledge from testing our DWRO™ membrane elements' efficiency in removing a selection of heavy metals from drinking water.

Aquaporin Inside® DWRO™ membrane elements

The Aquaporin Inside® Drinking Water Reverse Osmosis (DWRO™) membranes are standard-sized and used in household water purifiers. The Aquaporin Inside® technology transforms tap water into high-quality, great tasting water that has been filtered just as nature intended.



What are heavy metals?

Heavy metals are metals which are defined to have a high relative density or a high relative atomic weight. Some examples of heavy metals are mercury (Hg), nickel (Ni), arsenic (As), chromium (Cr), and lead (Pb). As humans, our bodies require trace amounts of heavy metals, such as zinc, copper, magnesium, iron, and calcium. However, at higher dosages, these heavy metals can be toxic to human bodies.

Heavy metal poisoning seldom results from large one-off doses, but far more often from small, regular doses. These small doses produce little immediate effect, but can build up slowly until the symptoms start to appear. Whether in elemental or organic and inorganic forms, heavy metals can pose serious health risks – including cancer. The effects accumulate through long-term exposure because some heavy

metals cannot be readily excreted from our bodies. If your local drinking water is contaminated with high levels of heavy metals, your long-term health might be at risk.

Heavy metals are released into the environment through natural processes and human activity. Industrial activities like mining, metal smelting, and combustion of fossil fuels are examples of human activity that may contaminate drinking water with heavy metals. Poorly treated domestic, industrial, and agricultural wastewaters can also contain high concentrations of metals, and are unfortunately often not appropriately treated to remove heavy metals prior to discharge. Even water tanks and plumbing pipes leading tap water into our homes may bring heavy metals into our drinking water as well.

Below are a few examples of harmful metals in drinking water and their detrimental effects:

As

Cd

Pb

Heavy metal	Arsenic	Cadmium	Lead
Detrimental effects	<ul style="list-style-type: none"> Affects skin Affects nervous and digestive systems Impairs brain function Carcinogenic 	<ul style="list-style-type: none"> Affects kidneys, may lead to severe fevers and gastrointestinal problems Affects musculoskeletal system, impacting movement and ability to stand Carcinogenic 	<ul style="list-style-type: none"> May lead to anemia, kidney damage, and nervous system issues May lead to severe brain damage and mental impairment

The test

We commissioned the testing to verify our membranes' efficiency in rejecting a wide variety of heavy metals in drinking water. A third-party lab was contracted to test our DWRO™ 1812-150 elements – one of the standard reverse osmosis membranes used in many water purifier units to treat drinking water. The tests were conducted in close agreement with NSF/ANSI 58 standard test methodology for inorganic chemical reduction claims in reverse osmosis drinking water treatment systems.

To conduct the test, a known amount of contaminants were added to locally available tap water (760 ppm TDS, 220 ppm total hardness, 130 ppm total alkalinity, < 1.0 NTU, pH = 7.4, T= 25 °C) which made up the water for testing. These contaminants included a number of heavy metals such as arsenic, cadmium,

lead, copper, and mercury. The test water was then run through the Aquaporin DWRO™ membrane element without any pretreatment of the test water or post-treatment of purified water. Test pressures and water recovery conditions are detailed in Table 1 below. The pressures used are equivalent to what is used in most purifiers. Elements were tested under the condition of 15% water recovery to simulate their function in older purifier models; the elements were also tested under the condition of 65% water recovery to represent their performance in many direct flow and high end purifiers in the current market. Samples were regularly taken from the contaminated test water and purified water over a testing period of seven days. Samples were then analysed for the presence of the heavy metal contaminants, and each of their concentrations were measured.

Contaminant	Influent contaminant concentration* (µg/l)	Aquaporin Inside® DWRO™ element #		Maximum allowable contaminant level by NSF 58 (µg/l)	Maximum allowable contaminant level by US EPA (µg/l)	Maximum allowable contaminant level by WHO (µg/l)	Aquaporin DWRO™ meets all standards
		60psi, 15 % recovery	80 psi, 65 % recovery				
		Product water contaminant concentration (µg/l)	Product water contaminant concentration (µg/l)				
Lead	150	< 1.1	< 0.8	< 5	< 15	< 10	✓
Arsenic	300	1.1	< 0.7	< 10	< 10	< 10	✓
Selenium	100	2.6	1.9	< 50	< 50	< 40	✓
Cadmium	30	< 0.5	< 0.5	< 5	< 5	< 3	✓
Chromium	300	< 0.5	< 0.5	< 50	< 100	< 50	✓
Copper	3000	0.9	< 0.9	< 1300	< 1300	< 2000	✓
Barium	10000	1.5	1.5	< 2000	< 2000	< 1300	✓
Mercury	6	< 0.5	< 0.5	< 2	< 2	< 6	✓
Fluoride	8000	274	384	< 1500	< 4000	< 1500	✓

*The input contaminant concentration may have ±10 % variation.

#Tests were conducted in close accordance with NSF/ANSI 58 standard test methodology for inorganic chemical reduction claims in reverse osmosis systems.

Conclusion

Our Aquaporin Inside® DWRO™ membrane elements successfully remove a wide variety of heavy metals in contaminated water streams with a high degree of efficiency. The contaminant concentrations in the processed water were all well below the guideline limits of different international standards such as NSF58, US EPA and WHO. Water purification systems based on our Aquaporin Inside® DWRO™ technology are an effective solution to prevent the long-term adverse health effects from heavy metal in contaminated drinking waters.