Investigation of potential leaching into water from Future Post samples.

25 November 2019

Report prepared for:
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Introduction.

Future Post produces fence posts for farms using post-consumer polyethylene. They wanted to know if anything leaches from their posts into water in the enviroment. Callaghan Innovation agreed to perform a study where post samples are leached for a period of 21 days and then the leach water is analysed. The effect of UV exposure on the posts will not be part of the scope of this study.

Future Post was not interested in any particular leachate, therefore it was agreed to analyse the water samples by two techniques:

- Gas chromatography - mass spectrometry (GC-MS), to look for the presence of small organic molecules.
- Inductively coupled plasma mass spectrometry (ICP-MS), to look for metal ion leachates.

Results.

On a visit to the Future post factory. three samples (approximately 100 mm long) were cut from the pointy end of three 100mm diameter posts. These post samples were rinsed with water to remove any loose material such as swarf from the cutting and then placed in glass leaching vessels (Figure 1) with 1.5 L of distilled water (samples 1 - 3). Distilled water (1.5 L) was also placed in a leaching vessel without a post sample so that the concentration of analytes coming from other sources could be accounted for (sample 4, water control).

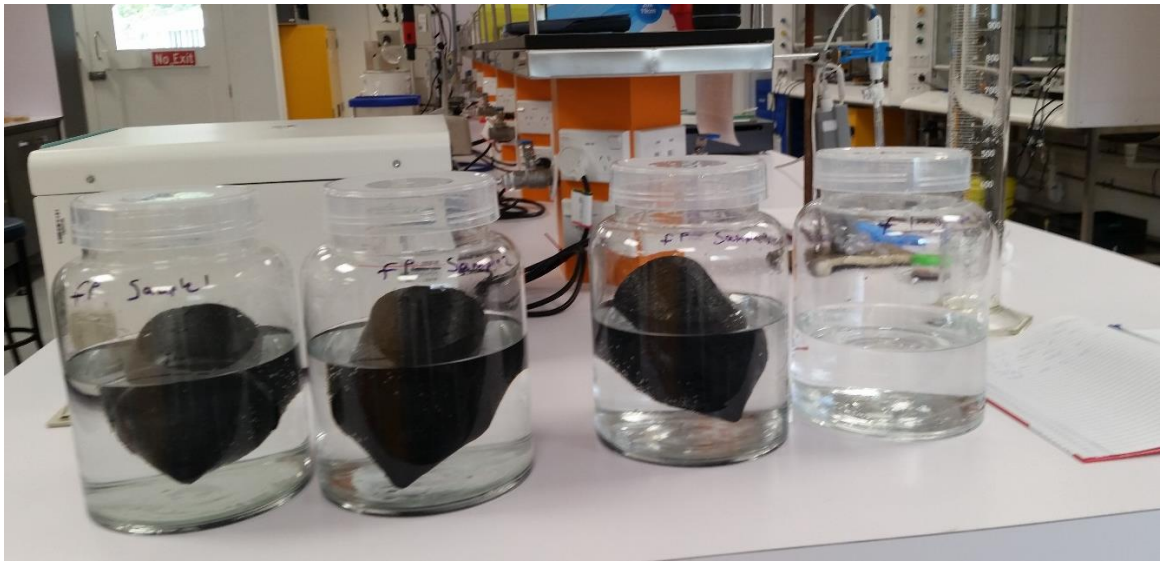

Figure 1. Post samples in glass leaching vessels containing water.

The leaching vessels were placed in an environmental chamber at 35°C for 21 days, during the 21-day period the samples were subjected to 6 freezing cycles (-5°C for 12 hours). After the completion of the leaching period water samples were taken from each of the vessels for analysis by ICP-MS and GC-MS (see below for details). The remainder of the water (1.3 L) was then evaporated in a pre-weighed flask such that the weight of any residue remaining could be quantified (Table 1).

Table 1. Weight of residue left after evaporation of water samples to dryness.

Sample	Description	Residue weight
1	Post sample 1	0.1 g ± 0.1 g
2	Post sample 2	0.1 g ± 0.1 g
3	Post sample 3	0.1 g ± 0.1 g
4	Water control	0.1 g ± 0.1 g

There was a small amount of white residue left after the evaporation of the water samples, due to the weight of the flasks this could not be weighed more accurately than to 0.1 g ± 0.1 g. As the sample with no post also had some residue remaining this could be due to dissolution of glass (silicate glasses are known to slowly dissolve) [1] or other impurities in the water.

GC-MS analysis of the water samples was performed using a GCMS-QP2010Ultra (Shimadzu) gas chromatograph equipped with ZB-5HT (15 m x 0.32 mm i.d., 0.25 µm) capillary column (Phenomenex). Helium was used as the carrier gas. The injector temperature was 350°C. Oven temperature programme was started at 150°C, followed by a rise to 350°C at a rate of 10°C/min, and maintained for 15 min. The limit of detection for common organic molecules using this system is approximately 1 ppm. No molecules were detected in any of the four water samples (Figure 2) using this technique. Although without running specific standards we are unable to specifically rule out if molecules are present in the sample, GC-MS is typically used to detect organic small molecule pollutants at low concentrations [2] so it is unlikely that any significant organic pollutants are present at concentrations above 1ppm in the leach water samples.

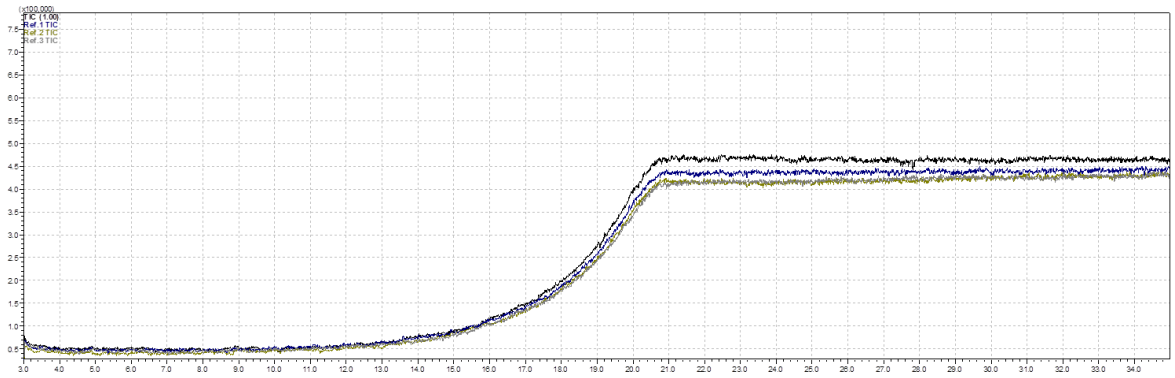

Figure 2. Results of the GC-MS analysis sample 1 (black), sample 2 (blue), sample 3 (yellow), and sample 4 (grey), Note the grey and yellow lines are overlaid.

Leach water samples were sent to Eurofins for ICP-MS analysis in order to determine the concentration of metal ions in the leachate, this analysis determined the concentration of 13 metal ions; aluminium, antimony, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and sodium. Although the analysis did not determine the concentration of all metal ions in the sample, the metals that were chosen are the ones commonly tested in water quality testing and contains the most common metal pollutants. The water testing report from Eurofins is shown in Appendix 1.

The ICP-MS analysis was only able to detect (in the samples with the highest concentration of each) antimony 0.004 ppm, copper 0.003 ppm, and manganese 0.004 ppm, as well as sodium 1 ppm. These concentrations are very close to the detection limit for each metal, and below the maximum acceptable values in drinking water, which are antimony 0.02 ppm, copper 2 ppm, and manganese 0.4 ppm, (low concentrations of sodium are not considered toxic). [3]

Summary.

Post samples were placed in glass leaching vessels and leached for 21 days. Although this is a relatively short timeframe in comparison to the expected lifetime of a post, it is likely that if something was going to leach out of the post into water, it should be detectable within this timeframe.

There was a small amount of residue left after evaporation of the leach water and this was also the case with the water control. It is likely due to silicates that have dissolved from the glass leaching vessels.

The leach water samples were analysed by GC-MS, a technique that is commonly used to test for small organic molecule pollutants in the environment, and no molecules were detected by this technique. These data provide evidence that it is unlikely any organic molecules are leached from the posts at concentrations that would be harmful to the environment.

The leach water was also analysed by ICP-MS, a technique that is commonly used to test for metal ion pollutants in water samples. All samples (including the water control) contained sodium which is considered non-toxic. Although traces of antimony, copper and manganese were detected in at least one of the three samples, the concentrations of these metals in the leach water was significantly below the maximum acceptable values for drinking water. [3] In contrast CCA (copper, chromium, arsenic) treated wooden posts are reported to leach significantly higher concentrations of copper, chromium and arsenic into water. [4]

References

[1] G. Perera, R. H. Doremus and W. Lanford, "Dissolution Rates of Silicate Glasses in Water at pH 7," *Journal of the American ceramic society,* pp. 1269-74, 1991.

[2] Wikipedia, "Gas chromatogrphy - Mass spectrometry," 21 November 2019. [Online]. Available: https://en.wikipedia.org/wiki/Gas_chromatography%E2%80%93mass_spectrometry.

[3] Ministry for the enviroment, "Appendix 6: Maximum Acceptable Values for Determinands in the Drinking-water Standards for New Zealand 2005," 21 November 2019. [Online]. Available: https://www.mfe.govt.nz/publications/rma/draft-users-guide-national-environmental-standard-sources-human-drinking-water-1.

[4] I. Vogeler, S. Green, B. Robinson, C. van den Dijssel and B. Clothier, "Enviromental risk assessment of CCA leaching from treated vineyard posts.," Hort Research, Palmerston North, 2005.

Appendix 1. Eurofins ICP-MS test report.

Inductively coupled plasma mass spectrometry (ICP-MS) testing of the leach water samples for metal contaminants was carried out by Eurofins. The report provided by Eurofins is on the following 3 pages.

eurofins | ELS

Eurofins ELS Limited

Callaghan Innovation Research Ltd
PO Box 30 144

LOWER HUTT
5040
Attention: Dr Robert Breukers

Analytical Report

Report Number: 19/60934
Issue: 1
19 November 2019

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/60934-01	Callaghan Innovation Research Ltd - Dr. Robert Breukers		14/11/2019 00:00	14/11/2019 16:05	PO108159

Notes: rbD10 sample 1

	Test	Result	Units	Test Date	Signatory
6601	Aluminium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6602	Antimony - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6603	Arsenic - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6607	Boron - Total	< 0.05	g/m³	18/11/2019	Sharon van Soest KTP
6608	Cadmium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6611	Chromium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6613	Copper - Total	0.003	g/m³	18/11/2019	Sharon van Soest KTP
6617	Iron - Total	< 0.1	g/m³	18/11/2019	Sharon van Soest KTP
6618	Lead - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6621	Manganese - Total	0.002	g/m³	18/11/2019	Sharon van Soest KTP
6622	Mercury - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6624	Nickel - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6628	Selenium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6631	Sodium - Total	0.8	g/m³	18/11/2019	Sharon van Soest KTP
P1855	Aqueous Total Metal Digestion	Completed		16/11/2019	Paige Falconer .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/60934-02	Callaghan Innovation Research Ltd - Dr. Robert Breukers		14/11/2019 00:00	14/11/2019 16:05	PO108159

Notes: rbD10 sample 2

	Test	Result	Units	Test Date	Signatory
6601	Aluminium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6602	Antimony - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6603	Arsenic - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6607	Boron - Total	< 0.05	g/m³	18/11/2019	Sharon van Soest KTP
6608	Cadmium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6611	Chromium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6613	Copper - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6617	Iron - Total	< 0.1	g/m³	18/11/2019	Sharon van Soest KTP
6618	Lead - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6621	Manganese - Total	0.002	g/m³	18/11/2019	Sharon van Soest KTP
6622	Mercury - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6624	Nickel - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6628	Selenium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6631	Sodium - Total	0.8	g/m³	18/11/2019	Sharon van Soest KTP
P1855	Aqueous Total Metal Digestion	Completed		16/11/2019	Paige Falconer .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/60934-03	Callaghan Innovation Research Ltd - Dr. Robert Breukers		14/11/2019 00:00	14/11/2019 16:05	PO108159

Notes: rbD10 sample 3

	Test	Result	Units	Test Date	Signatory
6601	Aluminium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/60934-03	Callaghan Innovation Research Ltd - Dr. Robert Breukers		14/11/2019 00:00	14/11/2019 16:05	PO108159

Notes: rbD10 sample 3

	Test	Result	Units	Test Date	Signatory
6602	Antimony - Total	0.004	g/m³	18/11/2019	Sharon van Soest KTP
6603	Arsenic - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6607	Boron - Total	< 0.05	g/m³	18/11/2019	Sharon van Soest KTP
6608	Cadmium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6611	Chromium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6613	Copper - Total	0.002	g/m³	18/11/2019	Sharon van Soest KTP
6617	Iron - Total	< 0.1	g/m³	18/11/2019	Sharon van Soest KTP
6618	Lead - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6621	Manganese - Total	0.004	g/m³	18/11/2019	Sharon van Soest KTP
6622	Mercury - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6624	Nickel - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6628	Selenium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6631	Sodium - Total	1.0	g/m³	18/11/2019	Sharon van Soest KTP
P1855	Aqueous Total Metal Digestion	Completed		16/11/2019	Paige Falconer .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
19/60934-04	Callaghan Innovation Research Ltd - Dr. Robert Breukers		14/11/2019 00:00	14/11/2019 16:05	PO108159

Notes: rbD10 sample 4

	Test	Result	Units	Test Date	Signatory
6601	Aluminium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6602	Antimony - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6603	Arsenic - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6607	Boron - Total	< 0.05	g/m³	18/11/2019	Sharon van Soest KTP
6608	Cadmium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6611	Chromium - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6613	Copper - Total	< 0.002	g/m³	18/11/2019	Sharon van Soest KTP
6617	Iron - Total	< 0.1	g/m³	18/11/2019	Sharon van Soest KTP
6618	Lead - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6621	Manganese - Total	0.001	g/m³	18/11/2019	Sharon van Soest KTP
6622	Mercury - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6624	Nickel - Total	< 0.001	g/m³	18/11/2019	Sharon van Soest KTP
6628	Selenium - Total	< 0.005	g/m³	18/11/2019	Sharon van Soest KTP
6631	Sodium - Total	0.7	g/m³	18/11/2019	Sharon van Soest KTP
P1855	Aqueous Total Metal Digestion	Completed		16/11/2019	Paige Falconer .

Comments:

Sampled by customer using ELS approved containers.

Test Methodology:

Test	Methodology	Detection Limit
Aluminium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.005 g/m³
Antimony - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.002 g/m³
Arsenic - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.002 g/m³
Boron - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.05 g/m³
Cadmium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³
Chromium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³
Copper - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.002 g/m³
Iron - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m³
Lead - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³
Manganese - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³

Test	Methodology	Detection Limit
Mercury - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³
Nickel - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.001 g/m³
Selenium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.005 g/m³
Sodium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m³
Aqueous Total Metal Digestion	Follows APHA Online Edition Method 3030E (modified) using nitric acid.	n/a

Unless otherwise stated, all tests are performed in Wellington.

The laboratory is not responsible for the information provided by the customer which can affect the validity of the results.

"<" means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.

g/m3 is the equivalent to mg/L and ppm.

Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

Report Released By

Rob Deacon

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