

Assessment of in-home reverse osmosis systems for removing pesticides and nitrate-nitrogen from private well water

Background

In an effort to provide homeowners with information about the use of in-home reverse osmosis (RO) water treatment systems for the removal of pesticides and nitrate-nitrogen (nitrate), the Minnesota Department of Agriculture (MDA) conducted a study to evaluate RO treatment system effectiveness. From 2017 through 2020, the MDA collected samples before and after RO system treatment from 54 private wells that were known or suspected to contain pesticides and nitrate. The average age reported by homeowners since installation, for 32 of the RO systems, was approximately 11 years and most of the homeowners (36) indicated their RO systems had been maintained (filters changed) within the last two years. The result summaries below include all RO systems tested, regardless of age or if the homeowner was able to provide age and/or maintenance records.

Results

Overall, RO treatment systems performed well for removing pesticides and nitrate. The average total pesticide concentration (summed total of all pesticides detected) was reduced by 99.7%, and the average nitrate concentration was reduced by 79.1%. Most (47) of the RO systems evaluated indicated a complete removal of pesticide compounds. A few (7) systems had very small amounts of pesticides in the treated water. Of the wells that were evaluated with RO treatment, 17 had a pesticide concentration and 32 had a nitrate concentration over a human health guideline in the water before RO treatment. After RO treatment, all wells were below the pesticide and/or nitrate human health guideline. The figure below indicates the reduction in total pesticide and nitrate concentration in the 54 RO systems tested.

Reverse Osmosis Treatment Results, 2017-2020

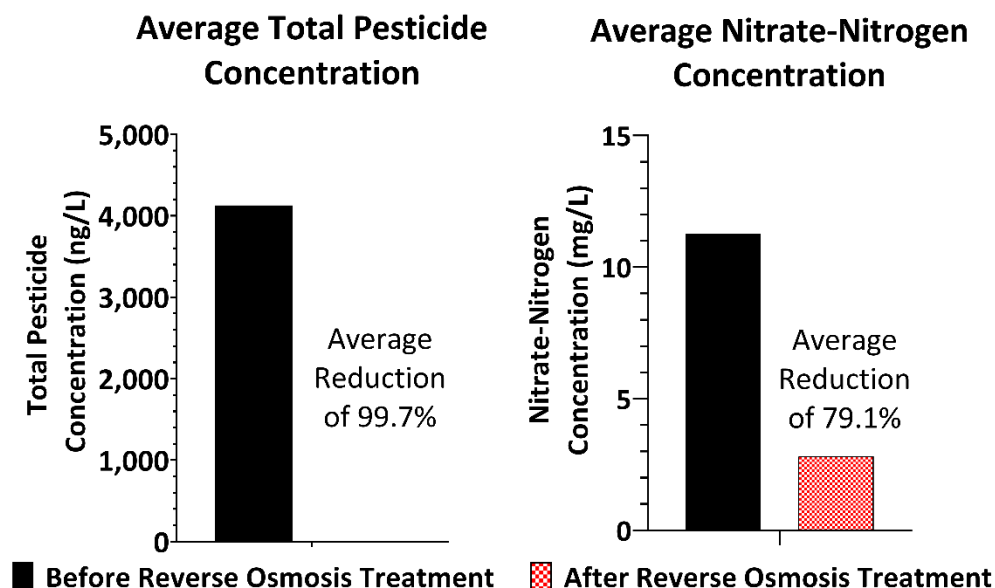


Table 1 shows the RO removal efficiency for all detected pesticide compounds and nitrate. This table will allow homeowners to assess RO treatment efficiency if they are concerned about a specific compound.

For Additional Information: Bill VanRyswyk, Supervisor

(507) 344 3203 • bill.vanryswyk@state.mn.us • 625 Robert Street North, Saint Paul, MN 55155-2538

Table 1. Pesticide compounds and nitrate removal efficiency from 54 private well water samples with in-home reverse osmosis treatment, 2017 through 2020. Pesticide compounds are reported in ng/L (parts per trillion), and nitrate is reported in mg/L (parts per million).

Compound Name	Number of Samples	Before Reverse Osmosis (RO) Treatment		After Reverse Osmosis (RO) Treatment		
		Detections	Detection Range (ng/L)	Detections	Detection Range (ng/L) *	Concentration Removal Percentage
2,4-D	54	1	24.6	0	ND	100%
Acetochlor ESA	54	35	39 - 430	0	ND	100%
Acetochlor OXA	54	8	42 - 340	0	ND	100%
Alachlor	54	5	32 - 130	0	ND	100%
Alachlor ESA	54	50	44 - 8,000	1	43	99.9%
Alachlor OXA	54	15	53 - 930	0	ND	100%
Aminopyralid	51	1	112	0	ND	100%
Atrazine	54	37	31 - 920	0	ND	100%
Bentazon	54	20	5.4 - 251	0	ND	100%
Clothianidin	54	2	28 - 87	0	ND	100%
Cyanazine acid	51	28	10 - 1,400	0	ND	100%
Cyanazine-amide	51	22	11 - 1,100	0	ND	100%
Deethylcyanazine acid	51	46	34 - 3,800	0	ND	100%
Deethylcyanazine amide	51	1	100	0	ND	100%
Deisopropylatrazine	54	31	26 - 390	0	ND	100%
Desethylatrazine	54	36	53 - 1,200	0	ND	100%
Didealkylatrazine	54	44	69 - 1,400	1	69	99.4%
Dimethenamid ESA	54	16	6.8 - 230	0	ND	100%
Dimethenamid OXA	54	6	10 - 130	0	ND	100%
Flumetsulam	54	1	98	0	ND	100%
Fomesafen	51	4	130 - 4,100	0	ND	100%
Hydroxyatrazine	54	10	6.8 - 23	0	ND	100%
Imazapyr	54	1	20	0	ND	100%
Imazethapyr	54	1	10	0	ND	100%
Imidacloprid	54	3	6.1 - 57	0	ND	100%
Metalaxyl	54	1	20	0	ND	100%
Metolachlor	54	7	27 - 610	0	ND	100%
Metolachlor ESA	54	47	39 - 4,900	4	12 - 110	99.8%
Metolachlor OXA	54	43	14 - 1,700	0	ND	100%
Metribuzin DA	54	1	68	0	ND	100%
Metribuzin DADK	54	1	2,600	0	ND	100%
Picloram	54	1	72	0	ND	100%
Saflufenacil	54	3	16 - 96	0	ND	100%
Sulfentrazone	51	1	55	0	ND	100%
Thiamethoxam	54	1	170	0	ND	100%
Nitrate**	54	52	0.1 – 26 mg/L	47	ND – 9.1 mg/L	79.1%

*ND = not detected

**Nitrate results reported in mg/L