Design of a large scale outdoor mesocosm to investigate heavy metals and polycyclic aromatic hydrocarbons phyto- and bio-remediation

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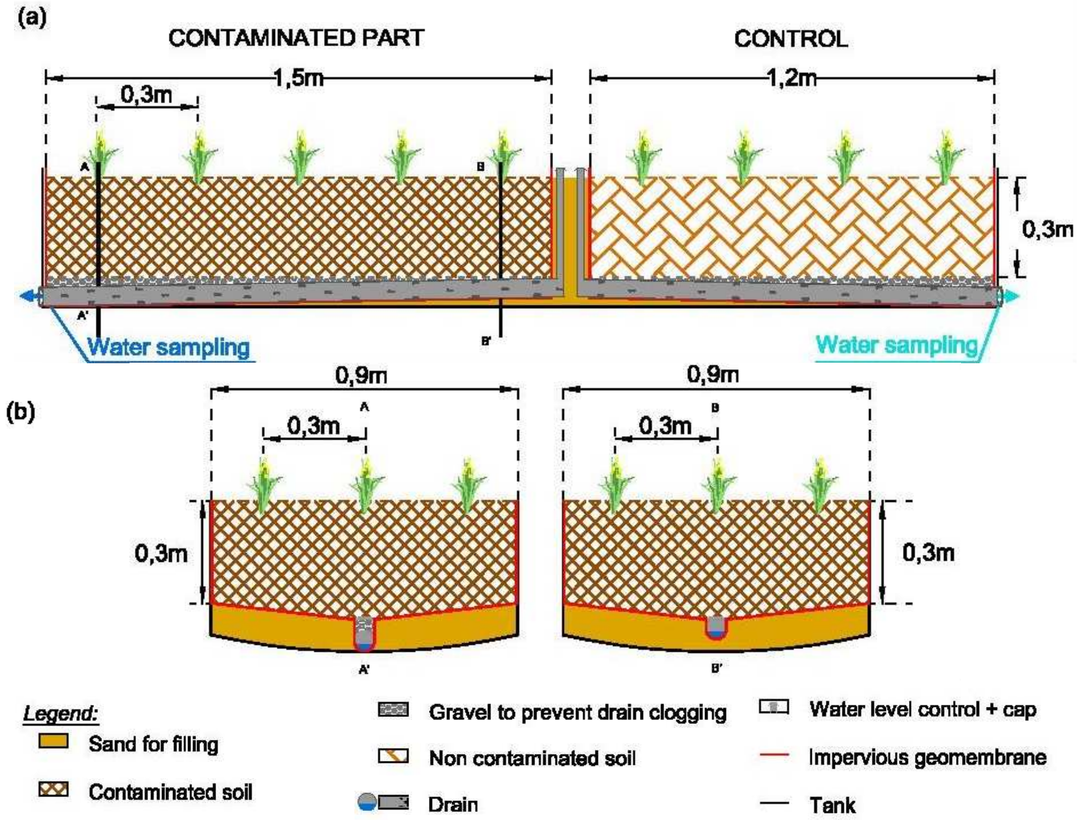
Nowadays, infiltration technics to catch highway and urban run-off are more and more used (Debecdelièvre *et al.*, 2009; Lami *et al.*, 2006).Thereby, it is a real concern to understand the fate of pollutants in the environment to prevent groundwater contamination. Despite numerous studies that take interest in the removal capabilities of ponds (*e.g.* in Faulwetter *et al.*, 2009; Imfeld et *al.*, 2009; Marchand *et al.*, 2010), planted trenches remain poorly investigated (Citeau, 2008; Delmas-Gadras, 2000) due to the complexity of the system (three media: plants, soil, and, water; physico-chemical conditions depending on weather, mix of organic and inorganic pollutants) which usually exhibits a low level of pollutants. To access to the system behaviour under natural conditions better than microcosm experiment offers to, we designed a large-scale outdoor mesocosm experiment to determine the fate of heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs) in this infiltration system (*i.e.* the trench).

A 2.7 meters-long tank, was divided in two parts: the control (not contaminated) part and the contaminated part spiked according to the method described in Zhang *et al.* (2011) with Cd, Pb, and Zn (at 2, 100 and 300ppm, respectively) along with phenanthrene, pyrene, and benzo[*a*]pyrene (at 10ppm each). A drain with a diameter of 60 mm was placed at the bottom of the tank to collect infiltrated water, and was covered by a 3 cm-thick layer of gravels and a 60 cm-thick layer of loamy soil typical from Normandy region (Figure 1). Three similar tanks were built and each was planted with one different species to reach a density of 11,1 plants/m². In order to maintain soil structure and biodiversity, only 0.2% of dried soil was taken out of the mesocosm, sterilized, and powdered for PAHs contamination. This amount was mixed with 3% of fresh soil then spread on top of the mesocosm. Then the mesocosm was watered with a solution containing Cd, Pb, and Zn in deionized water at the aimed concentration. After two weeks of equilibration, we investigated soil contamination and microbial abundance. The results showed that the contamination seemed to be homogeneous along the mesocosm. Microbial abundance and diversity investigations remain in progress.

This setting provided an efficient contamination of a large amount of soil of which quality was preserved. Thus, the fate of organic and inorganic pollutants in infiltration water, soil, and plants in a large mesocosm subject to outdoor conditions can be studied. Therefore, mesocosm was designed to illustrate specific contribution of both soil microorganisms and plants (*i.e.* rhizosphere) to the degradation and accumulation of targeted pollutants.

Figure 1. (a) Longitudinal- and (b) cross-sections of the mesocosm.



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