

# A Review on the Application of Fresnel Lenses for Solar Radiations Concentrator

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**Abstract**— In today's era the solar energy become very essential for saving this beautiful earth from pollution. For concentrating solar energy Fresnel lenses plays very important roll. The Fresnel lens is used for concentrating solar incident radiations. The present research review is on the use of Fresnel solar concentrator for solar power performance improvement; also present study explores the approach for developing the proposed experimental model for low pressure steam generation.

**Key words:** Fresnel Lens, Solar Energy, Solar Concentrator, Low Steam Generation

## I. INTRODUCTION

The continuous increase in the level of greenhouse gas emissions, limited resources of the conventional fuels and the increase in the fuel prices are the main driving forces behind efforts to more effectively utilize various sources of energy. The use of renewable energy for the purpose is the best option and has been the topic of research worldwide [1]. In many parts of the earth direct solar radiation is considered to be one of the most probable sources of energy. The solar energy can be used in many applications by following three different ways. The conversion of photons energy of sun into useful energy carried out by:

### A. Photo Thermal

The solar incident photons get converted in to the heat energy.

### B. Photo Chemical

In the photo chemical type of conversion the solar radiation which is kept between 0.3 and 1.0 $\mu\text{m}$  of wavelength can leads to chemical reactions, sustain development of plants and animals and through photosynthesis convert exhaled carbon dioxide to breakable oxygen.

### C. Photo Voltaic

The best example of photo voltaic is solar cell or photovoltaic cell. The solar photons having the band between 0.33 and 1.2  $\mu\text{m}$  of wavelength can be converted directly into electricity by photovoltaic cells. The photo thermal processes are the efficient systems developed to connect solar energy into the directly usable form. In concentrated solar system concentration is achieved by refraction or reflection through mirrors. The used of any type of concentrator like parabolic dish type concentrators or quantum type Concentrators becomes bulky and transportability is a problem and less efficient in as required maximum time for temperature rising. Moreover for increasing the temperature of photovoltaic cell quickly Fresnel lenses are best option. The present study review on the used Fresnel lens for low pressure steam generation. This study divided into two parts, firstly the selection of solar concentrator system and the secondly is the

applicability of Fresnel lens based system for low pressure steam generation.

## II. DIFFERENT TYPES OF FRESNEL LENSES

The Fresnel lenses are used for concentrated the photons of sun on the area of application. The Fresnel lenses are mainly classified as imaging and non imaging type. The following are the types of Fresnel lenses:

### A. Imaging Type

#### 1) Spherical

A spherical Fresnel lens is equivalent to a simple spherical lens, using ring-shaped segments having each a portion of a sphere, and capable to all focus light on a single point. This type of lens produces a sharp image, although not quite as clear as the equivalent simple spherical lens due to diffraction at the edges of the ridges.

#### 2) Cylindrical

A cylindrical Fresnel lens is equivalent to a simple cylindrical lens, using straight segments with circular cross-section, focusing light on a single line.

This type produces a sharp image, although not quite as clear as the equivalent simple cylindrical lens due to diffraction at the edges of the ridges.

### B. Non-Imaging

#### 1) Spot

A non-imaging spot Fresnel lens uses ring-shaped segments with cross sections that are straight lines rather than circular arcs. Such a lens can focus light on a small spot, but does not produce a sharp image. These lenses have application in solar power, such as focusing sunlight on a solar panel.

#### 2) Linear

A non-imaging linear Fresnel lens uses straight segments whose cross sections are straight lines rather than arcs. These types of lenses focus light into a narrow band. It cant produce a sharp image, but can be used in solar power, such as for focusing sunlight on a pipe, to heat the water.

## III. LITERATURE STUDY ON FRESNEL LENS

E.M. Kritchman A.A. Friesem and G. Yekutieli, et.al.carried out work for judging the efficient of fresnel lens for solar concentration. In this work the effectiveness of Fresnel lens are compared with the ideal concentrators [2].Ralf Leutzakio and Suzukitakao Kashiwagi et.al.investigated on the design of non imaging Fresnel lens for increasing solar concentration. In this study the optimum convex lens are used for investigating the performance of fresnel lens [3].Kwangsun Ryua and Jin-Geun Rhee presented the study on the design of Fresnel lenses for PV solar concentration. They have used Fresnel lens for concentrating the sun radiation on the PV cell and transmission emission of 20%.The improvement in the efficiency is found to be 70%

[4]. Daniel Chemisana, et.al. presented the comparative study on the fresnel concentrator. The different parameters such as shadowing effect, optical concentration efficiency and placement of the focal area are studied in respect to the fresnel lens concentrator. The results of study found that the used of concentrating can absorbed more than 50% of global radiation [5]. Daniel Chemisana et.al. presented study on the Linear Fresnel concentrators for building integrated application. In this study Fresnel lens is combined with CPC for track the sun radiation. It is concluded from the study that a concentration ratio of 12.5 suns is the optimum geometric concentration for the Fresnel lens to satisfy both architectural features and solar concentration requirements [6]. D. Chemisana et.al. carried out the worked on the Characterization on PV thermal module for Fresnel linear concentrator. The various parameters are studied and conclude the results on the basis of thermal and electrical analogy [7]. W.T. Xiea, Y.J. Daia et.al. carried out the review on the application of Fresnel lenses. The study shows the different application of fresnel lenses. The efficiency is found to be improved with used of solar concentrated fresnel lenses for PV module [8]. David C. Miller et.al. presented work on the durability of Fresnel in PV cell. The study presented the review on the application of fresnel lens and its durability. In this study the different material constructed lenses are studied and analysed, also different working parameters are studied and analyzed [9]. H. Zhai and Y.J. Dai carried out the experimental investigation and analysis on concentrating solar collector using the linear fresnel lenses. In this study fresnel lens is used to concentrated the solar radiation flat collector. The experimental study shows that thermal efficiency is improved by 50% with used fresnel lens [10]. Naichia Yeh analytical investigated on the spectral and optical distribution losses of Fresnel lenses. The losses inherent in the linear fresnel lenses are studied and the analyzed for concluding results [11]. W.T. Xiea and Y.J. Daib carried out work on the Numerical and experimental analysis of a point focus solar collector using high concentration imaging PMMA Fresnel lens. In this study the fresnel lens are used to concentrated on the solar flat collector. The flat plate collector having fluids inside and inserts inside tubes, flow rate of fluid is varies, the concluding study shows the improves the efficiency in case of conical cavity [12]. M.M. Valmiki et.al. studied the novel application of Fresnel lenses in the stove and solar heating. The radiation from the sun is concentrated with used of Fresnel lens in order to get high energy concentration [13]. Chung-Feng Jeffrey Kuoa et.al. investigated on the analysis of processing parameters in fabrication of fresnel lens solar collector. The different working parameter such as mold temperature, pressure etc are considered for design the system and results obtained from the study is analyzed [14]. P.J. Sonneveld investigated on the performance of a concentrated PV energy system with static linear fresnel lenses. The used of fresnel lens with PV cell concentrated improves the performance of photovoltaic model and shows upto 70% improvement in efficiency [15]. Atsushi Akisawaa et.al. investigated on the design of dome-shaped non-imaging fresnel lenses considering chromatic aberration into account. The researcher have investigated on the dome shape concentrated with fresnel lens results of study shows that the efficiency of the PV cell improves by the 40%, also

new design of solar concentrator is more efficient than conventional concentrator [16]. D.T. Nelson et.al. investigated on the linear fresnel lens concentrator with seasonally adjusted sun rays tracker. Resercher had studied the different aspect in relation with the incident radiation [17]. Vinod Kumara et.al. presented research review on the fresnel lens concentrator used for the solar power generation. The different parameters are considering for presenting this research such as incident light wavelength, refraction etc. [18]. Khalil E.J. investigated on the performance and efficiency analysis of flat linear Fresnel lens with solar tracking system. The study work on the performance improvement in solar flat plate collector. The result concludes that the thermal efficiency of the solar plate collector is improved by 65 % [19]. David R. Mills et.al. carried out the research works on the compact linear fresnel lens solar reflector. The system is design for PV power plants. The linear fresnel lens are used for improved the performance of solar PV cell [20].

#### IV. PROPOSED EXPERIMENTAL WORK

The proposed setup of work as shown in fig.1.1

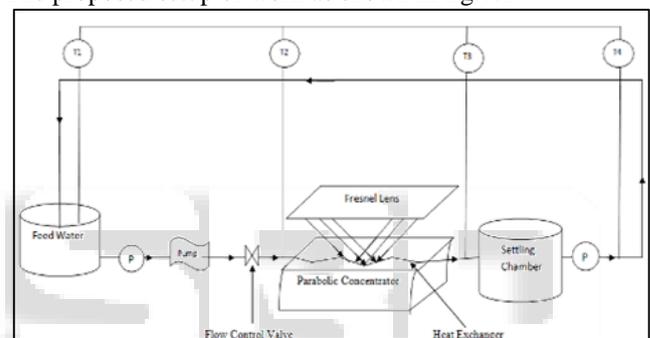


Fig. 1: Proposed Experimental Work

The experimental work for low pressure steam generation using the Fresnel lens shows in above layout. The layout shows the feed water shell. The feed water passed through heat exchanger which is located on the linear fresnel parabolic solar concentrator. The temperature of feed water is measured by K-type thermocouple also pressure of inlet water is measured with U-tube manometer. The feed water absorbed heat due to continuous concentrated of solar rays through Fresnel lens. The heated water collected in the dome shape settling shell chamber. In that chamber the steam get formed and collected in the dome. The formed steam pressure is measured with help of pressure gauge also the steam settling chamber is equipped with safety valve. The flow of feed water is control by feed control valve. The readings are taken with different flow rate of feed water.

#### V. CONCLUSION

The necessitate for the development of a Fresnel lens collector solar steam generator arise as an alternative to solve the thermal energy needs of the country. The used of conventional energy resources will help to reduce the total dependency on fossil fuels, as such can creates deforestation and adverse effect on the environment. The present study on Fresnel lens concentrator helps for developing proposed experimental model.

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