Assessing water quality risk in plastic water pipes affected by bushfires

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Introduction

Rising mean global temperatures are predicted to increase the frequency and severity of severe bushfire due to the compounding of extreme drought intensity, heatwave and precipitation cycles. In this study the resilience of drinking water pipes to simulated bushfire induced thermal exposure was investigated. Experimental trials using HDPE and PVC water pipes were conducted to understand the variety and concentration of aqueous contaminants and the physical impact to pipes that resulted from thermal exposure.

Figure 1: *a) Paradise Irrigation District Service Reservoir – Nov 2018, and b) Wickepin-Dumbleyung Pipeline – Feb 2022*

Experimental method

HDPE and PVC reticulation samples were subjected to thermal exposure up to 200°C for 1 or 4 hours.

Samples were then stagnated with test-water using two methods

- Capped method (test-water contained within pipe section)
- Static method (small pipe sample submerged in test-water)

Exposed test-water was analysed for Volatile Organic Compounds (VOC) contaminants.

Differential scanning calorimetry (DSC) was used to identify thermally induced changes in the plastic matrix.

Figure 2: *Stagnating pipe samples with the a) capped method, and b) static immersion method*

Results

- Thermal exposure increased chloroform levels due to chlorination of organics in potable test water
- Benzene was detected above Australian Drinking Water Guidelines (ADWG) & US EPA health guideline values

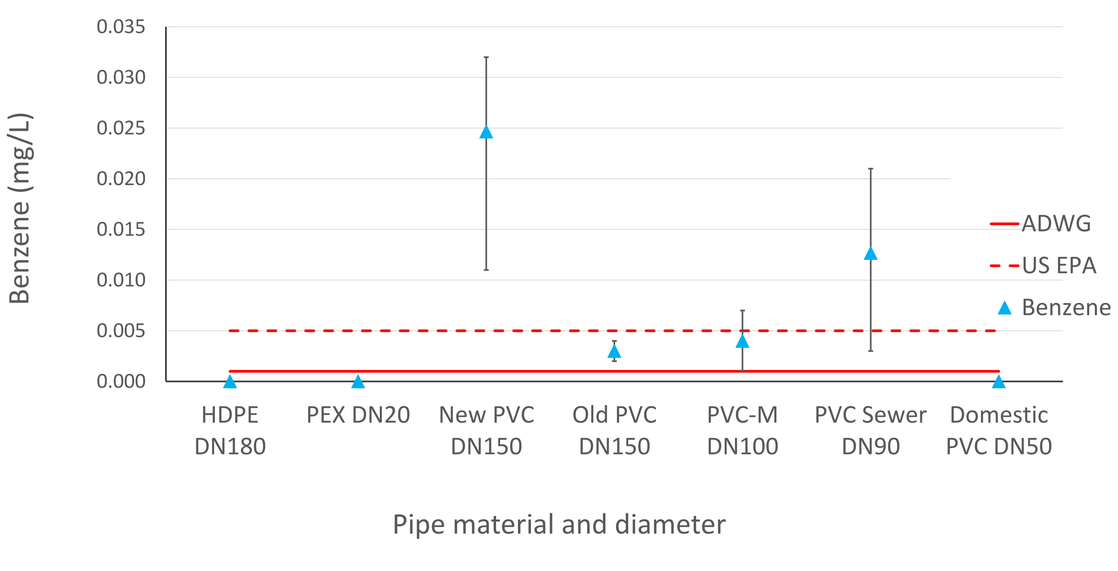

Figure 3: *Aqueous benzene concentration in test-water stagnated with various pipe material and diameter at 200°C for 4 hours*

- PVC pipe exposed to as little as 150°C saw increased gelation percentage which increases pipe brittleness
- HDPE pipe samples retained adequate antioxidants to prevent pipe performance loss

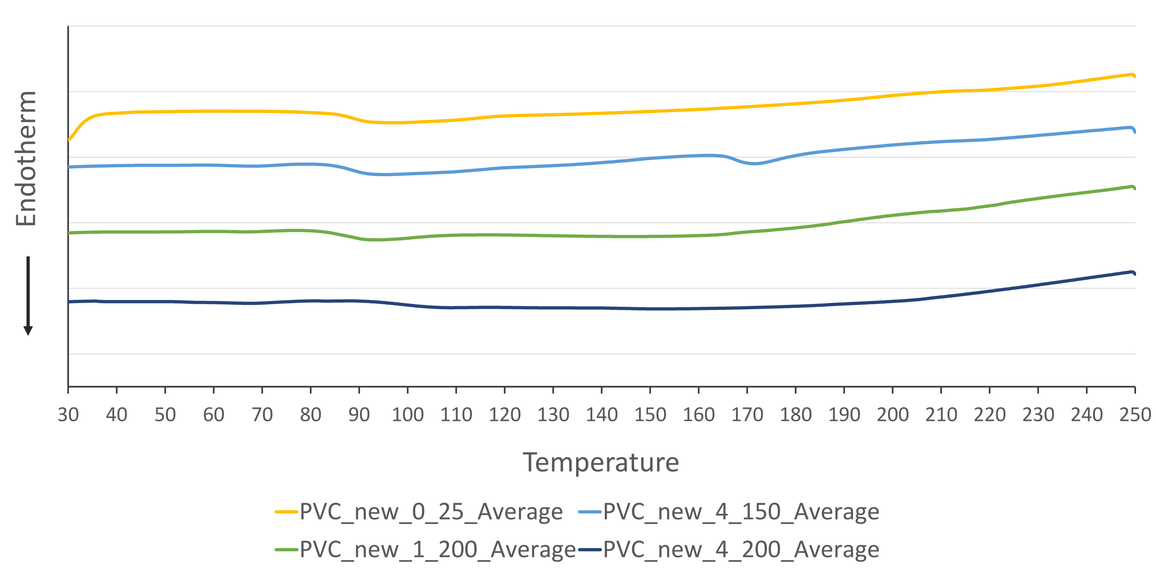

Figure 4: *DSC endotherm curves for various PVC-M samples following simulated bushfire exposure*

Conclusions

This study showed that thermal exposure of HDPE and PVC water pipelines can result in elevated level of VOCs and reduced mechanical strength. Water operators should consider the effects of increased bushfire risk and impact upon reticulation pipe networks. Despite an increased understanding of the likely contaminants and the physical damage to pipe assets, further research and increased planning in this area is essential to design and install bushfire resilient networks.