

## Rainwater harvesting structure made of used tires: possible release of dissolved organic carbon and metals

Systèmes de collecte d'eau de pluie à base de pneus  
usagés : possible désorption de matière organique et de  
métaux

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### RÉSUMÉ

L'évaluation de la possible désorption de composés organiques et de métaux de fragments de pneus utilisés dans des systèmes de collecte d'eau de pluie a été réalisée avec des expériences en batch et dans un pilote de laboratoire. Des méthodes optiques (spectroscopie UV-visible, spectroscopie de fluorescence) combinées à la mesure du carbone organique dissous sont utilisées pour suivre globalement les composés organiques. Les premiers résultats montrent que cette désorption est possible que les pneus soient neufs ou usagés, avec une grande similarité entre les signatures optiques, ce qui laisse à penser que les matières organiques désorbées proviennent de la gomme. Du zinc, du cuivre et du nickel ont également été détectés dans la phase liquide.

### ABSTRACT

The possible desorption of organic matter and metals from tire fragments used in rainwater harvesting systems (HVS) has been studied in batch tests and in lab-scale HVS. Optical methods (UV-vis spectroscopy, fluorescence) have been combined to dissolved carbon analysis to monitor globally the organic substances. First results show that desorption is possible with new as well as with old tires. Optical signatures are very similar, which indicates that the desorbed organic matter could originate from the gum. Zinc, copper and nickel have been detected in the liquid phase.

### KEYWORDS

Desorption, Dissolved organic carbon, Metals, Tires

## 1 INTRODUCTION

It has been proposed to recycle old tires in rainwater harvesting structures (Markevitz et al., 2006; Mariappan et al., 2008). In an urban environment tires are in contact with impervious surfaces (streets) and are likely to collect micropollutants (PAHs, metals, etc.). The tire itself is made of natural and/or synthetic rubber, mixed with chemical additives (oils, carbon black, sulfur, etc) and textiles or metallic cables. The question arises whether the pollution collected on impervious surfaces or tire components can desorb in presence of rain water, which can affect the quality of the harvested rainwater. To answer this question, batch desorption tests and experiments in a lab-scale rainwater harvesting structure have been run with new and old tires fragments.

## 2 MATERIALS AND METHODS

Two directions are explored:

- Batch desorption tests at constant temperature: two tires (a new tire and an old tire (> 50,000 km of use) of the same brand were shredded in pieces. Thread and side walls were considered separately.
- Semi-continuous tests in a lab-scale rainwater harvesting structure filled with tire fragments (Figure 1). The bottom of the structure is isolated from a porous medium (glass beads) by a geotextile. Simulated rainwater (pure deionized water or deionized water loaded with organic micropollutants (PAH) or metals (Zn)) are fed to the structure. Water is collected at the bottom and the upper overflow.

The samples are analyzed for dissolved organic carbon (total and optical properties by UV-vis spectroscopy and fluorescence spectroscopy). Metals are analyzed by ICP-OES.

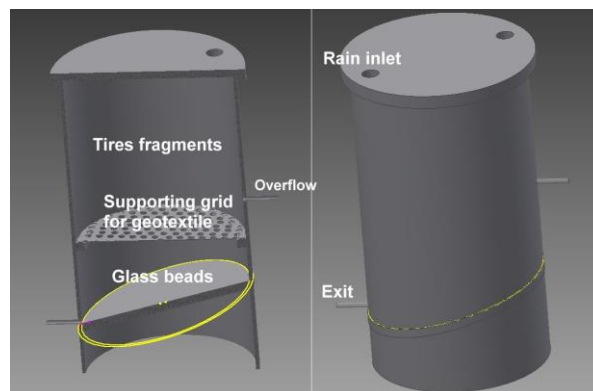


Figure 1: Lab-scale rainwater harvesting system

## 3 RESULTS

Results obtained in batch tests with ultra-pure water after 24h at 25°C are shown in Figures 2 and 3. The UV-visible spectra of the four samples exhibit a slight peak around 290 – 300 nm. Except for the old side wall sample, a peak is also detected at 220 nm. This peak is often attributed to nitrates (Ferree and Shannon, 2001). Figure 3 presents the synchronous fluorescence spectra obtained with a difference of 50 nm between excitation ( $\lambda_{exc}$ ) and emission. A peak at  $\lambda_{exc} = 277$  nm is obtained for both thread samples and a peak at  $\lambda_{exc} = 289$  nm is obtained for both side wall samples. The difference in excitation wavelengths indicate that the desorbed organic matter is different between the thread and the side walls, the tire being new or old. A peak at  $\lambda_{exc} = 350$  nm is detected for all the samples. Finally a peak at  $\lambda_{exc} = 500$  nm is detected for the new tire samples.

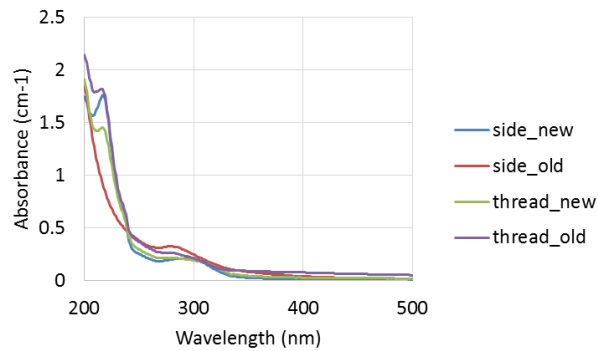


Figure 2: UV-visible spectra of the liquid phase after a 24hr batch test

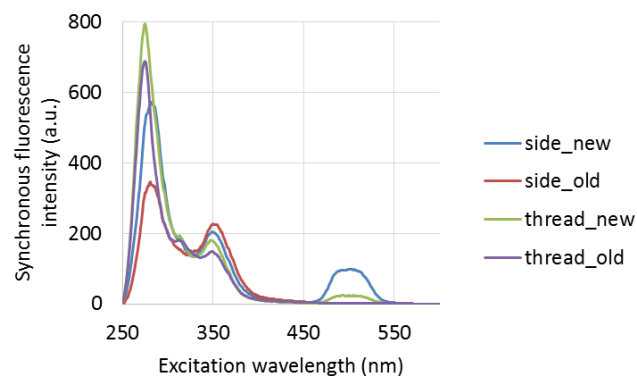


Figure 3: Synchronous fluorescence spectra of the liquid phase after a 24hr batch test

These experimental results show that organic matter is desorbed from old and new tires. There is a high similarity between the optical signatures: It is likely that this organic matter comes from the gum and not from the road pollution that could be adsorbed to the external gum. Finally metals were also found in the liquid phase after the desorption tests: zinc was predominantly found with traces of copper and nickel

## REFERENCES

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