CHAPTER 1

INTRODUCTION

1.1 Background of the Study

There are several industries sectors have major emission sources of sulfide into the environment include effluents in cement works and lime kilns, food fermentation, rubber, distillery, paper and pulp, viscous rayon, tanneries, petrochemical and photographic industries. (Ravichandra et al, 2007). One of the alternatives is to use biological treatment through activated sludge method. Activated sludge is one of the oldest methods in biological treatment that used of highly concentrated microorganisms to produce a high-quality effluent by degraded organics and removed nutrients from wastewater. It is widely used process by large cities and communities where large volumes of wastewater must be highly treated economically. Activated sludge process plants are good choices too for isolated facilities, such as hospitals or hotels, cluster situations, subdivisions, and small communities (Process, A. S., 2003). The activated sludge process under aerobic conditions relies on the dense of the microbial population that being mixed with wastewater. It consists of two phase which is aeration and sludge settlement. (Gray, 2004).

In Malaysia, there is legislation that related to the control of pollution and enhancement of the environment which is the Environmental Quality Act, 2009. From this legislation, the industrial effluent means any waste either in the form of liquid or wastewater that being generated from manufacturing process including the treatment of water for water supply or any activity occurring at any industrial premises (EQA, 2009). The Act limits the discharge of wastes into the environment in contravention of the acceptable conditions. In the Table 1.1 below shows the effluent discharge standard ordinarily applicable condition for discharge of industrial effluent or mixed effluent following either standard A or B.

Table 1.1: The Acceptable Condition for Discharge of Industrial Effluent or Mixed Effluent of Standard A and B; Environmental Quality (Industrial Effluent) Regulations 2009

	Parameter	Unit	Standard	
			A	B
	(1)	(2)	(3)	(4)
i.	Temperature	^oC	40	40
ii.	pH Value	–	6.0-9.0	5.5-9.0
iii.	BOD_5 at 20oC	mg/L	20	50
iv.	Suspended Solids	mg/L	50	100
v.	Mercury	mg/L	0.005	0.05
vi.	Cadmium	mg/L	0.01	0.02
vii.	Chromium, Hexavalent	mg/L	0.05	0.05
viii.	Chromium, Trivalent	mg/L	0.20	1.0
ix.	Arsenic	mg/L	0.05	0.10
x.	Cyanide	mg/L	0.05	0.10
xi.	Lead	mg/L	0.10	0.5
xii.	Copper	mg/L	0.20	1.0
xiii.	Manganese	mg/L	0.20	1.0
xiv.	Nickel	mg/L	0.20	1.0
xv.	Tin	mg/L	0.20	1.0
xvi.	Zinc	mg/L	2.0	2.0
xvii.	Boron	mg/L	1.0	4.0
xviii.	Iron (Fe)	mg/L	1.0	5.0
xix.	Silver	mg/L	0.1	1.0
xx.	Aluminium	mg/L	10	15
xxi.	Selenium	mg/L	0.02	0.5
xxii.	Barium	mg/L	1.0	2.0
xxiii.	Fluoride	mg/L	2.0	5.0
xxiv.	Formaldehyde	mg/L	1.0	2.0
xxv.	Phenol	mg/L	0.001	1.0
xxvi.	Free Chlorine	mg/L	1.0	2.0
xxvii.	Sulphide	mg/L	0.50	0.50
xxviii.	Oil and Grease	mg/L	1.0	10
xxix.	Ammoniacal Nitrogen	mg/L	10	20
xxx.	Colour ADMI*		100	200

From table 1.1, the acceptable effluent discharge for example sulfide, both standard, A and B is 0.5 mg/L. In reality, effluent of primary treatment for petrochemical industry, the concentration of the sulfide is around 150mg/L, few hundreds fold compare to the discharge limit. Therefore, in order to follow the law and legislation, the secondary treatment should be done. To eliminate sulfide, there are several secondary treatment can be implemented. From previous studies, there are other alternatives in treating sulfide from wastewater. The possibility secondary treatment to eliminate sulfide are aerobic and anaerobic treatment, physicochemical treatments and chemical treatment.

Sulfide exists in three forms in the sulfide system (i) gas; hydrogen sulfide (H2S), (ii) aqueous; bisulfide ion (HS-), (iii) aqueous; sulfide ion (S2-) that can cause wide range of health effects depend on their concentration. Although the exposure to it at low concentration, the effect still there, this approved by OSHA(occupational safety and

health) and NIOSH(The National Institute for Occupational Safety and Health) saying it have long recognized this acute risk with appropriate short-term maximum exposure levels.(International & Assessment, 2003). From the previous study, sulfide will increase the acidity of water, this is because of if further oxidation of sulfide. (Ravichandra et al, 2007). In wastewater systems, sulfides cause damage to concrete structures in collection systems and contribute to odor problems in treatment facilities that can lead to serious environment pollution. (Mojiri et al, 2015). Other than that, the corrosion caused by sulfide will increase of economic cost.

1.2 Motivation and Problem Statement

There are several industries sectors have major emission sources of sulfide into the environment include effluents in cement works and lime kilns, food fermentation, rubber, distillery, paper and pulp, viscous rayon, tanneries, petrochemical and photographic industries (Ravichandra et al, 2007). Petrochemical industry produced large amount of wastewater from manufacturing processes like desalting, hydrocracking, hydroskimming, and vapor condensate (Al Zarooni and Elshorbagy, 2006). Petrochemical effluent are characterized by high chemical and biological oxygen demand (COD and BOD), significant concentrations of suspended solids, oil and grease, sulfide, ammonia, phenols, hydrocarbons, benzene, toluene, ethylbenzene, xylene and polycyclic aromatic hydrocarbons (PAHs) (Diya'udeen et al., 2011). These organics are highly toxic (Guo et al., 2009). Previous studies indicated that the elimination of sulfides was feasible by using physicochemical, chemical, and biological techniques. Although, physicochemical and chemical treatments have potential for high removal efficiency but it still have limitations due to high operational cost and restricted application in small scale facilities (Cho et al., 2008). Conventional biological removal of sulfides is using activated sludge systems. Activated sludge produced a high-quality effluent by degraded organics and removed nutrients from wastewater. Moreover, sludge containing living, or active, microorganisms will increase the available biomass and speed up the reactions. The presence sulfide in wastewaters has become a serious environmental problem. Because of the corrosive properties that can cause damage to concrete walls of reactors, sewer systems and steel