Investigation on Performance of Flate Solar Still by using Different Coating Material on Absorbing Plate: A Review

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Abstract - *Solar still is an apparatus which uses solar energy to produce distilled water from saline water. This can be used in remote areas effectively wherein electricity is not available. The output from a conventional solar still is found to not sufficient for the large family. Hence more research is required to increase the productivity of conventional solar still.so main objective of this project is to increase the productivity of solar still. The study was conducted to investigate the effect of different coating material on the absorber plate on the performance of solar still. Oxide of Aluminum, copper, etc used as a coating material in this study because of their high heat absorbing ability. Absorber plate of the thicknesses1 millimeter and 2 millimeters used which is suitable for the conduction of heat to the working fluid. A model was designed for the experiment to find out best coating material.*

Key Words: flat solar still, absorbing plates, oxide coating, performance analysis.

1. INTRODUCTION

The requirement of drinking water is a major challenge in South Asia, Africa and rural area where there is no availability of potable water for drinking and cooking purpose. This problem occurs due to release of chemicals into rivers, population growth, inefficiently used of water, climate change, the lake of investment to develop technology to draw potable water from the sea, etc.Clean water must need for leaving life and development.in During 21st century 5 million people die each year from diseases caused by unavailability of fresh water. Although water occupies approximately 70% of the world, only 3% of the water is available for all the activity like drinking, food production, in the industry for production and development.97%water contain salt and is not suitable for drinking. Means most of the water on the earth is brackish.so some water treatment is required to convert brackish into potable.

There are many methods for converting brackish water into potable water.

1.1 Method of converting brackish water into potable water.

- *Desalination.*
- *Vapor compression.*
- *Electro dialysis.*
- *Reverse osmosis effect.*

1.2 Desalination process.

Desalination is processed in which the saline water is evaporated using thermal energy and the Resulting steam is collected and condensed as a final product and collected in a channel located at bottom of solar still.

1.2.1 What is solar still?

Solar still is the oldest method of desalination of water. In this method, the radiation from the sun is passed through a glass cover and collected on black plate and heated it. The saline water is fed on a black plate of the basin of solar still. The heat is transfer from the black plate to water inside the basin and the water evaporated inside a closed chamber. Water vapor travel toward cooled inclined glass surface and clinged on it. As time pass this water vapor condensed on the glass surface and to form pure water droplets. This droplet sticks on this surface due to the effect of surface tension and collected in channels located at bottom of solar still by gravity effect. Whatever salt and other impurities remain at the base.

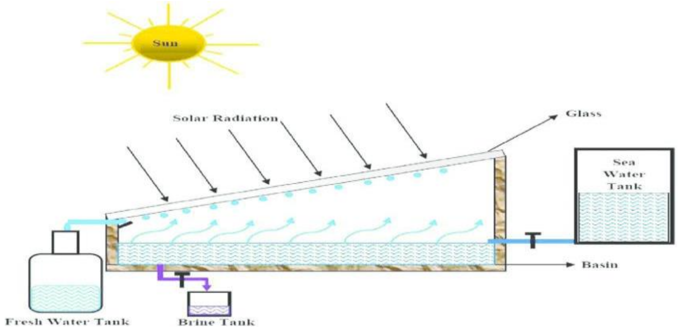

Figure 1: conventional solar still.

1.2.2 Types of solar still.

- *Single slope solar still.*
- *Double slope solar still.*
- *Pyramid type solar still.*
- *Step basin type solar still.*
- *Single basin solar still.*
- *Double basin sola still.*
- *Tubular solar still.*

2. FACTORS INFLUENCE ON PERFORMANCE OF SOLAR STILL

- The solar intensity and ambient temperature.
- Wind velocity.
- Water depth.
- The thickness of the glass cover.
- Glass cover angle.
- Heat absorber material or heat storage material.

3. COATING ON PLATES.

3.1 What is a selective coating?

The efficiency of solar still increases in two ways.

- A high Absorptivity rate, meaning the maximum amount of solar radiation transformed into heat and this heat is transfer to saline water.
- A low emissivity rate, meaning the minimum amount of heat loss by heat emission.

Losses due to heat emission are minimized by using highly efficient absorbers are provided with selective coatings. Such coatings make it possible to absorb and transform a large part of the short-wave Solar Radiation into heat, and, simultaneously, to reduce the losses of long wave radiation emitted from the absorber itself.

3.2 Types of coating on the plate.

3.2.1 PVD coating.

PVD coating is a vacuum coating process in which first the material is vaporized and then after deposited on the selected object as a thin layer. If we required the oxide, nitride or carbide coating then reactive gas like oxygen, nitrogen introduced which chemically react with metallic vapor to produce oxide or carbide coating.

•The advantage of the PVD coating.

1 high durability.

2 resistances to wear.

3 corrosion resistance and environmentally friendly.

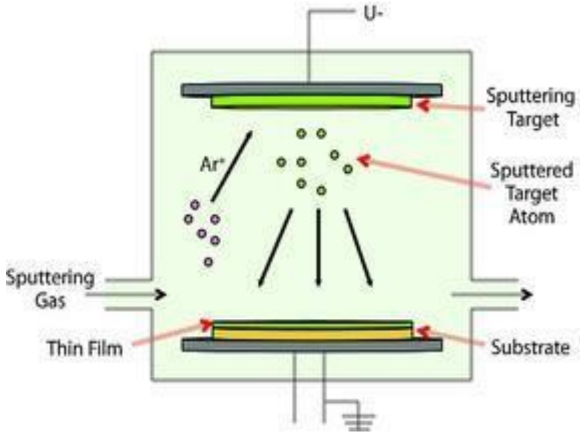

Figure 2: PVD coating.

3.2.2 Plasma sprays coating.

In Plasma Spray Process the powder form of material is introduced into the high-temperature plasma flame, which vaporized it and accelerated toward the work piece and then rapidly condenses on it and forming a coating.

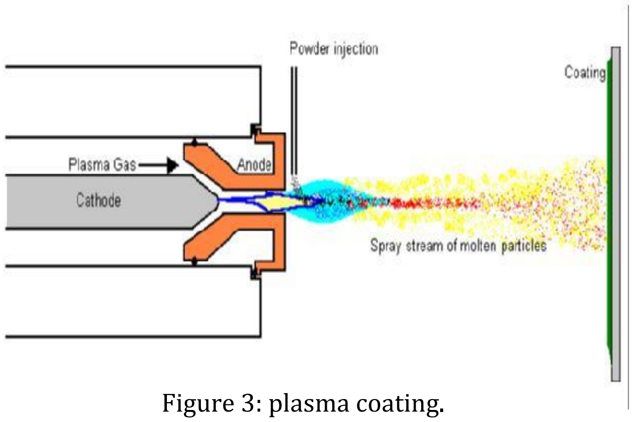

Figure 3: plasma coating.

•The advantage of plasma spray coating.

1 spray very high melting point materials such as refractory metals like tungsten and ceramics.

2 much denser, stronger and cleaner than the other coating.

3 produced a high-quality coating.

3.2.3 Colors painting on plats.

In this type coating, the different type of color is used as paint on absorbing plate. Absorbing capacity of a different color has different which given below.

Table -1: absorbance of different colors.

NO	MATERIAL COLORS	ABSORBANCE (α)
1	Flat black	0.98
2	Black tar	0.93
3	Grey paint	0.75
4	Red brick	0.55
5	Green paint	0.50
6	White enamel	0.35
7	White paint	0.07

4. LITERATURE REVIEW

P. Konttinen, P.D. Lund(2009)conducted a series of accelerated aging tests in order to determine the service life of mechanically manufactured selective C/Al2O3/Al absorber samples. These tests were mainly conducted under IEA SHC recommendations. The main degradation mechanism is found to be hydration of aluminum oxide to pseudoboehmite and boehmite, caused a decrease in service life of mechanically manufacturing coating C/Al2O3/Al.Aging test typically conducted under three different conditions: high temperatures and low humidity, service temperatures and high-humidity air containing Sulphur dioxide. And service temperatures under condensation conditions.

Manoj Kumar Sain, Godhraj Kumawat(2015)had an experiment to improve the productivity of solar still using Nano-particles because these particles increase the surface area of absorption to solar radiation. In this work, the Al2O3 used as nanoparticles and mixed with black paint is used to increase the productivity of solar still. This Experimental is performed for the single slope solar still under climatic conditions of Jaipur to check the significance of the difference in productivity of solar still with and without Nano-particle mixed black paint. The productivity enhancement due to Nano-particle mixed black paint is significant at 95% confidence interval.

V Ramanathan, B Kanimozhi, V K Bhojwani(2017) had to work on how to increase the productivity of solar still. A flat mica plate is used as an absorbing plate in the conventional solar still to increase evaporation of the water from the input saline water. The flat plate absorber is placed in such a way that it is parallel to the glass cover of the solar still so as to maximize the absorption of solar radiations. By this modification, the maximum temperature of the absorber plate achieved was 95oC in comparison to 67oC of the conventional solar still and distillate output increased by 25% with a flat plate absorber compared to conventional still.

L.Cindrella(2007)have recommended the real utility ranges of the solar selective coatings regard to temperature and the type of installations of solar still. This study brings out the impact of the different combinations of the optical parameters of the selective coatings on the efficiency of solar thermal systems with various concentration ratios (CRs). Composite selective black coatings of cobalt– cadmium, and nickel–cadmium systems developed by us earlier have been analyzed in the present study.

Hemin Thakkar, Dr. Hitesh PancShal(2017) Has investigation on solar still Integrated with Nano-composites with and without the use of paraffin wax as a Phase change material. For the comparison of performance, three identical 1 square meter area solar stills have used. The first solar still is without Nano- composites and PCM, second with only Nano-composites and third integrated with Nano composites and PCM. Aluminum oxide is used as Nano-composites and coated on the surface of the Absorber plate. It has found that solar still integrated Nano-composites and phase change material found 92% more productive compared with alone solar still and only Nano-composites integrated solar still is 106 % more productive compared with alone solar still.

Teresa C. Diamantino, Rita Gonçalves, Ana Nunes, SoraiaPáscoa, M. JoãoCarvalho(2017) Objectives of this study was to investigate the degradation and durability of aluminum absorber surfaces with different PVDs and paints coatings (PCs) in outdoor exposure testing sites with different atmospheric corrosively, it was possible to conclude that OET sites, namely in places with high corrosively as in marine and/or industrial areas. During one year of outdoor exposure, it was possible to establish a ranking of the performance of anticorrosive protection of the coatings where PCs showed much higher anticorrosive protection than a PVDs(PVD2<PVD1<<PC1≅PC2<PC3).

M. Farooqa, M.G. Hutchinsb(2002) They describes the development of multilayer metal-dielectric graded index solar selective coatings in which the metallic volume fraction increases with depth, from the top(air-film interface) to bottom (film–substrate interface).On examination of multi-layer structures, it is found that multi-layer composites improve the solar absorptance due to destructive interference effects within the coating. Among the designs worked out for selective absorbers, it is perceived through calculations and experimental findings that a four-layer modified selective absorber design (4-PGSAC) gives the best efficiency among all the studied selective coatings.

5. CONCLUSIONS

•The productivity of solar still enhancement by using Nano-particle mixed black paint is up to 95% confidence interval.

• During one year of outdoor exposure test showed that PCs much higher anticorrosive protection than PVDs (PC3 > PC1≅PC2 >> PVD1 > PVD2).

• solar still integrated Nano-composites with PCM found 92% more productive compared with alone solar still and only Nano-composites integrated solar still is 106 % more productive compared with alone solar still.

• If the flat plate absorber is placed in such a way that it is parallel to the glass cover of the solar still then distillate output increased by 25% compared to conventional still.

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