# CHAPTER I

# INTRODUCTION

## 1.1 Background and motivation

Thailand, a country in Southeast Asia, has extensively supported for industrial development. However, the more manufacture products, the more waste and pollutants are generated and released into environments if they are not improperly managed. The Pollution Control Department (PCD) estimated that in 2003, the industrial sector generated about 1.4 million tons of hazardous waste. Not only the residues from production processes, but also the products used and discarded by consumers could be considered as toxic waste. It was calculated that household hazardous waste was about 0.4 million tons produced in 2003 (PCD, 2003). The used fluorescent lamp is an example of a common hazardous waste generated by the industrial and community sectors. A fluorescent lamp is widely used since it provides an energy-efficient source of lighting. It was estimated that Thailand generated about 41 million tubes of used fluorescent lamps in 2004 (PCD, 2005).

In U.S., the used fluorescent lamp has been classified as a hazardous waste since it exhibits the toxicity characteristic of mercury (EPA Hazardous Waste number D009). Therefore, it is fully and stringently regulated as a hazardous waste. Subsequently, the EPA announced changes to this waste as it is not a strong hazardous waste. These changes resulted in the used fluorescent lamps being treated as a universal waste (Daly, 2000). In Thailand, the fluorescent light tube has also been set as hazardous material under the Notification of Ministry of Industry No.6, B.E.2540 since they consist of mercury as a part of their constituents (Ministry of Industry, 2002). Management of fluorescent lamp waste may be divided by waste generators into two main sectors: industrial and community sectors (PCD, 2005). The used fluorescent lamps in the industrial sector are treated as a hazardous waste. The generators of this sector must send these lamps to a hazardous waste management facility sanctioned by Department of Industrial Work. This waste stream is controlled

under the Department of Industrial Work by the hazardous waste manifest system (Ministry of Industry, 2004). On the other hand, the used fluorescent lamps generated from households are not yet regulated under any laws for disposal. The lamps are still discarded, collected and transported to a disposal facility by local authorities conventionally. During these processes, the lamps are often broken and the mercury contained in the lamps threatens the health of sanitation workers, and is also released into environments. Landfill is the method widely used for solid waste disposal throughout Thailand. Most of these landfill sites are without lining system and improperly operated (PCD, 2005). Therefore, after the used fluorescent lamps are disposed of onto a landfill, mercury, in its liquid, gaseous and compound forms, is released into air, soil, and water resources.

In the foreign countries, fluorescent lamp crushing units are available in the market. These devices are used to manage mercury containing lamps by reducing the volume of the used lamps and controlling the amount of mercury vapor that is emitted from the crushed lamps. The lamp residue is then sent to a recycling facility to recover the mercury, glass, and other metals or sent to a waste disposal site (O'Brien, 2000; Davis, 2001; Battye, 1994). Since Thailand does not have any recycling facilities to recycle the lamp waste, the used lamps from households are still sent to landfill facilities without any pre-treatments. And most of these lamps are broken during their collection or transportation. Therefore, the used fluorescent lamps are still a pressing problem in household hazardous waste management. To manage the used fluorescent lamps and prevent the release of mercury into environments, a crushing unit was designed and constructed in this study.

## 1.2 Objectives

The main objective of this study was to develop a prototype of the crushing unit to remove mercury in the used fluorescent lamps. The specific objectives were as follows:

1. To study the release of mercury from the crushed used fluorescent lamp.
2. To determine the optimum dose of sodium sulfide to reduce the mercury vapor emitted from the crushed used fluorescent lamp.

3. To study the stabilization/solidification of the fluorescent lamp residue sprayed with sodium sulfide and solidified using cement.

## 1.3 Hypothesis

The designed fluorescent lamp crusher with sodium sulfide spraying can reduce the amount of mercury released from the crushed used fluorescent lamps into environments.

## 1.4 Scope of study

The scope of work consisted of construction of a fluorescent lamp crusher; using 36 watt, used fluorescent lamps 4 foot long with a 1-inch diameter as samples; crushing a fluorescent lamp in the crushing unit; and determining the release of mercury from the crushed used lamp. This included analyzing sodium sulfide spraying's capability of capturing the mercury vapor emitted from the crushed lamp and stabilizing the mercury in lamp residue, and studying the solidification of lamp residue by cement. This study did not cover all brands of the used fluorescent lamps. One widely used brand was selected for the experiments.

## 1.5 Expected results

A prototype of a fluorescent lamp crushing unit with a sodium sulfide spraying system to reduce the amount of mercury released into environments, which could lead to an alternative way for communities to manage the used fluorescent lamps, is the expected result of this study.