Water Sciences Laboratory
Nebraska Water Center,
A part of the Robert B. Dougherty Water for Food Institute

Distillation for Removing Low Concentrations Of Glyphosate and AMPA in tap water

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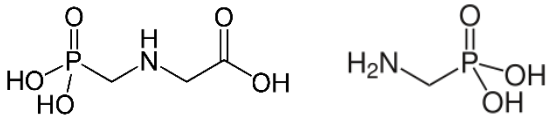
Introduction



Chemical structures of glyphosate and aminomethylphosphonic acid.

Glyphosate is a broad spectrum herbicide used for weed control in urban and agricultural areas. It is relatively nontoxic, but because of widespread use, traces of this chemical are appearing in crops, waterways, and in vulnerable drinking water supplies. The EPA maximum contaminant level for glyphosate in drinking water is 700 µg/L (ppb). The treatment and removal of glyphosate in water is somewhat difficult because of its high solubility. Advanced oxidation using titanium dioxide is effective, and partial treatment is possible with chlorine or ozone. This test was undertaken to evaluate the effectiveness of distillation in removing glyphosate and its most comment degradation product aminomethylphosphonic acid (AMPA).

Procedure

A Purewater, Inc. "Steampure PD" table-top water distillation unit was tested for treatment and removal efficiency by distilling tap water containing relatively high concentrations (~200 µg/L) of glyphosate and AMPA. Samples were analyzed using a high throughput method that has been developed to measure these chemicals in water at low concentrations using ion chromatography coupled to inductively coupled plasma mass spectrometry (IC-ICP-MS). This method requires little sample preparation and provides high sensitivity (IDL ~5 µg/L) at low cost.

Four liters of Lincoln tap water was collected and spiked in the laboratory with glyphosate and AMPA standards (SPEX Certiprep, 1000 µg/mL) to a concentration near ~200 µg/L. The concentration of glyphosate and AMPA was measured in samples collected from the boiling tank and treated distilled water at four time points during distillation. The distillation unit was first operated for 1-day, distilling approximately 4 liters of unmodified tap water. The unit was then drained and refilled with the spiked and run again for up to 6 hours to complete one distillation cycle. Portions of treated water was collected after volumes of 200 mL, 400 mL, 800 mL, and 1600 mL have been distilled. The concentrations of glyphosate and AMPA was measured in both the boiler and distillate.

Results

Results of the sample analysis are shown below. The removal efficiency of the distillation system was calculated by averaging the results of the duplicate treated distilled spiked tap water samples, dividing by the concentration of the spiked tap water sample and subtracting from 100 %. The % removal efficiency are listed below along with the concentrations of glyphosate and AMPA in both the boiler and distillate at the four time points during distillation.

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Lab ID String	Sample ID	Sampling time point	Volume of water collected (mL)	Sample collected from	Concentration (µg/L)		Removal efficiency (%)
					Glyphosate	AMPA	
19-2215	BOILER_0	Pre distilled	0	Boiler	184.5	180.8	
19-2216	BOILER_200	1	200	Boiler	185.8	187.6	
19-2217	DISTILL_200	1	200	Distillate	ND	ND	100
19-2218	BOILER_400	2	400	Boiler	196.5	190.5	
19-2219	DISTILL_400	2	400	Distillate	ND	ND	100
19-2220	BOILER_800	3	800	Boiler	228.0	220.6	
19-2221	DISTILL_800	3	800	Distillate	ND	ND	100
19-2222	BOILER_1600	4	1600	Boiler	312.5	306.5	
19-2223	DISTILL_1600	4	1600	Distillate	ND	ND	100

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