Solar Water Purifier For Indian Villages – A Review

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ABSTRACT

Solar distillation proves to be both economical and eco-friendly technique particularly in rural areas. Many active distillation systems have been developed to overcome the problem of lower distillate output in passive solar stills. Solar still is a useful device that can be used for the distilling of brackish water for the drinking purposes. In this article a review has been done on different types of solar still. This article provides a detailed review of different studies on active solar distillation system over the years. This review would also throw light on the scope for further research and recommendations in active solar distillation system.

Keywords: solar energy, solar still Distillation system, drinking water.

1. INTRODUCTION

Solar water purification involves purifying water for drinking and household purposes through the usage of solar energy in many different ways. Using solar energy for water treatment has become more common as it is a usually low-technology solution that works to capture the heat and energy from the sun to make water cleaner and healthier for human use and consumption. Solar water treatment is particularly beneficial for rural communities, as they do not have other forms of water purification infrastructure and more importantly, electricity to run such structures. The most positive feature about solar water purification is that there is no requirement of fuel. It's precisely due to the lack of fuel that makes solar applications relatively superior than conventional sources of energy as it does not cause pollution (global warming, acid rain, ozone depletion) or health hazards associated with pollution. There are four main types of solar water treatment: solar water disinfection (SODIS), solar distillation, solar water pasteurization, and solar water treatment systems. Some of these technologies have been around for a very long time, but most are new adaptations to the concept of solar energy. These technologies are quite simple and easy to understand, usually require low financial input, and are proven effective.

2. COMMON METHODS FOR SOLAR WATER PURIFICATION

2.1 SOLAR WATER DISINFECTION

Solar water disinfection is a low technology, simple process of purifying water using solar energy and solar radiation. SODIS as a technology was first introduced in 1980 by Aftim Acra et al. from the American University of Beirut. The process involves contaminated water being filled in transparent PET or glass bottles which are then exposed to the sun for approximately 6 hours. The UV rays of sun eliminate the diarrhoea-causing pathogens, thereby making the water fit for consumption.

2.2 Solar Water Distillation

Solar water distillation uses a solar still to condense pure water vapor and settle out harmful substances to make clean, pure drinking water. This process is used when the water is brackish containing harmful bacteria, or for settling out heavy metals and also for desalination of sea water.

2.3 Solar Water Pasteurization

Solar water pasteurization involves the use of moderate heat or radiation to kill disease - causing microbes. This heat is provided from cookers that trap solar energy. This method has proven to kill bacteria, viruses, worms and protozoa.

2.4 Solar Water Purification

This method integrates electricity generated from solar energy for water purification. Solar panels generate power for a battery which is used for filtration and purification systems .These structures are generally mobile and are immensely helpful for disaster - relief efforts. They also come in various sizes meant for small scale use to commercial/community supply.

3. LITERATURE RIEVEW

3.1 M. Gowtham et al. (2012) In this research work the performance of solar concentrated distiller with latent heat storage capacity is compared with solar concentrated distiller with trays on the basin. Paraffin wax is used as the latent heat storage material. Experiments are conducted for improving productivity and this is done by various factors like heat storage capacity, exposure area and maintaining low depth. Hourly Productivity of the concentrated solar distiller is obtained for experimental duration 9AM to 5AM water was measured every hour by maintaining low depth**.** Analysis was made between two types of basin. Sponges were added to increase the exposure area by capillarity effect. It is observed that due to the presence of sponges, the water output is increased to 40.83% in latent heat storage distiller and 19% increase in tray basin type, while comparing with the plain basin type. Overall productivity was improved by a maximum of 48% by using various modifications [1]**.**

3.2 Ozuomba J.O. et al. (2012) In this paper find a roof-type solar water distillation (RSWD) kit was fabricated and tested under actual environmental conditions of Urualla, an ancient town in the Eastern part of Nigeria. The system includes four major components; a rectangular wooden basin, an absorber surface, a glass roof and a condensate channel. The RSWD was able to generate 2.3m3 of distilled water within six days. Though the condensate was not large enough compared to human need as is peculiar to many solar stills, the efficiency can be enhanced by using large solar absorber surface and by any method that can increase radiant energy [2].

3.3 Caroline S.E. Sardella (2012) We analyze in this paper the production rate of distillate water is estimated to be between 100 and 590 l/d per berkad depending on the efficiency of the system. The water extracted from the drinking water tank is expected to be within the bacteriological and mineralogical advised quantities where no adverse health effects are observed. The distillate is expected to be partially re-mineralized during the mixing process with the harvested rain water. However, accurate monitoring and analysis of the water quality is advised during the pilot project. In this project using the water extracted from the drinking water tank is expected to be within the bacteriological and mineralogical advised quantities where no adverse health effects are observed. The distillate is expected to be partially re-mineralized during the mixing process with the harvested rain water. However, accurate monitoring and analysis of the water quality is advised during the pilot project low cost technology with low cost maintenance, it is possible to improve the quantity and quality of the available water [3].

3.4 Prof. Alpesh Mehta et al.(2011) In this paper we observed that the increase in temperature and hence the evaporation is maximum in the period of 11:15 am to 1:30 pm. The maximum temperature achieved is 53 ^{0}C which is at 1:30 pm. then the temperature decreases. This experiment was to get pure water from the brackish water available. The brackish water we have supplied was 14litres and at the end of the experiment we got 1.5litres. The experiment was carried out in winter season. The TDS level of purified water obtained is 81 PPM. So the water obtained is potable. Theoretically, the experiment should fetch out 2.33litres. So the efficiency of the system is 6% [4].

3.5 Aayush Kaushal et al. (2010) According to this there are many methods for desalination of brackish water in to potable water. Therefore, different types of solar stills are discussed for the production of pure water. A proper combination of cooling film parameters enhanced the still efficiency by 20%. In multi-effect diffusion model the productivity decreases about 15% with an increase in diffusion gaps between partitions from 5 mm to 10 mm. So for specific requirement there is a requirement to select solar still very
Continuously based upon the local condition and operating conditions [5].

3.6 K. Sampathkumar et al. (2010) In this paper we noted that, under developed countries and developing countries face a huge water scarcity because of unplanned mechanism and pollution created by manmade activities. Water purification without affecting the ecosystem is the need of the hour. In this context, many conventional and non-conventional techniques have been developed for purification of saline water. Among these, solar distillation proves to be both economical and eco-friendly technique particularly in rural areas. Many active distillation systems have been developed to overcome the problem of lower distillate output in passive solar stills. This article provides a study on active solar distillation system over the years [6].

3.7 John ward (2003) In this paper designed black plastic sheet covered by a white glass window. The plastic is formed into an array of interconnected square cells which contain impure water output. There are no filter, no electronics no moving parts and cleaning is rarely needed. This solar water purifier has been designed, made and tested successfully. It will readily convert impure water such as bore, sea, brackish, urine ,radioactive, arsenic contaminated, effluent etc into pure drinking water with a TDS content of 1-2ppm. Insolation values of about 1000 W/m result in output of about 9 l/m day at Adelaide, South Australia, Latitude 35 South. It is rugged, lightweight, portable and suitable for remote outback or third world countries [7].

4. MARKET SURVEY:

The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions conducive to its spread within the country. The immediate aim is to focus on setting up an environment for solar technology penetration in the country both at a centralized and decentralized level. According to this mission Solar power as a resource would find its greatest usage in decentralized and off-grid applications as grid penetration is neither feasible nor cost effective, solar energy applications are cost-effective. The key problem is to find the optimum financial strategy to pay for the high-end initial costs in these applications through appropriate Government support. Currently, market based and even micro-credit based schemes have achieved only limited penetration in this segment. The Mission would consider up to 30 per cent capital subsidy for promoting innovative applications of solar energy and would structure a non-distorting framework to support entrepreneurship, up-scaling and innovation. Also, to create a sustained interest within the banking community, the Mission proposed to provide a soft re-finance facility through Indian Renewable Energy Development Agency (IREDA) for which Government will provide budgetary support. IREDA would in turn provide refinance tNBFCs and banks with the condition that it is on-lend to the consumer at rates of interest not more than 5 per cent.

The general plan envisaged by the National Solar Mission for solar power application is as follows:

Serial Number	Application Segment	Target for phase I (2010-13)	Target for phase II (2013-17)	Target for phase III (2017-22)
1	Solar collectors	7 million sq meters	15 million sq meters	20 million sq meters
2	Off grid solar applications	200 MW	1000 MW	2000 MW
3	Utility grid power, including roof top	1,000-2000 MW	4000-10,000 MW	20000 MW

The Mission seeks to create a policy and regulatory environment which provides a predictable incentive structure that enables rapid and large-scale capital investment in solar energy applications besides encouraging technical innovation, thereby cost reduction. Solar water purification is another unexplored avenue of solar power application which could be considered under this Mission. As of now, solar water purification lacks market mechanisms to promote its growth and spread but if its application uses are considered, it would be a considerable venture for solar applications along with solar photo voltaic product

4.1 MANUFATURES/SUPPLIERS OF SOLAR WATER PURIFIER IN INDIA

S. NO.	MANUFACTURER / SUPPLIER	CONTACT DETAIL
1.	V S Saurya Enertech Private Limited	A - 28/20, DLF Phase 1 - Near Sikandarpur Metro Station Gurgaon - 122 002, Haryana, India
2.	N. G. Water Processors	A/11, Upper Floor, Shivam Complex, Opp. Agrawal Tower, Bhuyangdev Cross Road, Sola, Ghatlodiya, , Ahmedabad, Gujarat -380061, India
3.	El-Sol Energy Systems	A-1, Bhagwatnagar Society, Opp. Gulab Tower, Sola Road, , Ahmedabad, Gujarat -380061, India
4.	Next Generation Solar Solutions	156, Parsn Trade Plaza, No. 3, 3rd Floor, Nanjappa Road, , Coimbatore, Tamil Nadu - 641018, India
5.	Reliance Industries Limited	Rcp,Bldg No.5a 1st Floor Ws 192,Thane-Belapur Road,Navi Mumbai Maharashtra 400706 , Navi Mumbai, Maharashtra -400021, India
6.	Kotturs Renewable Energy Private Limited	105, Pete Chennappa Industrial Estate, Magadi Main Road, Kamakshipalya, , Bengaluru, Karnataka -560079, India
7.	Global Energy	Door No-336, Royal Complex, Bhut Khana Chowk, Dhebar Road, , Rajkot, Gujarat - 360003, India
8.	Unique Aqua Solutions	Jasmine Towers, 2nd Floor, Beside Icici Direct Bank Lane, Shivam Road, , Hyderabad, Andhra Pradesh -500039, India
9.	Kemflw Water Treatment Pvt. Ltd.	Wz-1198, Nangal Raya, Mini Market Near, Dda Block, Janak Puri, , New Delhi, Delhi -110046, India
10.	Orbit Technologies	Near- Civil Station, Wayanad Road, , Kozhikode, Kerala -673020, India

5. CONCLUSION:

The solar still are friendly to nature and eco-system. Various types and developments in active solar distillation systems, theoretical analysis and future scope for research were reviewed in detail. Based on the review and discussions, the annual yield is at its maximum when the condensing glass cover inclination is equal to the latitude of the place. The multistage solar desalination system with heat recovery system produces higher yield than the simple solar still. The length of solar still, depth of water in basin, inlet water temperature and solar radiation are the major parameters which affects the performance of the still. Higher productivity during night time is achieved by using energy storing materials in the active solar stills.

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