iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3196

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Sea Water Distillation and Steam Power Generation

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Abstract: ***The origin and continuation of mankind is based on water & electricity. Water is one of the most abundant resources on earth, covering three-fourths of the planet's surface. However, the small percentage of the earth's water which supplies most of human and animal needs exists in ground water, lakes and rivers. T***
The seawater desalination is the process of separation of salts from seawater. Humans cannot drink saline water. But, saline water can be made into freshwater. But, fresh water can be in short supply in some parts of the country. As the problem of population is continues to grow, the problem of shortages of fresh water will occur more often, if only in certain locations. In this study, water is converted into a steam by using Thermal energy. When water is converted into steam which is produced under high temperature, impacts on the blades of steam turbines which results generation of electricity. The distillation of seawater is obtained by utilizing a thermal energy source. Water is heated and producing steam that moves forward & condenses in surface condenser to form distilled water. In this study, we have collected the sample as a sea water from 'Purngadh beach' (Dist. Ratnagiri, Maharashtra). After that, all process is done as per methodology & then various tests are conducted on distilled water as pH test, alkalinity test, chloride content test, hardness test & dissolved oxygen test on sample in laboratory. It was found that, distilled water is suitable for the various purposes such as drinking purpose as well as irrigation purpose

Keywords: sea water, distilled water, steam turbine, thermal energy, distillation, etc

I. INTRODUCTION

The scarcity of fresh water resources and the need for additional water supplies is already critical in many arid regions of the world and will be increasingly important in the future. Many arid areas simply do not have fresh water resources in the form of surface water such as rivers and lakes. They may have only limited underground water resources, some that are becoming more brackish as extraction of water from the aquifers continues.
A few of the negative results of this water crisis are:

A. Inadequate access to water for sanitation and waste disposal.
B. Groundwater over drafting (excessive use) leading to diminished agricultural yields.
C. Overuse and pollution of the available water resources harming biodiversity.
D. Regional conflicts over scarce water resources.

There is a severe lack of fresh water in the world today. Along with the deterioration of existing water supplies, the growing world population leads to the assumption that two thirds of the population will lack sufficient fresh water by the year 2025. In view of these facts, desalination seems to be the only realistic hope for a new source for fresh water. Desalination is most important and traditional process to get the potable water.
Day to day the demand of fresh and potable water is increased, so that desalination is important and gained more attention. In conventional process desalination for heating process fuel is used as the thermal source but the due to rapid decrease in the fuel storage it is necessary to go with the renewable energy for the desalination process. Traditionally fuel is used which emits the pollutants after burning and it is harmful to environment and human being also. In this project an important technology is used to tackle this problem is desalination for making fresh drinking water from saline seawater and suitability is checked for the used of various purposes of distilled water which obtained by distillation process of sea water

II. DESIGN PARAMETERS OF STEAM TURBINE

The various design parameters of steam turbine are as follows

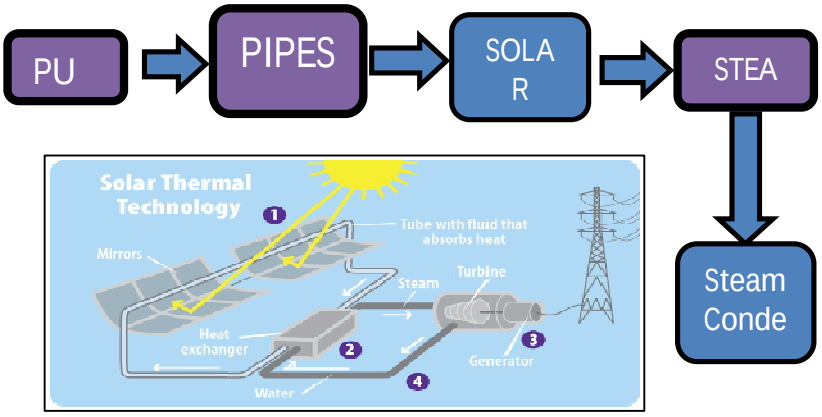


Fig.2.1- Design parameters of steam turbine

A. PUMP

A pump is a device that moves fluids, slurry by mechanical action. Here, there are various applications mentioned below:

1) Clean ,Turbid or slightly contaminated liquids.
2) Medium to Low heads and High discharge in water works, sewage works.
3) Irrigation and drainage
4) Dewatering and pumping sea wate
5) Spray Pond / Injection Water applications in Sugar mills.

B. Steam turbine

As its name suggests, a steam turbine is powered by the energy in hot, gaseous steam and works like a cross between a wind turbine and a water turbine. Like a wind turbine, it has spinning blades that turn when steam blows past them; like a water turbine, the blades fit snugly inside a sealed outer container so the steam is constrained and forced past them at speed. Steam turbines use high-pressure steam to turn electricity generators at incredibly high speeds, so they rotate much faster than either wind or water turbines. Just like in a steam engine, the steam expands and cools as it flows past a steam turbines blades, giving up as much as possible of the energy it originally contained. But, unlike in a steam engine, the flow of the steam turns the blades continually: there's no push-pull action or waiting for a piston to return to position in the cylinder because steam is pushing the blades around all the time. A steam turbine is also much more compact than a steam engine.

C. Solar Dishes

Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect. The two main components of Solar Dish are :

1) *Concentrator:* This element of solar dish tracks the path of sun. It is a reflective surface and made from metalized plastic or glass. Its size depends upon the capacity of the engine. Usually, silver or aluminum coating is used above the metalized plastic or glass base. Attempts are being made for developing thin polymer film to reduce the cost of production.
2) *Receiver:* The energy reflected by the concentrator is absorbed by the receiver and then directed to the engine fluid. The absorber is placed exactly behind the concentrator's focal point where an aperture is provided that can reduce radiation (from the absorber) and protect the loss of heat energy through convection. Generally, well insulated liquid metal pipes (mostly sodium) are used as receivers to protect heat loss.

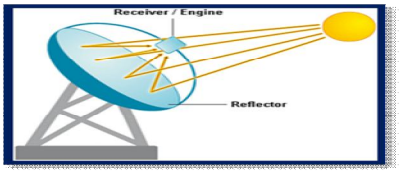


Fig.4.3- Solar dish

D. Condenser

Condensers are devices which accept a vapor stream and convert it to a liquid using heat transfer and/or compression. A condenser may refer to a heat exchanger used specifically for cooling gases and process fluids below their boiling points. However, condensing units (such as those in air conditioners) are used in systems which cool the outside environment. These systems may include a compressor, an evaporator, fans, and other components in addition to a heat exchanger (condenser) section. Condenser units are typically components of larger systems used to cool an environment through the evaporation and condensation of a fluid. In these systems, a cool fluid (typically a refrigerant) enters into a compressor which raises its temperature through compression. It then enters the condenser section which removes heat to the outside environment, converting it to a liquid. After uncondensed particles are removed in a drier or collector, the fluid enters an expansion joint which relieves pressure and cools it down. Finally, the fluid enters an evaporator which collects heat from the target environment (area being cooled) to evaporate the fluid and send it back to the compressor as a gas.

III. OBJECTIVES & METHODOLOGY

The aim of present project is to obtain distilled water from sea water and to check suitability of sea water for various purposes such as drinking, irrigation etc. This project work is explained with the help of following points:

1) To study various properties of sea water.
2) To develop a model of steam turbine.
3) To check generation of electricity from sea water distillation process.
4) To obtain distilled water by eliminating salts from sea water.
5) To check suitability of distilled water for various purposes .

A. Methodology

Here, the activities which are taken grouped to prepare the detailed project report,

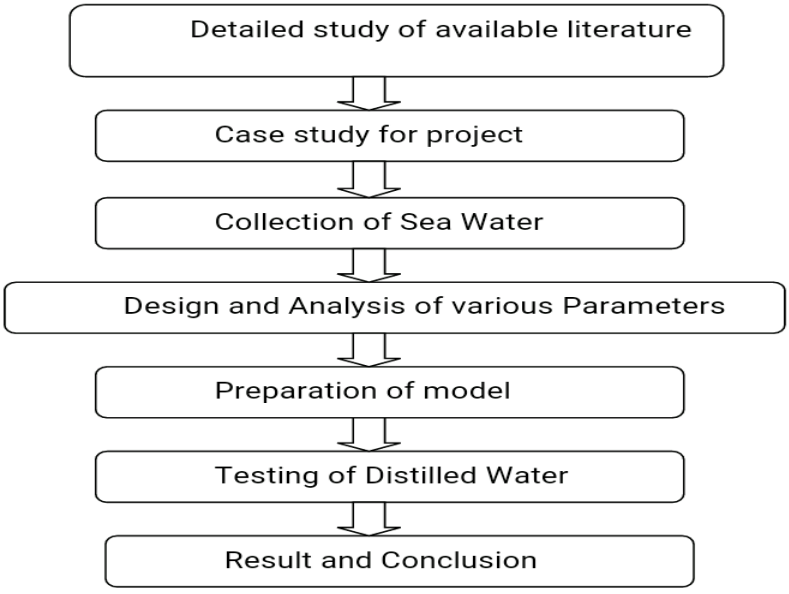


Fig.3.1- Flow Chart of Methodology

IV. CASE STUDY

A. Datta Sugar Factory

1) Location = Datta Sugar Factory Urjankur Plant, Shirol
2) Tal=Shirol, Dist=Kolhapur
3) Capacity of Electricity Generation of Plant= 36 mega watt
4) Boiler Pressure of Plant = 104 kg/Cu.m
5) Boiler Temperature = 540 c
6) Steam Turbine Rotation = 6500 rpm

Fig.4.1 steam turbine at factory

B. Shirdi Solar Cooking System

1) Speciality of project : Worlds largest solar cooking system
2) Cost of project : 1.33crore
3) Financial aid : 58.40lakhs
4) Project comp. period : 150 days
5) Area of project : 2500sq.m
6) Total solar dishes : 73 dishes
7) Area of dish : 16sq.m
8) Energy create by 1 dish : 37840kcal
9) Total energy created by all dishes : 2762320kcal
10) Steam generation capacity per day : 3500kg per day

Fig.4.2 solar cooking system

V. DESIGN AND ANALYSIS

A. Pump Design

Discharge (Q) = Mass/Density
Q = 31.49 / 4.16 . . . . . .(ρ = 4.16 given in table)
Q = 7.56 say 8 m^3/sec
By considering some frictional losses is 20%
Q = 8× 1.2 = 9.6 m^3/sec
Assume pump size = 500mm . . . . . By considering market survey

Assume Head = 4m

Power of Pump (wHP)

wHP = Q×H / 3960 . . . . . .

(1gpm = 0.000063 m^3/ sec)

(1KW = 1.34 HP)

Total discharge (Q) = 9.6 m^3 / sec

We provide 6 No. of Pumps

(Q) of each pump = 1.6 m^3 / sec. . . . . .1 gpm = 0.000063 m^3 / sec

Q = 25396 gpm

wHP = Q × H / 3960

= 25396 × 4 / 3960

wHP = 25.65 KW. . . . . .1KW = 1.34 HP

wHP = 34 HP

Hence We provide 50 HP Pumps

No. of Pumps required

We assume pipes provided in parallel, So that for each pipe one pump is required

No. of Pumps = 6 Nos

B. Design of velocity of pipe

Discharge (Q) = 8m^3 / sec

Assume,

Frictional losses = 20%

Total Discharge (Q) = 8×1.2 = 9.6 m^3/sec

Assume,

6 No. of pipes in parallel form

Diameter of pipe = 0.5 m

Discharge for per pipe = 1.6 m^3/s

Calculation of Velocity (V) :

Discharge (Q) = Area (A) × Velocity (V)

$1.6 = \pi/4 \times d^2 \times V$

$1.6 = \pi/4 \times 0.5^2 \times V$

V = 8.14 m/ sec

C. Design Of Steam Flow Rate

Given,

Electricity power required(wt)= 10 Mw

(cp)= 2.4951 kJ/kgk

T1 & T2 are taken for our case study of Steam power generation, plan at Shirdi.

T1= (Inlet Temp.)= 170^{o}c

T2= (Outlet Temp.)= 30^{o}c

Assume,

Efficiency (ή)= 90%

The efficiency is assume from referring 'Dr. R. K. Bansal Book

Calculations:

ή = Generator power / Shaft Power

o.9= 10 / shaft power

Shaft power = 11 MW

calculation of mass flow rate

WT= m. cp (T1-T2)

$11 \times 10^6 = m(2.4951) \times 10^3 \times (170-30)$

$11\times10^6 = m(2.4951)\times10^3\times(140)$
$11\times10^6 = m(349.314\times10^3$
$m = 11\times10^3 / 349.314\times10^3$
$m = 31.49 kg/sec$
Mass flow rate (m)= 31.49kg/sec

D. Design of shaft

1) Calculation of Force:

Force (F) = mass × Velocity
= 31.49 × 8.14
= 256.32 KN

2) Specific Speed (Ns) :

Ns = 885.5 / Hd·²5
Ns = 626 rpm

3) Speed (N) :

N = Ns. Hd©¹·²5 / √ Pt
N = 1067 rpm

E. Design of Torque :

Assume dia. Of shaft = 3.5m … by considering koyana hydroelectric power plant
T = F x perpendicular distance
T = F x D/2
Hence T = 256.32 x 3.5 /2
T = 448.56 KN.M

F. Sample collection

Fig.5.1- Sample collection

1) Location : Purngad beach (Ratnagiri dist.)
2) Sea : Arabian Sea
3) Quantity of sample 1.5 litre

G. Sea Water Distillation Process

In this project, sea water is distilled by thermal energy. First of all stove is used for generation the heat. Then water is filled into pressure cooker for generation the steam. Then the pipe is connected to pressure cooker for transforming the steam. The other end of pipe is connected to assembly which contains turbine of aluminum sheet. By using steam which is produced under high temperature, impacts on the blades of steam turbines which results generation of electricity. For condensation process ice is used to get water vapors, finally distilled water is obtained.

Fig.5.2- Working Model Condensation

Fig.5.3- Steam Generation

Fig.5.4- Preparation Of Distilled Water

H. Tests Required for sea Water And Distilled Water

1) *pH test* - pH indicates the sample's acidity but is actually a measurement of the potential activity of hydrogen ions (H+) in the sample. (Range – 6.5 – 8.5)
2) *Alkalinity* – It is the primary way of measuring the acid neutralizing capacity of water. (Range – Max. 200 mg/lit.)
3) *Chloride Content* - The measured chloride ions can be used to know salinity of different water sources. For brackish water (or sea water or industrial brine solution). (Range – Max. 250 mg/lit)
4) *Hardness* - Hardness is defined as calcium and magnesium ion content. Water hardness is usually noticed because of difficulty in lathering soap and the formation of a scum in the bathtub. (Range – Max. 300 mg/lit)
5) *Dissolved Oxygen* - It is necessary for the survival of fish, invertebrates, bacteria, and underwater plants. DO is also needed for the decomposition of organic matter. (Range – more than 5 mg/lit)

VI. RESULTS & DISCUSSION

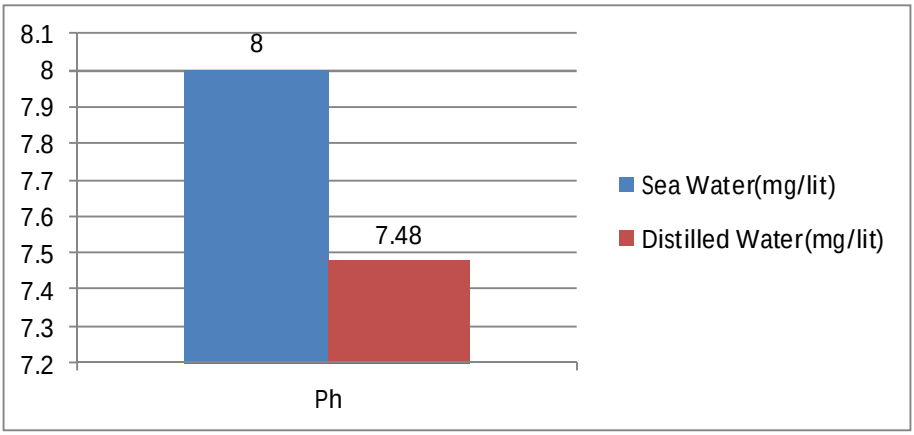
The comparison of tests were conducted on sea water and distilled water as shown below. In pH test, distilled water reading was 7.48 whose range is in between 6.5 to 7.5 which is in desirable limits. Then, In Alkalinity test, reading of distilled water was 64mg/lit whose desirable limit is 200mg/lit. After that, In Chloride Content test reading for distilled water was 44.02mg/lit whose permissible limit is 250mg/lit. In Hardness test, reading of distilled water was 176 mg/lit whose desirable limit is 300mg/lit. At last, Dissolved Oxygen test was carried out in which, reading of distilled water was 8.89mg/lit whose desirable limit is in the range of 8-11mg/lit .

Table no- 6.1 Comparison between sea water and distilled water

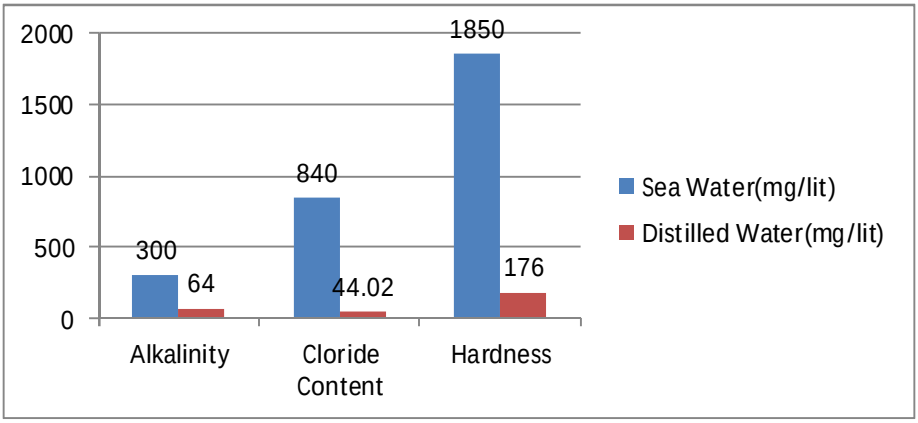
Tests	Sea water ranges	Sea water reading	Distilled water ranges	Distilled water reading
pH	7.8 to 8.4	8	6.5 to 8.5	7.48
Alkalinity	100-500 mg/lit	300 mg/lit	200 mg/lit	64 mg/lit
Chloride Content	1000mg/ lit	840 mg/ lit	250 mg/ lit	44.02 mg/lit
Hardness	1500-3000 mg/ lit	1850 mg/lit	300 mg/lit	176 mg/ lit
Dissolved Oxygen	10- 15 mg/lit	13 mg/lit	8 – 11 mg/lit	8.89 g/lit

A. Graphical Presentation Of Comparison Of Sea Water And

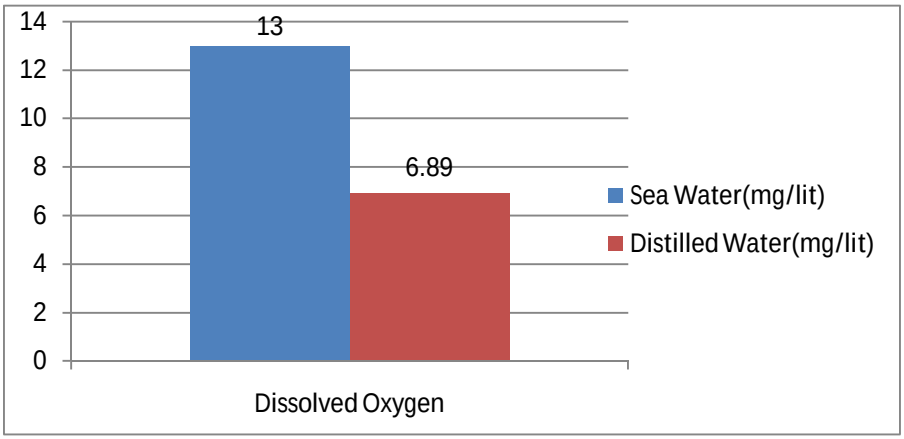
1) Distilled Water Results: By preparing the comparative graphs we are able to know the actually comparison between results of sea water and distilled water by means various properties such as pH, Alkalinity, Hardness, Chlorine Content, Dissolved Oxygen etc. These comparison between seawater and distilled water are shown as below:



Graph no.- 6.1 Comparison of pH between sea water and distilled water



Graph no.- 6.2 Comparison Of Alkalinity, Cloride Content And Hardness between Sea water and Distilled water



Graph no.- 6.3 Comparison of Dissolved Oxygen between sea water and distilled water

VII. CONCLUSION

According to the discussion of results the following conclusions are derived by this study:

All over the world, access to portable water to the people are narrowing down day by day. From this project it is found that for distillation of sea water is done by Thermal energy. It is simple method to get fresh distilled water from sea water which is used for various applications in domestic and industrial sectors. It generates the temperature near about 100 to 3000C. Due to which water get heated and it is converted into steam. The mass flow rate of steam is 31.49kg/ sec. and the discharge of water through the pipe is 9.6 m3/sec. For that, centrifugal pumps are more suitable.

Achieving the electricity demand, the steam turbine is used to generate the electricity. The steam which is generated under high temp that steam is highly compacted on blades of steam turbine due to which it rotates and it generates the electricity. The force of steam is required for rotating the blade is 256.32KN. The speed of shaft is 1067rpm. For generating the distilled water from steam, the condensers are used. For that condensation process surface condensers are used. After that various tests are taken as pH is 7.48 , Alkalinity is 64mg/lit, Chloride content is 44.02mg/lit, Hardness is 176mg/lit & Dissolved oxygen content is 6.76mg/lit which all are within permissible limits as required.

According to the discussion of results, following conclusions are derived by this project are :

Electricity generated from steam turbine.

Water is distilled due to thermal energy.

Distilled water is suitable for domestic purpose and irrigation purpose

The world's water and electricity needs are increasingly dramatically. For that achieving the electricity demand and distilled water demand is fulfilled by Thermal energy methods.

V. ACKNOWLEDGEMENT

The author thankfully acknowledge to Asst. Prof. A.S. Manjarekar, Asst. Prof. K.S.Sutar, Dr.N.K.Patil (HOD), Sanjay Ghodawat Institute, Atigre, Kolhapur, Maharashtra.

REFERENCES

[1] A. Sudheer Reddy, MD. Imran Ahmed, T. Sharath Kumar " Analysis Of Steam Turbines". International Referred Journal Of Engineering & Science(IRJES), Volume 3, 2Feb 2014.

[2] Akash Deep Kushwaha, Aakash Soni, Lovelesh Garewal "Critical Review paper of Steam Turbine Blades Corrosion and its Solutions", International Journal Of Scientific Research Engineering & Technologies (IJSRET), ISSN , 2278-0882 Volume 3, 4 July 2014.

[3] Ali M.El -Nashar "Multiple Effect Desalination Of Sea Water Using Solar Energy " International Center For Water & Energy System, ABu Dhabi, United Arab Emirates.

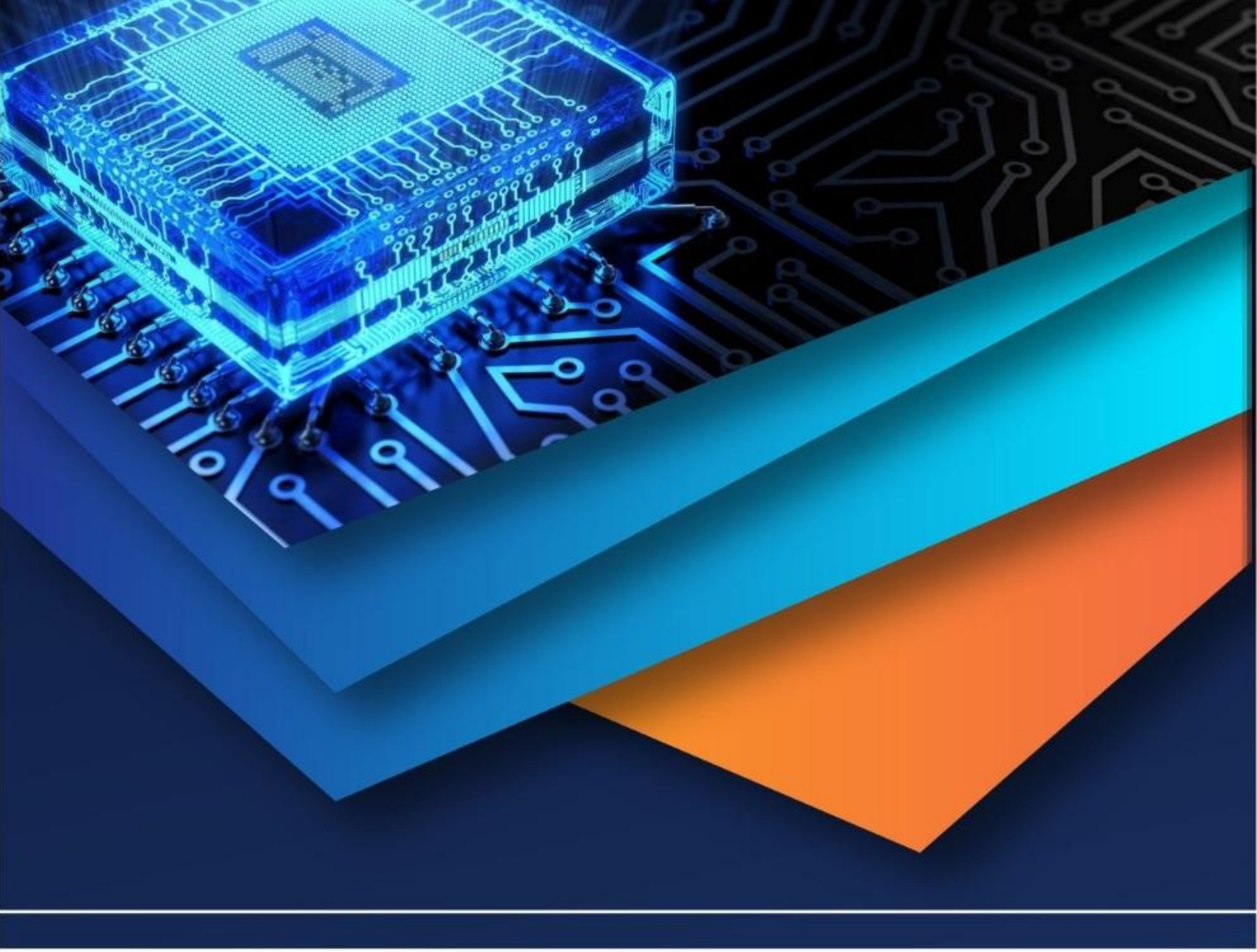
[4] Borouni K., et al. "Water desalination by humidification and dehumidification of air: state of the art", Desalination 2001:137, pp. 167-176.

[5] Deepak Devasagayam, "Solar Energy Based Purification Of Sea Water - A Detailed Review" International Research Journal Of Engineering & Technology (IRJET), Volume 2, 7 Oct 2015.

[6] Henrik Weihe, " Fresh Water from Sea Water: Distilling by Solar Energy", Solar Energy, 1972, Vol. 13, pp. 439-444. Pergamon Press. Printed in Great Britain, 20Aug 1969.

[7] Hugo Neising, " Solar Energy : Desalinating Sea Water Into Fresh Water " Co-operative Research Projects for SMEs - Volume 3 ,2005.

[8] Jenny Lindblom “Solar Thermal Technologies For Sea Water Disalination : State Of Art ” Renewable Energy Systems , Lulea Univercity Of Technology, SE-97187 Lulea, Sweden.
[9] Jinsong Tao, Huanbin Liu, Jigeng Li, Yongjun Yin, Yanming Zhou and Jingjia Jia "Optimization Analysis Of Multiple Steam & Condensers In Paper Mill Power Plant", International Conference on Renewable Energies & Power Quality (ICREPQ), Grnada (Spain), 25th March 2010.
[10] Kukulka D. J, Smith R . and Niu Z, "Comparison of the evaporation and condensation heat transfer coefficients on the outside of smooth, micro fin and vipertex 1eht enhanced heat transfer tubes", 11th International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics, 2015.
[11] Pocaterra, J.E. et al. "Design and experimental solar desalination plant to supply potable water to remote areas of the Venezuelan peninsula de la Guajira", Proceedings at the ISES Solar World Congress 2003, Gothenburg.
[12] Soteris A. Kalogirou “Seawater desalination using renewable energy sources”, Department of Mechanical Engineering, Higher Technical Institute, P.O. Box 20423, Nicosia 2152, Cyprus, Received 7 July 2004; accepted.
[13] Sumit M Kamble, A. D. Pitale, “A Review on Solar Powered Desalination Systems”, International Research Journal Of



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