CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Spent sulphide caustic (SSC) was classified as toxic and hazardous waste from industrial and does not decompose by biological treatment (Paulino & Afonso, 2012). SSC is formed when the NaOH has reacted with sulfur compound and has unpleasant smell, dark color, highly toxic and high pH. It contains several contaminants such as sulphides, naphthenic acids, phenols and emulsified hydrocarbon. Sodium hydroxide reacts with hydrogen sulphide as equation (1).

$$H_2S + NaOH \rightarrow NaSH + H_2 \quad (1)$$

Previous research has been reported that the common SSC treatment are using oxidizing agent, precipitating agent, ion exchange resin, diesel fraction and analytical method (Paulino & Afonso, 2012). However, these methods employed to clean up the environment contaminate are difficult to get optimum results and most of them are costly (Tangahu *et al*., 2010). Conventional remediation is the one of the methods to solve the problem (Seth *et al*., 2011). However, conventional remediation involved excavation process which remove soil and replace with non-contaminated soil that will affect the soil properties and not cost effective. In contrary, the phytoremediation which utilize of plants for cleaning up contaminants in soil and groundwater can be a non-polluting and cost effective way to remove or stabilize toxic chemicals (Seth *et al*., 2011). Phytoremediation is also an idea that has a good public acceptance because phytoremediation is suitable for large field sites where other remediation methods are cost effective and practicable (Ali *et al*., 2013). Plants have ability to remove or eliminate the pollutants from the environment and accomplish their detoxification by various mechanisms. *Scirpus grossus,* also known as giant bulrush was considered as one of the species of plant that have the ability to uptake contaminant

from their growth medium (Tangahu *et al*., 2010). *Scirpus grossus* was considered as a perennial plant with fibrous roots in white or brown colour. The leaves of *Scirpus grossus* were originated from the base of the stem with rosette and linear shape.

1.2 Problem Statement and Motivation

Generally, various chemical, biological and physical approaches had been used to purify soils and water contaminated by heavy metals in order to minimize their effects on the ecosystems. For example, treatment of SSC with oxidizing agent, removal of sulphur via precipitating agents, ion-exchange resin and analytical method were employed in the industries (Paulino & Afonso, 2012). However, most of them are difficult to get optimum results (Tangahu *et al.,* 2010). The limitation may include the monitoring difficulties and extended treatment time. (Dadrasnia *et al.*, 2013). Besides that, the conventional remediation methods which included soil incineration, excavation and landfill, soil washing, soil flushing, solidification, and stabilization of electro-kinetic systems. In general, the physical and chemical methods suffer from some limitations like high cost, intensive labour, irreversible changes in soil properties and disturbance of native soil microflora. In addition, chemical methods can also create secondary pollution problems. Therefore, research is needed to develop cost effective, efficient and environment friendly remediation methods for decontamination of metal polluted soils.

Phytoremediation is a low hazard, environment friendly and ecologically responsible solar driven method to remove environment contamination of soil and groundwater (Sharma & Pandey, 2014). Besides, plants that used in the phytoremediation can improve the site more attractive and improve the surrounding air quality (Nivala *et al.*, 2013). Furthermore, plant used in phytoremediation help reduce the noise and control the soil erosion (Licht & Isebrands, 2005). Generally, physical and chemical method for clean-up heavy metal contaminated in soil and groundwater have serious limitations. For example the high operation cost, destroy the soil properties, and creation of secondary pollution problem. In addition, phytoremediation has low cost installation and maintenance costs compared to other remediation option (Van Ginneken *et al.,* 2007). A preliminary study by Ramli in 2016 on the sulphide removal by phytoremediation process was performed successfully to degrade the sulphide up to 93.50 % of removal.

1.3 Research Objective

To investigate the removal of sulphide from spent sulphide caustic (SSC) using *Scirpus grossus* during phytoremediation process.

1.4 Scope of Research

Based on the research background and the problem statement described in the previous section, there are following scope in this research:

1) Re-planting the *Scirpus grossus* and observe the growth.
(Sixty *Scirpus grossus* were re-planted in six containers and the growth were observed for five weeks.)

2) The healthy grown *Scirpuss grossus* is taken for phytotoxicity test.
(The *scirpuss grossus* was determined based on its physical appearance i.e withered leaves.)

3) The semi-batch photoremediation
(Semi-batch experiments consist of adding a similar total amount of sulpide content to the *Scirpus grossus* plants over a seven-day period.)

4) Batch phytoremediation
(Batch experiment were carried out after the semi-batch process without adding new synthetic SSC over five-day period.)

5) Synthetic SSC and characterisation.
(The value of pH, COD, and sulphide content in SSC were determined throughout the experiment. This parameters were tested and analyzed.)