

CHAPTER ONE

1.1 INTRODUCTION

Flat plate collectors for solar water heat were popular in Florida and southern California in the 1920^S. Photo type Israeli solar water heater, the first commercial company to manufacture solar water heater due to abundance of sunlight is it used by 20% of the population by year 1967.

1.2 SOLAR ENERGY

Solar energy is the light which come in form of electromagnetic radiation. Electromagnetic radiation is a wave like phenomenon that move energy across distance.

Solar energy is the most abundant continuing source of energy available to the human race. Solar energy is not being used as primary sources of fuel energy but a large research and development effort has being underway to develop economical systems to harness solar energy as a major source of energy particularly for the heating and cooling of buildings.

Solar has the following advantage

- i) It is very attractive
- ii) It is non polluting
- iii) It is non deflectable (not quickly use)
- iv) It is reliable and free.

On the other hand, solar energy has this disadvantage

It is not constant for terrestrial application.

Solar energy can be converted directly into other form of energy in their separate conversion process, they are:

1) THE HELIOTHERMAL PROCESS : This is absorption of solar radiation and conversion of the energy into thermal energy is the only solar conversion that has a theoretical conversion efficiency of 100%

2) THE HELIOCHEMICAL PROCESS: This is the photosynthetic reaction. The reaction is the sources all biomass and fossil fuel.

3) THE HELIOELECTRICAL PROCESS: This is the production of electricity by photovoltaic or solar cells.

It is estimated that the rate at which solar energy arrives at the earth is about 1.72×10^{17} MW. The amount of solar energy incident on a horizontal surface range from 3.5 to $7 \text{ kwh/m}^2/\text{day}$. About 30% of the total amount is reflected to space, 47% is converted to low temperature heat and reradiated to space and 23% powers the evaporation/ precipitation cycle of the biosphere. Less than $1/2\%$ is represented in the kinetic energy of the wind and waves and in photosynthetic storage in plant.

1.3 USE OF SOLAR ENERGY

Over the years solar energy has been put to several uses ranging from drying of cloth and agricultural product to sun tanning the body and of course for food preservation. Other areas of solar energy use is air conditioning for cooling and heating of a building for human comfort using absorption cooling system.

Other area of uses of solar energy is solar cooler, warming pools, operating engine pumps, solar furnace and generating of electricity.

1.4 PRINCIPLE OF APPLICATION

Energy received from the sun comes in form of light but not all the rays are visible to human eye. When the

sun radiation hits an object, solid or liquid, these rays are absorbed, refracted and reflected. The absorbed rays are transformed into thermal energy which aids the object to get warm and heat is stored in the object. When the sun rays strike the mirror or the glass, it reflects the rays back to other material in its surroundings obeying the laws of optics, if the mirror or glass is shape in form of a cylinder or parabola. The Edge ray principle states that "If a ray of light is perpendicular to a parabolic surface, it reflects the rays back to the focal point. If a material for example, absorbent pipe is placed at the focus, there will be increase of solar energy resulting to an increase in temperature and if this is done, the rays are said to be concentrated. This is the principle employed in this project.

1.5 STORAGE OF SOLAR ENERGY

Storage is impedance in the research and use of solar energy since it cannot be stored in its original form. In order to use solar energy effectively. The thermal storage systems incorporate the use of fluid. Also steam accumulator rocks which are capable of storing both sensible and latent heat, while chemical energy storage uses the output of the solar collector to provide a chemical that can be used until the energy is required like the photovoltaic cell in the generation of electrical energy from solar radiation.

1.6 ENVIRONMENTAL IMPACTS OF SOLAR SYSTEM

Solar systems are usually considered to be rather beneficial. One of the reasons for the use of solar energy is to reduce environmental pollution and associated costs for its control. However they are a negative impact which has been identified. These are some of the impacts of solar usage.

1) AIR POLLUTION: The replacements of fossil fuel combustion with solar heat with reduce the emission of pollutants like CO_2 , NO , SO_2 , particulates, and unnamed hydrocarbons. However, certain solar systems using chemical reactants for storage or organic fluid for heat transport pose the threat of release of CO , SO_2 , SO_3 , hydrocarbon vapour and other noxious gases. A fire hazard may exist if overheated, organic working fluids are present near an ignition source form of air "pollution" exist near focus of larger solar reflectors or refractors. Human tissue would be destroyed upon only a short contact.

2) LAND USE: One of the largest impacts of solar collection is the requirement of relatively large amounts of land. This represents a severe problem in industrialized area such as the North East of the United States. The land intensiveness of solar plant is offset to some extent because they do not generate solid or liquid waste requiring land for disposal. Collector fields producing shading not normally represented over large areas. Impacts on the local ecosystem include an increase of shade – seeking flora, which may impair collector function.

3) THERMAL POLLUTION: Solar system elumiciate the local thermal pollution produced by fossil fuel combustion solar flux, formerly reflected or absorbed by the local environment, is partially collected and transported to a nearby solar- thermal conversion facility. Hence the thermal effects of solar plant are minor. If electric power by a solar plant is used hundreds of miles away in a city, some reductions in the local environment heat budget occur.

1.7 CONCEPT OF HEATER

Solar hot water is water heat by the use of solar radiation energy. Solar heating systems are generally composed of solar radiation collector to its point of usage. The systems may be used to heat water for a wide variety of uses including home, business and industrial uses.

Most solar water heater require a well insulated storage tank, solar storage tanks have an additional outlet and inlet connected to from the collector. The pressure at which all the water in the heater has been

converted to steam.

1.8 STEAM RAISING

Many ways are used to raise steam for domestic and industrial uses. The chemical energy, which is contained in a heater fuel, is converted into heat energy when the fuel is burned. However, if a heating element is used, electrical energy is converted into heat energy. This heat is transmitted by conduction through the wall of the heater furnace to the water.

In another way, energy from the sun can be used to produce steam by focusing the rays on an absorber when water passes through the absorber. This is the focus of this project.

Heat energy, which produces a rise in temperature when it is passed into the water, is known as the specific enthalpy of water (h_f). As more heat passes through the water the temperature of the water does not rise so long as the water is at atmospheric pressure but the heat is used in vaporizing the water and converting it into steam and the heat energy is called the specific enthalpy of evaporation (latent heat of vaporization) denoted as h_{fg} . The water change to steam as long as heat is added.

The specific enthalpy of dry “saturated” steam at any pressure denoted as h_g is given as:

$$h_g = h_f + h_{fg}.$$

1.9 SOLAR WATER HEATER FOR DOMESTIC USE

- The utilization of solar energy for domestic hot water.
- They can be used in any climate and the fuel they use sunshine is free
- Solar water heating systems use free heat from the sun to warm domestic hot water.
- Solar water heating can now reduce your domestic water.

1.10 THE BENEFIT OF SOLAR WATER HEATER

- **HOT WATER THROUGHOUT THE YEAR:** The system works all year round though you will need to heat the water further with a boiler or immersion heater during the winter months.
- **CUT YOUR BILL:** Sunlight is free, so once you have paid for the initial installation your hot water cost will be reduced.
- **CUT YOUR CARBON FOOTPRINT:** Solar hot water is a green renewable heating system and doesn't release any harmful carbon dioxide or other pollutants.

1.11 SOLAR WATER HEATING TECHNOLOGY

Solar water heating is a simple technology that uses free energy from the sun of heat water generally in collector mount.

There are two type of solar water heater (Active and Passive). Active system use electric pumps valves and controller to circulate water or they are more expensive than passive systems. Passive system move household water or a heat transfer liquid through the system without pumps.

1.12 WORKING PRINCIPLE OF THE SOLAR WATER HEATER

Solar water heater system use solar panel glass/mirror called collectors fitted to your tank. These collects heat from the sun and use it to warm water which is stored in a hot water tank (cylinder). This is when light ray from the sun strikes the solar collector and heats the black metal sun strip absorber underneath the glass cover.

A boiler or immersion heater can then heat this water further until reaches the temperature set by the cylinder thermostat this should be set at 60°C.

Larger solar panels can also provide energy to heat your home as well. Through usually only in the summer

months when home heating is unnecessary.

DESIGN AND CONSTRUCTION OF A SOLAR WATER HEATER FOR DOMESTIC USE

The complete project material is available and ready for download. All what you need to do is to order for the complete material. The price for the material is NGN 3,000.00.

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