iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** V **Month of publication:** May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5297

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

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 V, May 2018- Available at www.ijraset.com

Effect of $CaCl_2$ on the Evaporation Reduction ability of CETYL Alcohol

Dr. Jatin J. Upadhyay[1], Yogesh N. Dangar[2]
[1]*Department of chemistry Matushri Virbaima Mahila Science & Home Science College Rajkot – 360007, Gujarat, INDIA*
[2]*Department of chemistry Bahauddin Science College Junagadh-362001, Gujarat, INDIA*

Abstract: ***World is heading towards water crises due to rapid increase in population and industrial growth. In order to overcome water crisis it is necessary to develop novel techniques of water conservation. Retardation of water evaporation by using chemicals is one such novel method for the conservation of water. Cetyl alcohol is found to be very effective in reducing water evaporation. Here, efficiency of cetyl alcohol as water evaporation retardant (WER) is studied in the presence of $CaCl_2$. Calcium and chloride ions are commonly found in the most of natural reservoirs hence this study is useful for the assessment of efficiency of cetyl alcohol as WER in natural water reservoirs. Presence of calcium and chloride ions is found to be supportive in water evaporation retardation moreover it is observed that efficiency of cetyl alcohol remains unaffected by the presence of $CaCl_2$.***

Keywords: Water, evaporation, retardation, fatty alcohol, cetyl alcohol

I. INTRODUCTION

Water is the most crucial compound exists on the earth. Two third part of earth is covered with the water but only 2.5 % of total water is potable water. Out of 2.5% potable water only 1 % is accessible while remaining 1.5% potable water is trapped in snowfields and glaciers [1]. Nowadays demand of potable water is increasing day by day due to increase in population and industrialization. This increasing demand of water leads us towards water crises. It is believed that water crises can create serious threat to mankind in upcoming years [2]. In order to overcome this problem it is necessary to employ new techniques for the conservation of water. Evaporation retardation by using chemicals is a technique which can prove useful for the conservation of water. In 1925, it was found that certain compounds which can form layer on water surface can considerably retard water evaporation. These substances are termed as "Water evaporation retardants" and popularly known as "WER" [3]. Comprehensive study of many compounds has been carried out in laboratory to identify such compounds which can effectively work as WER. In 1927, Langmuir found that straight chain fatty alcohols such as cetyl alcohol can effectively retard evaporation of water [4]. After laboratory scale investigations, the first field experiment for the testing of cetyl alcohol was carried out in Australia around 1950 and it was found that cetyl alcohol can retard evaporation of water up to 30% [5]. Success of this field trial catches worldwide attention and comprehensive research in this area has been carried out rapidly [6 to 13]. Reputed research institutes of many countries like United States of America, Australia, India, Israel etc. have started comprehensive studies in this area of research. After comprehensive laboratory research and field trial cetyl alcohol is found to be an effective evaporation retardant. Most of laboratory investigations are made by using distilled water. Idea behind this practice is to eliminate probable errors in the estimation of evaporation reduction arises due to presence of dissolved impurities. It is valid to use distilled water at laboratory scale for the assessment of water evaporation retardation but in actual practice water in natural water reservoirs always contain some dissolved impurities so it is also necessary to know the effect of dissolved solids on the effectiveness of WER. We have studied the effect of $CaCl_2$ on the effectiveness of cetyl alcohol as WER. Calcium ion and chloride ion are the most common impurities found in water hence study of its effect on the effectiveness of cetyl alcohol as WER will be very important in this area of research.

II. EXPERIMENTAL

Distilled water for the experiment was collected by using simple distillation method. Cetyl alcohol solution (2mg/mL) was prepared by dissolving 40 mg Cetyl alcohol (Loba chemie, extra pure) in 20 mL n-Hexane (Merck, 95%). Aqueous solution of calcium chloride (15 mg/mL) was prepared by dissolving 1.5 g $CaCl_2$ (Oxford, 99%) in 100 mL Distilled water. To carry out evaporation reduction experiment plastic beakers (Height-17.7 cm, Diameter - 11.8 cm) are used. Beakers were labeled as Beaker -1 to Beaker -5. These beakers were filled with $CaCl_2$ solution, distilled water and cetyl alcohol solution as below, Beaker-1: 10 mL $CaCl_2$ solution + 990 g distilled water + 1 mL Cetyl alcohol solution.

Beaker-2: 20 mL $CaCl_2$ solution + 980 g distilled water + 1 mL Cetyl alcohol solution.
Beaker-3: 30 mL $CaCl_2$ solution + 970 g distilled water + 1 mL Cetyl alcohol solution.
Beaker-4: 1000 g Distilled water + 1 mL Cetyl alcohol solution.
Beaker-5: 1000 g Distilled water Initially Calcium chloride solution was added by using screw type burette followed by required amount of distilled water so that total weight of water became 1000 g. 1 ml cetyl alcohol solution in each beaker was added by using screw type burette. All the beakers are exposed to the same atmospheric conditions in a specially designed experiment chamber and weight loss was measured at an interval of 24 hours.

III. RESULTS AND DISCUSSION

Table I

Hours	Weight of water (g)				
	Beaker-1	Beaker-2	Beaker-3	Beaker-4	Beaker-5
0	1000	1000	1000	1000	1000
24	977	979	981	975	940
48	947	951	956	943	879
72	910	916	924	903	818

Table II

Hours	Weight loss per day (g)				
	Beaker-1	Beaker-2	Beaker-3	Beaker-4	Beaker-5
24	23	21	19	25	60
48	30	28	25	32	61
72	37	35	32	40	61

Table III

Hours	% Evaporation per day				
	Beaker-1	Beaker-2	Beaker-3	Beaker-4	Beaker-5
24	38.33	35	31.67	41.67	100
48	49.18	45.9	40.98	52.46	100
72	60.66	57.38	52.46	65.57	100

Table IV

Hours	% Evaporation reduction per day				
	Beaker-1	Beaker-2	Beaker-3	Beaker-4	Beaker-5
24	61.67	65	68.33	58.33	0
48	50.82	54.1	59.02	47.54	0
72	39.34	42.62	47.54	34.43	0

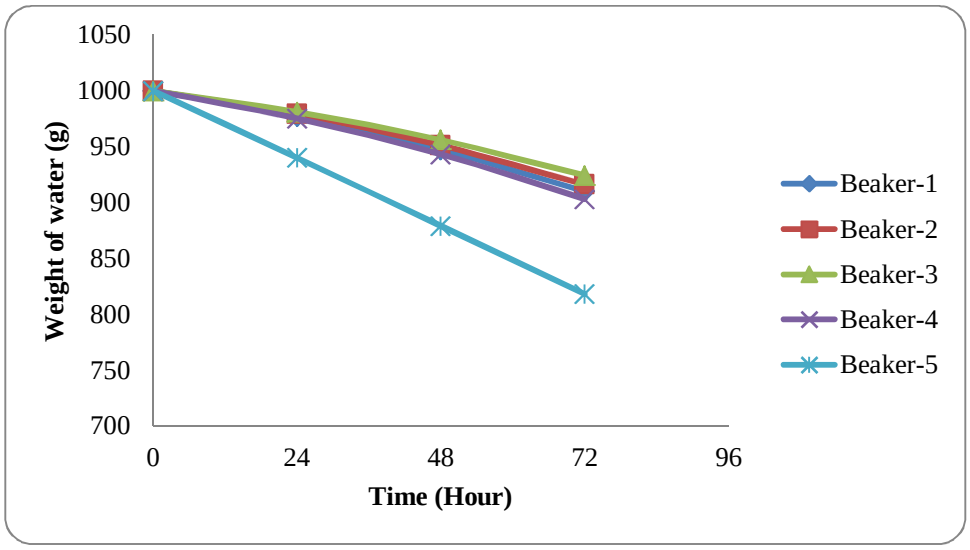


Fig. 1

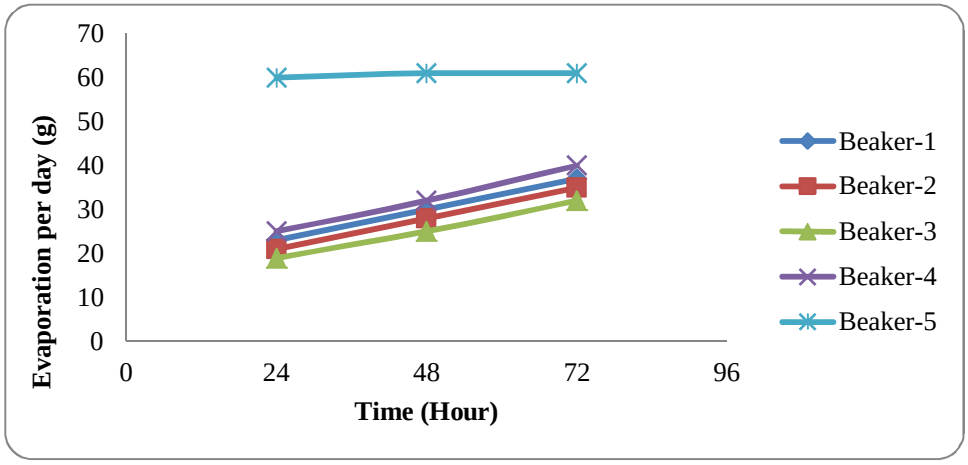


Fig. 2

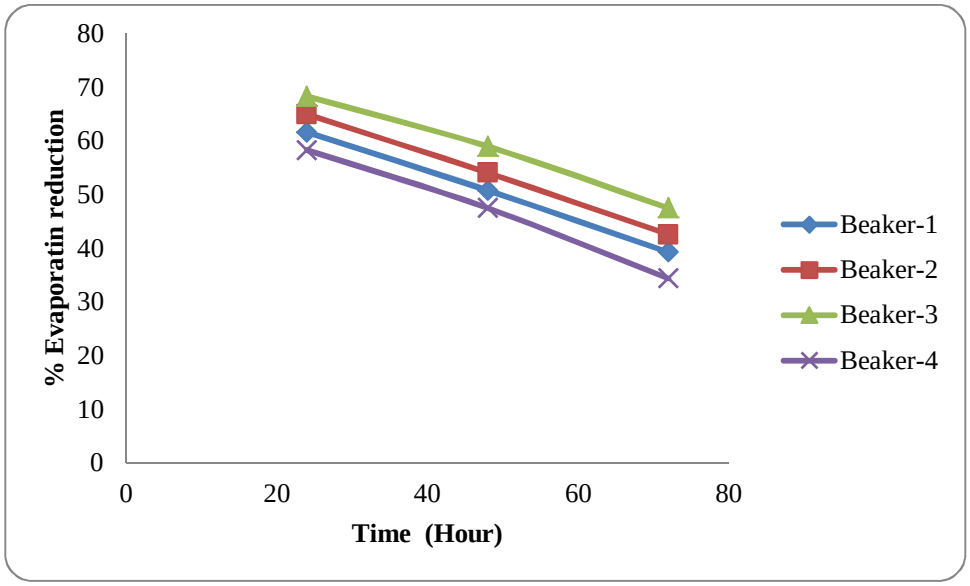


Fig. 3

It is evident from table -2 & 3 and graph – 1, 2 & 3 that presence of $CaCl_2$ also retard evaporation of water. This phenomenon was expected because we know that H_2O is a polar molecule in which O atom is partially negatively charged and H atom is partially positively charged. Due to electrostatic force of attraction between water molecule and $Ca^{2+}$and Cl^{-}ions energy required for water molecule to escape from liquid water surface increases which results in to lowering of evaporation. In graph – 1 and 2, a straight line is obtain for the beaker -5 it indicates that rate of evaporation of water in beaker -5 which contains only distilled water remains almost same throughout the experiment. Moreover it also indicates that atmospheric conditions i.e. temperature, humidity and wind velocity also remains identical during experiment period. Percentage evaporation reduction in graph – 3 is found to be decrease with time but all the four lines in the graph are parallel to each other it indicates that % evaporation reduction decreases with time due to decomposition or loss of cetyl alcohol but effect of $CaCl_2$ on rate of evaporation remains almost same throughout the experiment. Here, it is apparent that presence of $Ca^{2+}$and Cl^{-}ions also reduces rate of evaporation of water moreover it does not interfere in the working of cetyl alcohol. These results are very encouraging because water in most of natural reservoirs is found to be contaminated by $Ca^{2+}$and Cl^{-}ions.Average percentage evaporation reduction after 72 hours of application of WER is found to be minimum 50.61 % and maximum 58.61 %. These results show that cetyl alcohol can be effectively used as WER in hard water also. Even presence of $CaCl_2$ helps in retardation of water evaporation.

IV. CONCLUSION

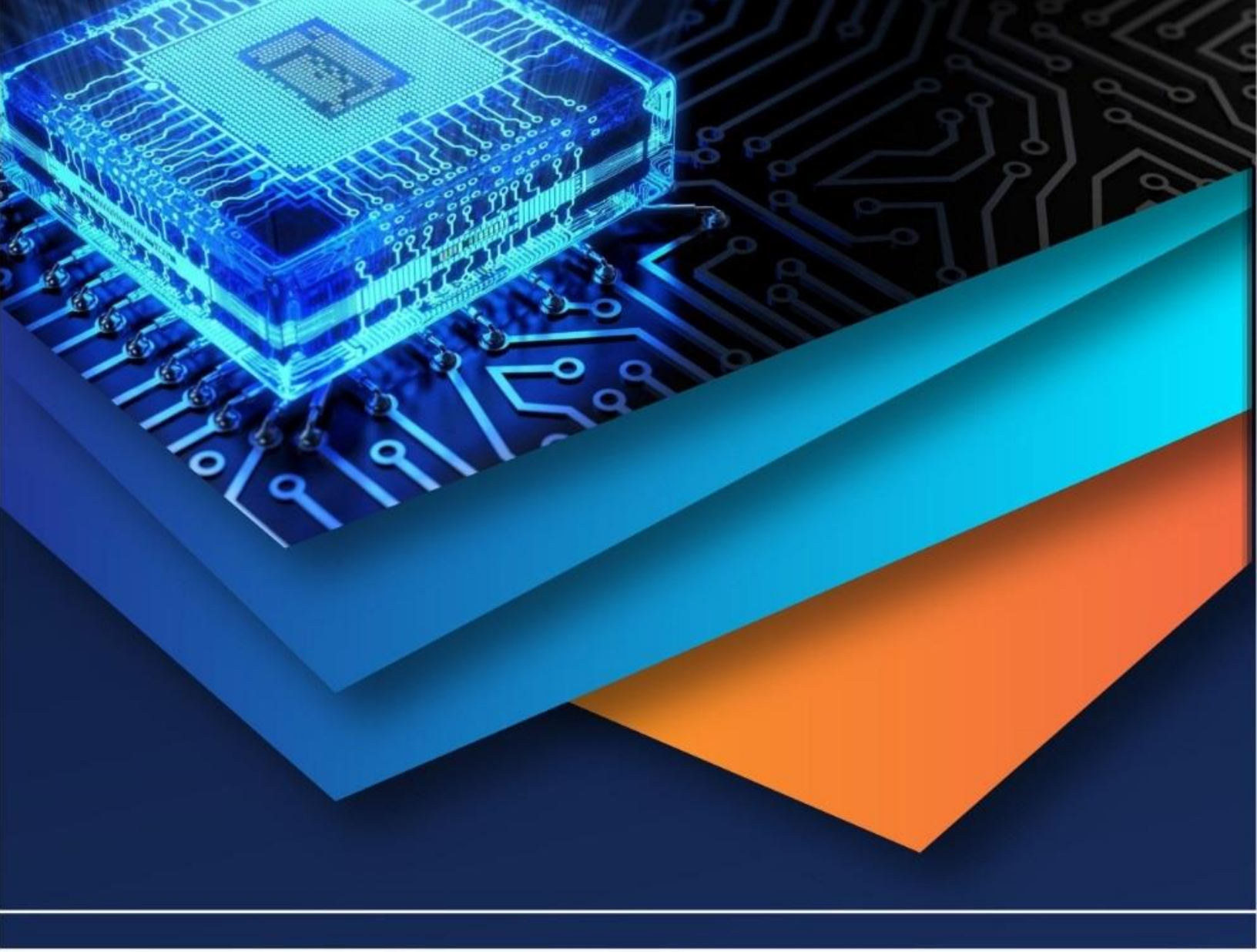
Evaporation of water is found to be decrease due to presence of calcium chloride moreover no negative effect on the effectiveness of cetyl alcohol is observed. These results show that cetyl alcohol can be used as WER even if water contains $Ca^{2+}$and Cl^{-}ions.

V. ACKNOWLEDGEMENTS

The authors want to thank Bahauddin Science College for providing necessary glassware and apparatus, Dr. M. M. Chavda and Dr. M. D. Visavadiya for their support and encouragement.

REFERENCES

[1] Gleick, P.H., Water in Crisis: A Guide to the World's Freshwater Resources. Oxford University Press. P. 13, ed. (1993).
[2] "Water crises are a top global risk". World Economic Forum. 16 January 2015.
[3] Evaporation reduction, J.Frenkiel, UNESCO.
[4] Langmuir, I.; Langmuir, D. B. 1927. The effect of monomolecular films on the evaporation of ether solutions. J. phys. Chem., vol. 31, no. 11, p. 1719-31
[5] Mansfield, W.W. 1953. The effect of surface films on the evaporation of water. Nature, Vol.172, no. 4389, p.1101.
[6] La Mer, V. K.; Robbins, M. L. 1958. The effect of the spreading solvent on the properties of monolayers. J. phys. Chem., vol. 62, no. 10, p. 1291-5.
[7] Robbins, M. L.; La Mer, V. K. 1959. The effect of the spreading solvent on the properties of monolayers. J. coll. Sci., vol. 15, no. 2, p. 123-54.
[8] La Mer, V. K. Barnes, G. T. 1959. The effects of spreading technique and purity of sample on the evaporation resistance of monolayers. Proc. Nat. Acad. Sci., vol. 45, no. 8, p. 1247-80.
[9] Barnes, G. T.; La Mer, V. K. 1960. Evaporation resistant measurement for investigating the molecular architecture of monolayer films. 3rd Int. Congr. Of surface activity, cologne, vol. 2, p. 192-5.
[10] Barnes, G. T.; La Mer, V. K. 1962. The evaporation resistance of monolayers of long chain acids and alcohols and their mixtures. In: La Mer, V. K. (ed.). Retardation of evaporation by monolayers: transport process, p. 9-33. New York and London, academic press.
[11] Barnes, G. T.; La Mer, V. K. 1962. The laboratory investigation and evaluation of monolayers for retarding the evaporation of water. In: La Mer, V. K. (Ed.). Retardation of evaporation by monolayers: transport process, p. 35-9. New York and London, Academic press.
[12] La Mer, V. K.; Aylmore, L. A. G. 1962. Evaporation resistance as a sensitive measure of the purity and molecular structure of monolayers. Proc. Nat. Acad. Sci., vol. 48, no. 3, p. 316-24.
[13] La Mer, V. K.; Aylmore, L. A. G. Healy., W. 1963. The ideal surface behavior of mixed monolayers of long-chain n-paraffinic alcohols. J. phys. Chem., vol. 67, no. 12, p. 2793-5.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY