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Zero water Wastage Condenser Column Cooling System for All Glass Distillation Units

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Abstract

An experiment on Zero water wastage condenser column cooling system for all glass distillation units has been conducted at Department of Soil Science and Agricultural Chemistry, Horticultural College and Research Institute, Dr Y.S.R. Horticultural University, Venkataramannagudem, Andhra Pradesh, during 2012, the setup can be made by doing few modifications to the existing, traditional distillation set by introducing a water storage reservoir, heat exchanger (or radiator) and a pump, in this water wastage prevented by condenser column cooling system which recycles the cool water by the method of forced convective heat exchange; hence it prevents wastage of precious natural resource – water and it also conserve energy.

Key words: Distillation unit, Cooling system and water recycling

1. Introduction

Distilled water usage in every analytical chemistry laboratory is inevitable, but production and consumption varies from work volume of the laboratory. Production of distilled water involves vaporization of clean water in the distillation still and condensation of Steam produced in the condenser column. Cold water is circulated continuously in the condenser column to get the steam condensed. In most of the cases water used in condenser column is drained, which goes as a waste. It has been observed that for the preparation of one liter of distilled water requires about 50 liters of cooling water circulation through the condenser column (Sharma K.K., 2004), such a huge quantity of water has been drained (wasted) for producing a liter of distilled water. Taking into account of the water scarcity, it's not desirable to waste such a large quantity of water during the process of distillation. Alternately, we can conserve

this cooling water by recycling it in a circuit having a Heat Exchanger which takes away the heat from this water. The entire setup can be made by doing few modifications to the traditional setup by introducing a water storage reservoir, heat exchanger (or radiator) and a pump.

2. Materials And Methods

This experiment has been conducted at Department of Soil Science and Agricultural Chemistry, Horticultural College and Research Institute, Dr. Y.S.R. Horticultural University, Venkataramannagudem, Andhra Pradesh.

3. Setup Description

The detailed experimental setup is as shown in the figure – 1, it consists of:

1. Distillation set (1.5 – 3.0 liter capacity)
2. Radiator
3. High speed radiator cooling fan (2500 – 3000 RPM, 40 or 60 Watt, DC/AC)
4. Micro/mini submersible pump (1.5 – 2.0 meter head, 15 – 20 Watt, DC/AC)
5. Water Reservoir (50 liter capacity)

4. Process of Cooling and Recycling of Water in Condenser Column

In this technique condenser column outlet hot water is passed through a heat exchanger to exchange heat and cool down the water that is coming out from the out let of the condenser column, this cool water is stored in a reservoir. The stored cool water in the reservoir is pumped by using a small submersible pump and fed to the inlet of the condenser column for condensing the vapour generated in the distillation still.

There is no effect on the quality of distilled water produced, because cooling water in the condenser column unit never comes in contact with water vapors. For small and medium sized distillation apparatus (*i.e.* 1.5 – 3.0 liter capacity) about 50 liters of cooling circulation water initially filled in the reservoir can be used again and again to cool the condenser unit for years by recycling it.

5. Results and Discussion

In this method, the cooling water which gets heated up after passing through condenser is made to pass through a radiator instead of draining it. The water gets cooled in the radiator since a fan is sucking air through radiator (this phenomenon is called Forced Convection). Now, this cold water is stored in a reservoir and is re-circulated to the condenser unit with the help of micro/mini submersible pump as shown in figure – 1. This method not only saves gallons of water but also produces better results as far as condensation of vapors is concerned.

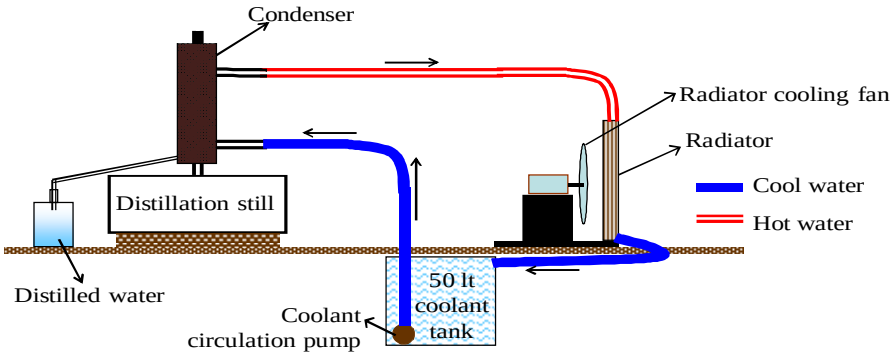

Figure – 1

6. Advantages of Condenser Water Cooling and Recycling Method

(i) This method recycles the water by forced convective heat exchange; hence it saves wastage of precious natural resource – water.

(ii) The technique is so simple that any user can install it with the existing distillation unit without any difficulty and total cost involved for this purpose comes to about Rs.2350/- only, excluding the distillation set.

(iii) The system can be placed anywhere in the laboratory, because this system does not require source of continuous water supply.

(iv) This system does not influenced by environmental conditions, especially heat for condensing vapours in the condenser column.

(v) The efficiency of the system can be enhanced by introducing thermal sensors and by using high energy efficient radiator cooling fan; the modified technique saves electrical energy also.

(vi) This system can be made fully automated by introducing thermal sensors and water flow controlling solenoid valves – system can be upgradable.

7. Economics of Entire Setup (In Indian Rupees)

Radiator	=	750/-
High speed fan	=	750/-
Mini submersible pump	=	150/-
Frame	=	250/-
Wire	=	50/-
Reservoir (50 lt.)	=	300/-
Water tubes (3 meter)	=	100/-
Total	=	2350/-

8. Conclusion

Zero water wastage condenser column cooling system for various distillation units recycles the water by the method of forced convective heat exchange; hence it prevents wastage of precious natural resource – water.

References

[1] Sharma K K (2004), Modification of distillation processes in laboratories and industries to conserve water. *Ind J. of Env. Sci.* **8**:108-116.

Plate1: Zero water wastage condenser column cooling system fitted to all glass distillation unit at our laboratory