Evaluation of Leachate from Recycled Crushed Concrete

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Introduction

The rapid expansion of the Auckland region has put pressure on existing quarries to supply virgin aggregate. Thus, the demand to use alternative materials is increasing. One material which may be an alternative to natural aggregate in the base course layer of pavements is recycled crushed concrete (RCC). There are however, environmental concerns for the effects this may have, thus this research explores the contents of RCC leachate.

Objectives

- Develop a test method which reflects New Zealand (NZ) field conditions
- Determine the contents of leachate from RCC, particularly Pb, Cr, Ni, Zn, As, Se, Al, SO_4^{2-}, and Cl^-
- Determine the environmental risks associated with utilising RCC for base course layer of pavements in NZ

Testing Equipment

New Zealand has high potential use of RCC in road construction but doesn't have a standard local test method on assessing environmental impacts of the material. Thus, a methodology and testing equipment was developed.

Lysimeter Test Setup

Batch Test Setup

Methodology

1. **Sample and Solution Preparation** — RCC samples from horizontal and vertical infrastructure were split and stored at optimum moisture content. Nitric acid was added to tap water to achieve a pH of 6.
2. **Lysimeter Testing** — Specimens were compacted in PVC pipes and positioned over mesh and PVC end caps. Solution was rained over each pipe daily.
3. **Batch Testing** — 4 L containers were agitated at 2 Hz for 4.5 hours.
4. **pH and Volume Measurement** — The pH and volume collected were measured daily for lysimeter testing and following completion of batch testing.
5. **Leachate Collection** — 200 ml of leachate was collected in PVC bottles and stored at 4°C prior to analysis.
6. **Chemical Analysis** — Samples were centrifuged and filtered. Concentrations of elements were measured using MP-AES & ions using IC.

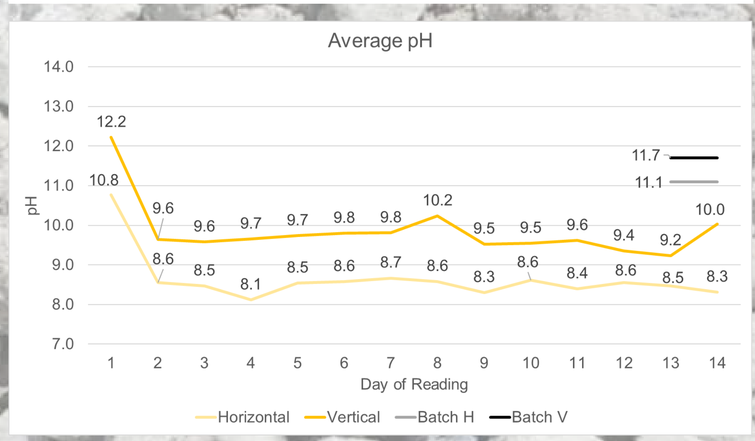
Results

Criteria / Elements	Drinking Water				Landfill Class B			
	Horizontal		Vertical		Horizontal		Vertical	
	Lysimeter	Batch	Lysimeter	Batch	Lysimeter	Batch	Lysimeter	Batch
Pb	x	x	x	x	✓	✓	✓	✓
Cr	✓	✓	x	✓	✓	✓	✓	✓
Ni	✓	✓	✓	✓	✓	✓	✓	✓
Zn	✓	✓	✓	✓	✓	✓	✓	✓
As	x	x	x	x	x	x	x	x
Se	x	x	x	x	x	x	x	x
Al	x	x	x	x	✓	✓	x	✓
SO_4^{2-}	✓	✓	✓	✓	✓	✓	✓	✓
Cl^-	✓	✓	✓	✓	✓	✓	✓	✓

Downer
Relationships creating success

Results (continued)

Concentrations of elements and ions were compared against NZ's drinking water standards and Class B landfill acceptance criteria. As and Se exceeded both standards for both sources. A significant drop in pH from Day 1 to Day 2 can be seen as a result of washing 8 L of solution through the specimen. The pH remained consistent for the remaining days.



Conclusions

- Washing RCC prior to use as a base course significantly reduces the pH to below 11 which is noted by TNZ M/4 to result in pipe corrosion
- As and Se are in exceedance of drinking water and landfill class B limits, and further research into the environmental effects would be beneficial
- Al is in exceedance of standards particularly from vertically sourced RCC possibly due to its higher purity
- NZ should produce its own local testing methods which align with building and environmental standards

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