

## Study and Construction of Evacuated Tube Solar Collector

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### Abstract

*Solar energy is non-polluting and eco-friendly. Its importance is on high track. Solar energy can be used into heat energy by using evacuated tube collector, flat plate collector, parabolic collector etc. Evacuated tube collector requires two layer glass tube with vacuum tubes with layers as insulation but ready-made evacuated tubes are not found anywhere in our country. So, as an alternative forms of an evacuated tube collector, fused tube light can be used. Unlike flat plate collectors, evacuated tube collectors do not heat the water directly within the tubes. Air is removed or evacuated from the space between the two tubes, forming a vacuum. By using fused tube light, it is very important for our country. It is low cost product while our country is developing country. This paper indicates study of the evacuated tube collector, how to construct an evacuated tube collector by using wasted or fused tube light. This paper also discusses the efficiency of the evacuated tube solar collector. This paper also finds the application such as water heating, space heating, cooking etc. Globally, the industries of solar evacuated tube collectors are growing at 15% annually.*

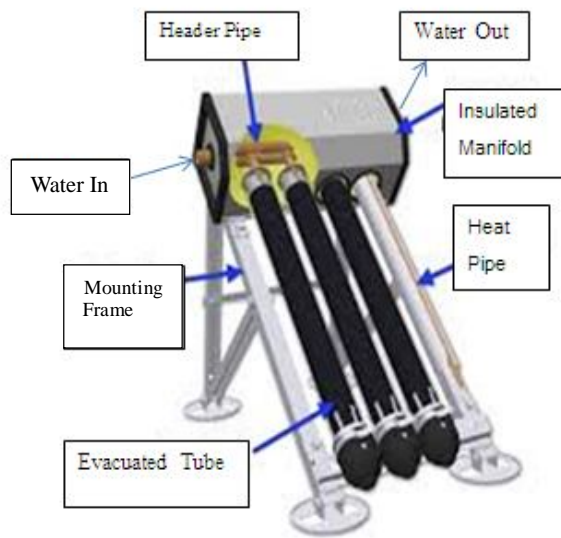
**Keywords:** Evacuated tube collector, Solar energy, water heating, wasted or fused tube light.

### 1. Introduction

The continuous rise and competitive demands for fossil fuel necessitate the need for alternative source of renewable energy. In present, Conventional energy source such as fossil fuels are decreasing day by day at faster rate. In today's world, global warming is becoming a serious issue slowly but steadily too. Developing countries Like Bangladesh are in a vulnerable situation in matters of energy demand. So, the interest of renewable energy has been revived over last few years, especially after global awareness and conventional energy crisis. Now-a-days, the demand of renewable energy sources like solar energy, wind, biomass, small hydro are increasing day by day. This paper indicates solar energy. It is clean and cheap. Vacuum tube solar collector is one of the most suitable ways of applying solar energy. In our country, summer weather is almost in seven months. There is another problem in our country that two layer borosilicate glass is not available. So, We have decided that fused or wasted tube light can be used. There are many fused tube light in our country which are almost misused. By using fused tube light, We save our wasted material. It is also low cost project. The main motivation behind this concept came from international ideas of evacuated tube solar collector and novelty of this thought in our country. Several countries are now enjoying the blessings of solar energy by utilizing it in reduction of electrical energy consumed by electrical machines. Some of the companies developing evacuated tube solar collectors are apricus, SunMaxx, Solar Cool and Northern Lights etc. Evacuated tube collectors are a slightly more recently developed technology, introduced to the market in the 1970's. E. Speyer, 1965, Studied on solar energy collection using evacuated no tracking collectors with selective coatings. Recently evacuated tube collectors are most extensively used device to convert solar radiation into heat. Evacuated tube collector is more efficient in high temperature. Dr. S. P. Vendan, L. P. A. Shunmuganathan, T. Manojkumar, C. Shiva Thanu [1], 2012, Studied on Design of an Evacuated Tube Solar Collector for High Temperature Steam Generation. Dilip Mishra, Dr. N. K. Saikhedkar [2], 2014, Studied on Evacuated U-Tube Solar Water Heating System.

### 2. Comparison between flat plate collector and evacuated tube solar collector

In evacuated tube, heat loss is minimum due to vacuum tubes. It is more efficient in high temperature than flat collector. Maintaining vacuum is difficult for evacuated tube collector. Evacuated tube is more expensive than flat collector because of many glass tubes are needed. If one of the tubes breaks or fails, tube replacement is simple and cheap. So, maintenance cost is quite low. It is another advantage of evacuated tube. Smaller collector area required to match energy output of flat plate collectors. For low temperature application, flat plate is more efficient. For but high temperature application, Evacuated tube is used.



**Fig.1.** Elements of an evacuated tube collector **Fig.2.** Experimental set-up

### 3. Construction of Evacuated Tubes

There are several elements of an evacuated tube collector such as evacuated tube, heat pipe, copper header, manifold, mounting frame etc. Now elements will be discussed below.

#### 3.1 Evacuated tube

Evacuated tube is two layer glass. It consists of borosilicate glass for greater thermal efficiency. But borosilicate glass is not available in our country. So, it has been decided that evacuated tube will be constructed from fused or wasted tube light. The two terminal points of tube light are connected with aluminum cover. Aluminum cover must be loosened by slight forcing system and cover can be removed. Aluminum cover must be dipped into water at high temperature and cover can be removed also. By electrical heating system, aluminum cover can be removed. Then, gas should be removed from the tube light. Citric acid can be used to remove white color of the tube.

#### 3.2 Heat pipe

The heart of the evacuated tube solar collector is heat pipe. It is hollow element that is partially filled with a working fluid and has two sections, an evaporator and a condenser. A liquid is heated to its boiling point, evaporator and absorbs heat and uses it to convert working fluid to vapor, which expands to fill the entire internal space of heat pipe. The condenser is in direct contact with heat sink and rejects heat leading to the vapor losing the heat and condensing back to liquid. The liquid returns to evaporator and the cycle repeats itself. So it can be said the heat pipe has a diode function. A heat pipe works in the same way as a high conductance thermal conductor. Its thermal-physical properties makes its heat transfer rate thousands of times greater than that of the best solid heat conductor of the same dimensions. In an evacuated tube solar collector a sealed copper pipe is coated with a thin absorber film inside the evacuated glass tube. A small copper condenser is attached to the top of each heat pipe. The common working fluids are acetone, water and methanol and common heat pipe materials are copper, iron, aluminum. Here Acetone was chosen as working fluid and copper was chosen as heat pipe material. Because copper has the highest thermal conductivity of the available materials and acetone is suitable with copper. Acetone has quite low boiling point at atmospheric pressure and under lower pressure it will be advantageous. Acetone is locally available. In table(1) gives the properties of different working fluids at atmospheric pressure and their useful ranges why we use acetone. And table(2) gives the thermal conductivity of some materials why we use copper.