

CHAPTER ONE

INTRODUCTION

1.1 Background

Solar thermal technology is one of the promising technologies that can be used for harnessing solar energy to generate thermal energy or electrical energy. For water heating system, this technology could produce a wide range of thermal energy from low, medium to high temperature depending on its solar thermal collector design. For production of low and medium temperature, flat plate collectors are usually used. However, for much higher temperature, mirrors or lenses are usually adopted where they are able to concentrate sunlight. This is known as concentrated solar thermal (CST) technology. Two important parts in solar thermal design are its collector and absorber. Collector is responsible to collect the solar radiation meanwhile absorber concentrates the solar radiation that has been collected by the collector.

Concentrating solar collectors usually refer to the parabolic collector has wider reflecting surfaces to capture and focus the sun's beam radiation into a smaller absorption area usually a tube. On the other hand, the non-concentrating collectors usually refer to flat plate collectors that used the flat area as the absorption solar radiation. Parabolic trough collectors (PTC) are the most mature technology of concentrating solar thermal with concentration ratio that can goes up to 100 times (Kalagirou, 2014).

1.2 Problem Statements

Due to the increase in electricity demand, issue in global warming and greenhouse effect as well as depletion in source of fossil fuels has forced the scientist around the world to look for alternative clean sources of energy. Solar energy is one of the potential renewable sources of energy especially to the country that receive high solar radiation such as in Malaysia. Implementation of solar thermal technology can be used to replace electricity in water heating system.

The implementation of CST using PTC technologies were not given much attention in Malaysia (Rosnani et al., 2014), due to its varying climatic nature characterized by heavy rainfall, light winds, formation of clouds among others. Similarly, the quantitative data to be used towards the development of concentrated solar power (CSP) technology for the generation of electricity in Malaysia is not readily available. Thus, this research is to investigate and improve the CST efficiency using parabolic trough concentrator (PTC) at minimal cost.

1.3 Objectives

The objectives of the research project are:

1. To design and fabricate a concentrated solar thermal (CST) using parabolic trough collector (PTC) embedded with automatic and manual tracking system for water heating application.
2. To determine the maximum temperature difference obtained by the fabricated concentrated solar thermal (CST) system under different water condition, either static or water flowing.
3. To determine the thermal performance of the PTC tube receiver under different tubes sizes which are 2 cm and 1 cm with covered or uncovered tube condition.

1.4 Significance of the Study

The research project focuses on a simple construction and evaluation of the concentrated solar thermal (CST) using parabolic trough collector (PTC) for water heating application. This type of study is very relevant in Malaysia, due to the abundant amount of solar energy received throughout the year. In addition, the parabolic trough collectors for industrial and domestic use are not readily available in the Malaysian markets (Chang et al., 2005). Solar water heating will not only conserve the energy but also reduce the usage of electricity consumption. However, solar thermal technology is not given much attention in Malaysia and there is low awareness among Malaysians on how to utilize this type of technology. Thus, it is hoped that this research will contribute

to knowledge in understanding feasibility of solar thermal system in water heating application in Malaysia. The study may also encourage the researchers in science and technology especially Malaysians to work in different fields of solar thermal technology, particularly parabolic trough solar concentrators for electricity generation.

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