RHIZOFILTRATION OF WATER CONTAMINATED WITH HEAVY METAL USING *IMPATIENS BALSAMINA* PLANT

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1. Letter of Report Submission

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Puan Syazuani Binti Mohd Shariff
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PENERIMAAN BORANG TAMAT PROJEK PENYELIDIKAN (RAGS)
TAJUK PROJEK: *Blastofiltration And Rhizofiltration Of Water Contaminated With Heavy Metal Using Impatiens Balsamina Plant*

Dengan segala hormatnya, perkara diatas adalah dirujuk.

2. Adalah dimaklumkan, Pusat Pengurusan Penyelidikan (RMC) telah menerima satu (1) salinan asal borang tamat projek bertajuk seperti di atas daripada pihak puan. Pihak RMC mengucapkan setinggi-tinggi tahniah. Sehubungan itu, projek penyelidikan pihak puan telah didaftarkan sebagai **TAMAT**.

3. Pihak puan perlu menghantar laporan akhir penyelidikan dalam bentuk satu (1) salinan cakera padat (CD) kepada RMC dalam tempoh satu (1) bulan dari dari tarikh surat ini.

4. Sekiranya penyelidikan masih belum memenuhi penunjuk prestasi utama (KPI) yang dikehendaki oleh Universiti, penyelidik perlu menyelesaikannya.

5. Setelah penyelidikan tamat, penyelidik hanya dibenarkan membelanjakan tuntutan dalam tempoh yang dibenarkan sahaja. Manakala Vot 21000 dan 29000 boleh dibelanjakan sehingga enam (6) bulan setelah tamat penyelidikan iaitu sehingga (**30 September 2016**).

6. Sebarang pertanyaan puan boleh menghubungi Unit Pemantauan Penyelidikan RMC di talian 03-5543 7874 / 03-5544 2753.

Selaras dengan dasar penyelidikan UiTM disamping meningkatkan kesarjanaan akademik, pihak puan adalah diharapkan untuk terus aktif memohon geran dan menjalankan penyelidikan berterusan.

Sekian, terima kasih.

Yang benar,

PROFESOR DR. HADARIAH BINTI BAHRON
Penolong Naib Canselor (Penyelidikan & Inovasi)

5.3 Introduction

5.3.1 Heavy metal pollution

The Earth is poised at the brink of a severe environmental crisis. Current environmental problems make its living communities vulnerable to disasters and tragedies in future ongoing. The changes in the environment has urged public to increase their awareness towards the problems that surround it. All across the world, pollution issue has become one of the critical environmental problems especially in developed and developing countries. Pollution of air, water and soil required millions of years to recoup. Human activities responsible for the pollution directly, meanwhile fertilization activities in agricultural farming caused the leaching process of abundance of concentrated essential nutrients in the soil. Excessive production amount of waste from industrial activities without proper disposal ethic and mechanism also contributed to the mobilization of hazardous contaminants thoroughly from soil to the underground water supply.

Due to the increasing accumulation of heavy metals in the underground environment, it has urged scientists to come out with new technologies to restraint and/or reduce the toxicity level of contaminant substances in the polluted aquatic environment. This is a very challenging job with respect to cost and technical complexity (Barcelò and Poschenrieder, 2003). In fact, the introduced conventional method in cleaning the polluted aquatic sites such as in situ vitrification, microfiltration and sedimentation techniques, solidification, and stabilization of electro-kinetic systems suffer from limitations, such as costly, intensive labor, irreversible changes in physico-chemical properties in aqueous and disturbance of native micro-flora, hence potentially create secondary pollution problems (Sheoran *et al.*, 2011). Since the conventional method mostly proved to be partially effective in decontaminating hazardous heavy metals in the environment, researchers have came out with a variety of biological sources that have been employed widely in developed and developing nations for the cleanup approaches. The basic idea of exploiting plants ability to decontaminate polluted sites has gained considerable momentum in early 1900's, when scientist from Soviet Union develop the concept of geobotany, known as the study of plants ability to grow dependence on environment (Rawat *et al.*, 2012).

5.3.2 Plant ability to decontaminate pollution

Plants generally handle variety of pollutants naturally, by adapting themselves with the constraints occurs in their surroundings. Greipsson (2011) stated that plants potentially can extract and concentrate particular elements from the environment through roots into their bodyparts. They found that plants show the potential for uptaking, recovering, filtering, and stabilizing contaminant substances through their roots system, known as rhizofiltration. Rhizofiltration technique is basically utilization of plants root system in reducing and/or removing contaminants from polluted water, also in soils environment (Dushenkov *et al.*, 1995a). Therefore, most of reseachers believed that plants ability in decontaminating polluted sites derived from their root efficiency to synthesis, filter, precipitate, and/or immobilize hazardous substances to rise into plant bodyparts. This subset of green technology works effectively in decontaminating pollutants in the underground without disturbing the soil structure itself naturally. Thus, it will become a great opportunity of using plants to cleanup the polluted environment.

Most of the idea of rhizofiltration derived from how to cleanup waste water or aquatic environment. Initially, there have been a lot of conducted research paid more attention on selection of aquatic, emergent, and/or sub-mergent plants for rhizofiltration approach. They believed that the mechanism of rhizofiltration lies in physical and biochemical impacts of plant roots in waste water treatment. Yet, aquatic plants did have hairy roots, which provided an enormous surface area that absorbs and accumulate the water, together with nutrient essential for growth along with non-essential contaminant. However, the efficiency of metal or contaminants by these species is reportedly low due to their small sizes, also small and slow-growing root system. The high water content of aquatic plants also complicates their drying, composting, and incineration. To overcome the circumstances, researchers turned their interest to the terrestrial plants in exploiting their natural cleaning up pollution in the environment. This is because of terrestrial plants develop much longer, fibrous root system covered with root hairs, which create and extremely high surface area, plus, are easily dried in open air.

Scientists found that various terrestrial plants species have been effectively remove toxic metals such as Cu, Cd, Cr, Ni, Pb, and Zn in aquoeus solutions. It was also proved that low level of radioactive contaminants can successfully be removed from liquid streams. For example, due to the insident of radioactive disaster happened in Chernobyl, Ukraine in 1986, scientists were hopeful that terrestrial plants may play a key role in cleaning up the contamination. Thus, they discovered that sunflower (*Helianthus annuus*) is the most promising plant in reducing the high level of hazardous radioactive contaminants in the underground environment (Raskin and Ensley, 2000). Initiated from the incident, researchers agreed that rhizofiltration is a achievable cleaning system that can consist of a “feeder layer” of soil suspended above a contaminated stream through which plants grow, extending the bulk of their roots into the underground water (McGraw-Hill, 2000). This layer potentially allowed the plants to receive fertilizer without contaminating the stream below, while they simultaneously removing pollutants from the water.

The higher rhizofiltration potential expectation in terrestrial plants is driven from their marginal quality and has a long life-span, thus, contribute to the low maintenance cost. In addition, their roots penetrate microscopic scale pores in the soil matrix and capable in recycling a large amount of water per day per plant. They act as almost like pump and treat remediation system, thus become as efficient rhizofiltrator (Dushenkov and Kalpunik, 2000). Due to the great importance of rhizofiltration, terrestrial plant is now potentially introduced as a cost effective with low labor cost of traditional practices of contaminated waste water treatment, without producing secondary wastes in future. Therefore, most of researchers agreed that rhizofiltration should become one of important technique in cleaning polluted sites rather than depending on the conventional cleaning method.