International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

# To Design and Fabricate a Working Model of Ammonium Hydroxide Power Plant

**Mr. Shubham Sarkar[1], Mr. A.Vishwanatham[2],**

**Mr. Hariom Sachan[3], Mr. Sushil Kumar Sharma[4]**

*[1,2,3] B.E. Student (Mechanical Engg.) & D.I.M.A.T, Raipur, C.G, India.*

*[4]Asst. Prof.Mech. Engg. Dept, & D.I.M.A.T, Raipur, C.G, India.*

---

**Abstract** – *Ammonium hydroxide power plant is a power generation concept in this the water of the higher level is heated, by the help of a solar water heater and then transferred to the boiler or heat exchanger as shown in the figure(1). The working fluid used in this type of power plant should have low boiling point, mild poisonous and less flammable than ammonia. So that ammonium hydroxide is used as the working fluid in this system. In this system the cycle is a used is Rankin cycle similarly which are used in the present conventional steam power plant. In this system or power plant a boiler, pump, primary and secondary condenser, turbine is a used. It is a founded as that after numerically analysis of the system the overall efficiency of this system is relevantly better than the otec system. In this numerical analysis the Rankin cycle efficiency was found to be 47.75% while the Carnot cycle efficiency was 75%.*

***Key Words***: **Cooling cycle, Heating cycle, Primary heat exchanger, Secondary heat exchanger**.

## 1. INTRODUCTION

Ammonium hydroxide power plants are a renewable source of energy and not emit any carbon to the environment. It is derived from (OTEC) ocean thermal energy conversion power plant. The power cycle of ammonium hydroxide power plant turn into heat engine. In this power cycle ammonium hydroxide is used as a working fluid which has very low boiling point of ($37^0$c). The idea used in the cycle is very simple. solar water heater's water is used as a heating source which is enough to boil the working fluid ammonium hydroxide, on the other hand cold water relatively lower than the boiling point of ammonium hydroxide is enough to condense the working fluid(steam) and help's to ammonium hydroxide gases to turn into liquid state. In this method the working fluid will operate in a closed cycle. The steam come from the low –pressure boiling system is enough to power a low-pressure turbine which produces work. The low temperature water ($15^0$c) is enough to condense the steam. In this system efficiency power of the cycle is examined. Ammonium hydroxide power plant uses ammonium hydroxide, a dilute solution of Ammonia with water the percentage of ammonia is 26%. The ammonium power plant works in closed cycle as similar OTEC system which uses ammonia as a working fluid ,But due to toxicity of ammonia, the dilute ammonia is used in ammonium hydroxide Power plant i.e. ammonium which is less toxic and flammable as compare to Ammonia. Due to dilute form of ammonia the boiling temperature also increase $37^0$C. So that in an ammonium hydroxide power plant a solar heater is used as a heat source and cause a thermodynamics cycle of a heat engine occur a closed Rankin cycle. Ammonium hydroxide power plant consist a condenser filled with cold water.

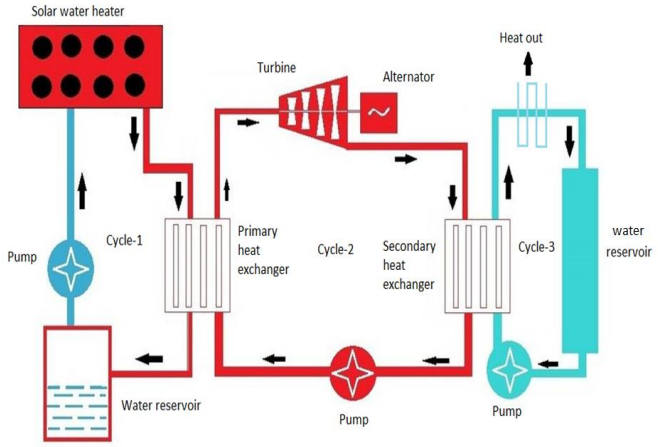


**Fig-1**: Ammonium hydroxide power plant

### 1.1 Primary Heat Exchanger

It consist a solar water heater which absorbs radiation emitted from the sum and increases the temperature of water, this high temperature water then transferred to the primary heat exchanger to give the latent heat of water to the working fluid ammonium hydroxide.

### 1.2 Secondary Condenser

It consist cold water relatively lower than the boiling temperature of ammonium hydroxide. In secondary heat exchanger the working fluid gives it's latent heat to the water ,this action increase the temperature of water which further cooled by the help of some arrangements as shown in the figure. The water is sprinkled on the surface of the narrow tubes to decrease the temperature of water and further transferred to the reservoir. The schematic diagram of

the cycle is shown in figure. This system is enough to condenser the working fluid. The data from the working model of ammonium hydroxide power plant is taken and the efficiency is examined.

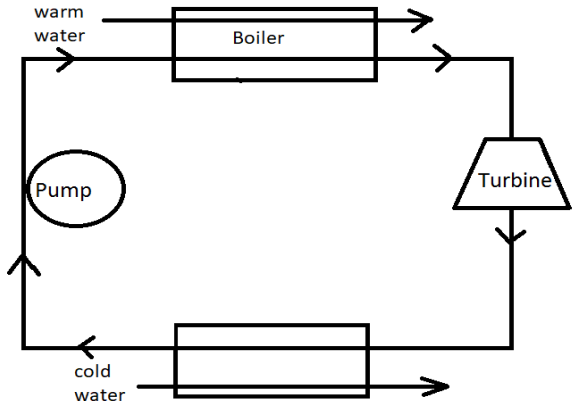


**Fig- 2**: Schematic diagram of A.H. power plant

## 2. CALCULATION

For analysis there were some equation are needed of Ammonium hydroxide power plant. Steam table of ammonium hydroxide is needed or will be used to find out value of the system at different point. The analyzed numerical value are showed in detail below in the table 1 and 2 below. The figure shown below represent the T-S diagram of the cycle. By the help of which, the whole calculation is to be done.

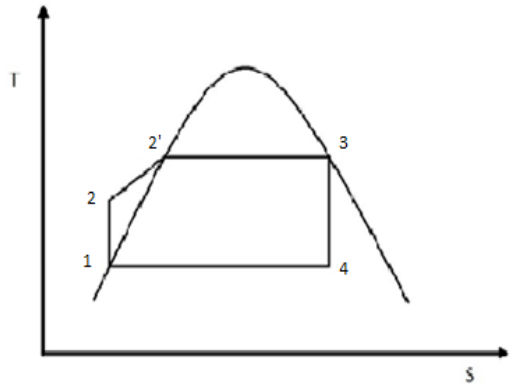


**Chart-1**: Temperature vs. Entropy Diagram

**Table -1:**Value of enthalpy for ammonium hydroxide from source table at different temperature.

| S.NO. | Value of enthalpy |
|---|---|
| 1 | H1= 1515.4472 KJ/KG |
| 2 | H2= 1560.6786 KJ/KG |
| 3 | H3= 1615.00 KJ/KG |
| 4 | H4= 1588.1588 KJ/KG |

TURBINE WORK (Wt)

Wt = (h3-h4)

= (1615-1588.1588)

Wt=26.48 KJ/KG

PUMP WORK= (Wp)

$$Wp = \int v.dp$$

=v(p2-p1)

=0.0018(276.6-227)

Wp=0.9 KJ/KG

For pump work referenced above:
p1=Pressure at the condenser.
p2=Pressure at the boiler.

Qh= (h3-h2)

Qh= (1615-1560.6786)

Qh= 54.3214 KJ/KG

QL= (h4-h1)

QL= (1588.1588-1515.4472)

QL= 72.7116 KJ/KG

Net work done will be= (Wnet)

Wnet= (Wt-Wp)

Wnet= (26.84-0.9)

Rankin cycle efficiency=Rankin efficiency (£r)

$$£r = \frac{Wt-Wp}{Qh}$$

$$£r = \frac{26.84-0.9}{54.3214}$$

£r=0.4775

Rankin efficiency(£r)=47.75%

Carnot cycle efficiency=Efficiency of Carnot cycle (£c)

$$£c = \frac{Th-Tc}{Th}$$

$$£c = \frac{60-15}{60}$$

$$£c = 0.75$$

Carnot efficiency=75%

## RESULT

In ammonium hydroxide power the values (pressure and temperature) obtained during the operation is numerically analyzed and the result obtained is shown below, in this analysis the Rankine cycle efficiency, Carnot cycle efficiency, net work done, pump work and turbine work of the cycle has analyzed.

On the basis of present analysis, following results are as follows:

1) Rankine efficiency is found to be= 47.75%
2) Carnot efficiency is found to be=75%
3) The net work done obtained is =25.94.
4) Obtained pump work is= 0.9 kj/kg
5) Obtained turbine work is =26.14KJ/KG

**Table-2**:Result of analyzed values.

| | |
|---|---|
| Wnet | 25.94 KJ/KG |
| Wpump | 0.9 KJ/KG |
| Wturbine | 26.14 KJ/KG |
| £thermal | 47.75% |
| Zcarnot | 75% |

## 3. CONCLUSIONS

Ammonium hydroxide power plant is a renewable source of energy and better then OTEC power source. In this the prototype of whole the plant is constructed and analyzed the result obtained was found better as compare to OTEC power plant. In this system there is no any need of fuel, which burned or consumed in the conventional power plant. In this system the power developed is self sustainable. The future of the Ammonium hydroxide power plant is very good as a power generation device because this system is eco-friendly and not produced any harm full gasses which are produced by the burning of fuel and has no any carbon emission. In the present experiment the analysis is done by the value obtained by the working model of ammonium hydroxide power plant whose schematic diagram is shown in figure which has three cycles they are.

1) **Cycle-1**: In this cycle the primary fluid water is heated in the solar panel and then supplied to the primary heat exchanger and transfer its latent heat to the working fluid ammonium hydroxide.
2) **Cycle-2**: This is the main cycle of ammonium hydroxide power plant which works on the principle of Rankine cycle for power production.
3) **Cycle-3**: In this cycle the hot working fluid ejected from the turbine is cooled in the third cycle by the help of following arrangement.

## ACKNOWLEDGEMENT

Working on this project has been a great learning experience for me. I would be grateful to acknowledge my deep feeling and gratitude with due respect to our project guide **Prof. Sushil Kumar Sharma** and **Mr. Abhinav vairagade**, Assistant Professor, Department of Mechanical Engineering, for their right orientation, invaluable knowledge and innovative criticism for uplifting my confidence level at all stages of my endeavor. His critical judgment and review shaped this thesis up to the mark of being a quality manuscript.

Last but not the least; I am grateful for my parents to whom 'thanks' is not just an enough word to acknowledge. Their moral support is the sole reason for all my achievements. I express a very special sense of appreciation to them for the everlasting support and encouragement they have provided throughout my life.

## REFERENCES

[1] Principle and Preliminary Calculation of Ocean Thermal Energy Conversion by welter Engels, Department of Mechanical Engineering West Virginia University Institute of Technology, Montgomery, WV, U.S.A. www.asee.org>zone1>PDFs

[2] MATERIAL SAFETY DATA SHEET

Ammonium hydroxide water solution, >14N NH4OH.

[3] Ocean thermal energy conversion (OTEC) system Er.Prashant kumar sahu and Er.Chinmaya Prasad nanda

[4] S. M. Masutani and P. K. Takahashi, University of Hawaii at Manoa,Honolulu,HI,USA. www.curry.eas.gatech.edu>Ency_oceans

[5] Indian Ocean Thermal Energy
1 Er. Prasant Kumar Sahu ,2 Er. Chinmaya Prasad Nanda
Aryan Institute of Engineering and Technology, BPUT BHUBANESWAR-752050, INDIA www.ijret.org>indian ocean thermal energy

[6] "World Ocean Atlas 2009 Figures." World Ocean Atlas2009 Figures. N.p., n.d. Web. 13 Nov. 2013.

http://www.nodc.noaa.gov/cgibin/OC5/WOA09
F/woa09f.pl?parameter=t

[7] The Ocean and Temperature

http://marinebio.org/oceans/temperature.asp

[8] IOA Newsletter; International OTEC/DOWA Association; 1999 – 2001 Editions

## Authors

Mr. Shubham Sarkar
B.E. (Mechanical Engineering)
U.G. Student
D.I.M.A.T, Raipur, C.G, India.

Mr. A.Vishwanatham
B.E.(Mechanical Engineering)
U.G. Student
D.I.M.A.T, Raipur, C.G, India.

Mr. Hariom Sachan
B.E. (Mechanical Engineering)
U.G. Student
D.I.M.A.T, Raipur, C.G, India.

Mr. Sushil Kumar Sharma
M.E. (Thermal Engineering)
Asst. Prof. Mechanical Engg.
D.I.M.A.T, Raipur, C.G, India