JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY EFFECT OF DEPTH AND SURFACE AREA ON EVAPORATION LOSSES FROM TANKS

[1]Dr. Jitendra Mehta, [2]Kinjal Rank, [3]Dr. Hitesh Ashani , [4]Bhargav Gokani
[1]Associate Professor, [2]Assistant Professor, [3]Assistant Professor, [4]Assistant Professor,
[1] Department of Civil Engineering,
[1]VVP Engineering College, Rajkot, India

Abstract: Water is very essential and without its life is not possible. As useful quantity of the water is inadequate and so losses of the water should be reduced. Evaporation is one of the major losses. To study the Effect of depth of water and surface area of the reservoir on the rate of the evaporation losses, experimental research had been conducted on the two tanks erected at Ghanshyam Nagar. The Results of the research show that whenever the depth of water in any tank decreases for given surface area of the same tank, the rate of the evaporation increases. The Evaporation losses were observed more whenever surface area to depth ratio is more

***Index Terms*: Depth of water, Evaporation, Evaporation Losses, Surface area, and Water.**

I. INTRODUCTION

The water is the most essential, basic, and significant need of all living organism and life is not possible. The water plays always significant roles in the development and growth of individual, society, city, and country. Water losses due to evaporation in India is very high. According to CWC report (1990), average annual evaporation from reservoirs/water bodies in India varies from 500 mm to 3250 mm as shown in the figure 01.

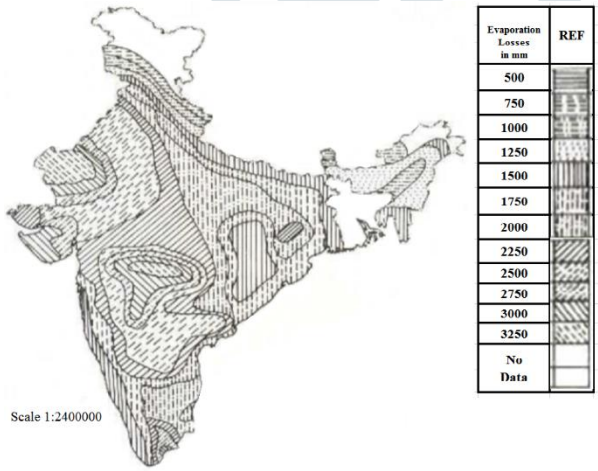

Figure 01 The Average Annual Evaporations in mm

Hence saving the water and its quantity is very much important. Rate of evaporation depends on many parameters such as temperature, wind velocity & direction, vapor pressure difference, Atmospheric Pressure, shape & Size of the reservoir, depth of water and surface area of the reservoir…etc. Experimental research had been conducted to identify effects of depth of water and surface area of water reservoir on evaporation losses. Two water storage tank of different surface areas and depths were taken during this research work

2. OBJECTIVES OF STUDY

1. To study the effects of the depth of the water and surface area on the rate of the evaporation from the water storage situated at Ghanshyam Nagar western zone of the Rajkot.
2. To estimate the quantity of the water loss due to the evaporation.

3. RESEARCH METHODOLOGY

This study is experimental research which is conducted on the artificial reservoir situated at Ghanshyamnagar western part of the Rajkot. The data which is needed practically recorded at site and are collected from reliable sources such as Government of India, Central Water Commission, Basin Planning and Management Organization, New Delhi, India, Rajkot municipal corporation, accuweather etc. The experiment is conducted for the one-year time period from 1st January 2014 to 31st December 2014.The various instruments such as thermometer, level staff, measuring tape, measuring cylinder etc. are used to study the effects of the depth of water and surface area on the rate of the evaporation and estimate the quantity of the water loss in the evaporation. The excel sheets are used to compute the evaporation losses and to prepare chart.

4. DATA COLLECTION AND ANALYSIS

Artificial water storage is set up at the location of Ghanshyam Nagar for the experimental research work. So, the data which were useful to carry out the experimental research work were either collected from the reliable sources or observed by using the standard instruments or the standard method. Following are the data which were collected initially but its value did not change throughout the experiments. Table 1 shows the information related to the geographical positions of the site of the experimental research work and technical details of two tanks which were used in the experimental research wok.

Table 1 Technical Details of the Tanks used in the experiment

1.	Latitude and Longitude are 22.2822º and 70.7596º respectively.
2.	Reduced Level of the floor on which the tanks are placed is 135.04 m.
3.	Length and Breadth of the Tank1 are 1760 mm and 950 mm respectively.
4.	Depth of the Tank1 is 650 mm.
5.	Surface area of the Tank1 (without covering) is 1672000 mm $^{2.}$
6.	Top of the Tank1 is covered partially (54%).
7.	Two numbers of the opening which are provided at the top of the Tank1.
8.	Both openings are rectangular in shape.
9.	Size of the first opening is 740 mm x 620 mm.
10.	Area of the first opening is 458800 mm ^{2}.
11.	Size of the second opening is 740 mm x 610 mm.
12.	Area of the second opening is 451400 mm ^{2}.
13.	Total surface area of the two openings is 910210 mm ^{2}.
14.	Total area of the horizontal plane inside the Tank1 is 1672000 mm ^{2}.
15.	Area of the surface of the Tank1 which is covered is 761790 mm ^{2}.
16.	Length, breadth and depth of the Tank2 are 1230 mm, 940 mm and 380 mm respectively.
17.	The Tank2 is fully open and the size of opening is 1230 mm x 940 mm.
18.	The total surface area of the water of the Tank2 is 1156200 mm ^{2}.

Observations such as temperature, depth of water in the both tank (Tank1 and Tank2) at start and end of each month of 2014 had been recorded. The data of Rainfall had been collected for the year of 2014.The depth of water decreased due to evaporation had been calculated using simple calculation Depth of water decreased= Depth of water at starting of a month minus depth of water at the end of the same month plus depth of water increased.

To know effect of depth of water and surface area of the water on the rate of evaporation losses, following points are important as same were consider during the research

1.To know effect of surface area two tanks of different surface area had been taken in the research.

2.Surface area of the tank1 is 910210 mm2.

3.Surface area of the tank1 is 1156200 mm2.

4.To know effect of depth of water on the rate of evaporation, term t/D is introduced.

Where, t is mean temperature in ° C and D is average depth of water measured on daily bases and calculated on monthly basis.

5.% of Evaporation Losses (EL) is calculated using following simple equation

$$EL = \frac{Decreased\ in\ depth\ of\ water\ due\ to\ Evaporation}{Original\ Depth\ of\ water} X100$$

Observed and Calculated parameter are listed in the Table 02 for the Tank1 and Table 03 for the Tank2.

Notes:

1. Refer Table 02, There are two raw for the month of May in case of tank1 whereas in other months only one raw. This is because of Tank was refilled to ensure minimum depth of water remains in the tank.

2. Similarly in case of Tank 2, Tank was refilled in the month of April. Please refer the table 03.

Table 2 Observations and Summary of Results of Tank1 during of 2014

Sr. No.	Month	Mean Temp. In °C	Depth of Water (in mm)				t/D	% of Evaporation Loss
			At Start of the Month	At End of the Month	Increased due to Rainfall	Decreased due to Evaporation		
1	Jan.	20	500	442.4	2.4	60	4	12
2	Feb	22.3	442.4	368.7	4.32	78	5	17.63
3	Mar	26.6	368.7	276.7	0	92	8	24.95
4	Apr	31	276.7	196.9	2.16	82	13	29.63
5	9th May	34	196.9	162.9	0	34	19	17.27
6	10th May	34	500	439.1	8.09	68.91	7	13.78
7	Jun	32	439.1	360	20.88	99.98	8	22.77
8	July	29	360	472.8	185.84	55	7	15.28
9	Aug	27.8	323	357.7	76.51	42	8	13
10	Sep	28.15	357.7	383	67.34	42	8	11.74
11	Oct	28.5	383	350.7	37.72	70	8	18.28
12	Nov	25.25	350.7	325	10.27	35.97	7	10.26
13	Dec	21.6	325	300.5	7.5	32	7	9.85

Table 3 Observations and Summary of Results of Tank2 during of 2014

Sr. No.	Month	Mean Temp. In °C	Depth of Water (in mm)				t/D	% of Evaporation Loss
			At Start of the Month	At End of the Month	Increased due to Rainfall	Decreased due to Evaporation		
1	Jan.	20	370	305	16	81	17.13	21.9
2	Feb	22.3	305	215	8	98	24.79	32.1
3	Mar	26.6	215	119	0	96	46.04	44.7
4	13TH Apr	31	119	37	0	82	111.7	68.9
5	14th April	34	200	115	4	89	59.74	44.5
6	May	34	115	109	15	21	84.01	18.3

7	Jun	32	109	65	6	50	105.8	45.9
8	July	29	65	350	345	60	40.4	17.1
9	Aug	27.8	90	217	142	15	52.35	6.91
10	Sep	28.15	150	252	125	23	40.48	9.13
11	Oct	28.5	150	187	70	33	48.89	17.7
12	Nov	25.25	187	107	4	84	49.65	44.9
13	1st Dec	21.6	200	143	14	71	36.41	35.5

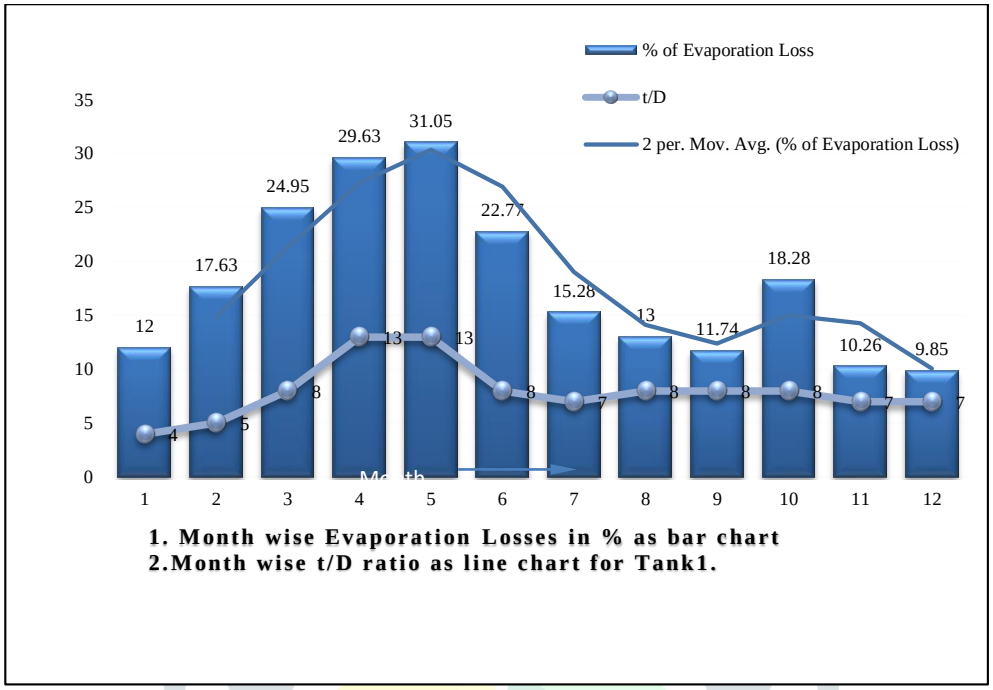

Chart 1 Two charts for Tank1

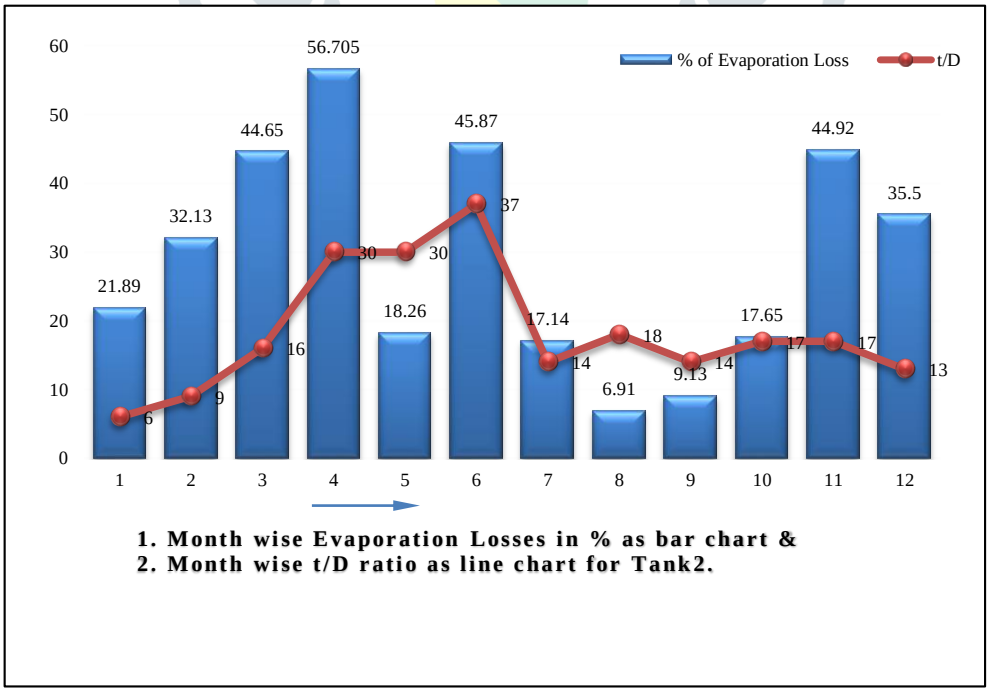

Chart 2 Two charts for Tank2

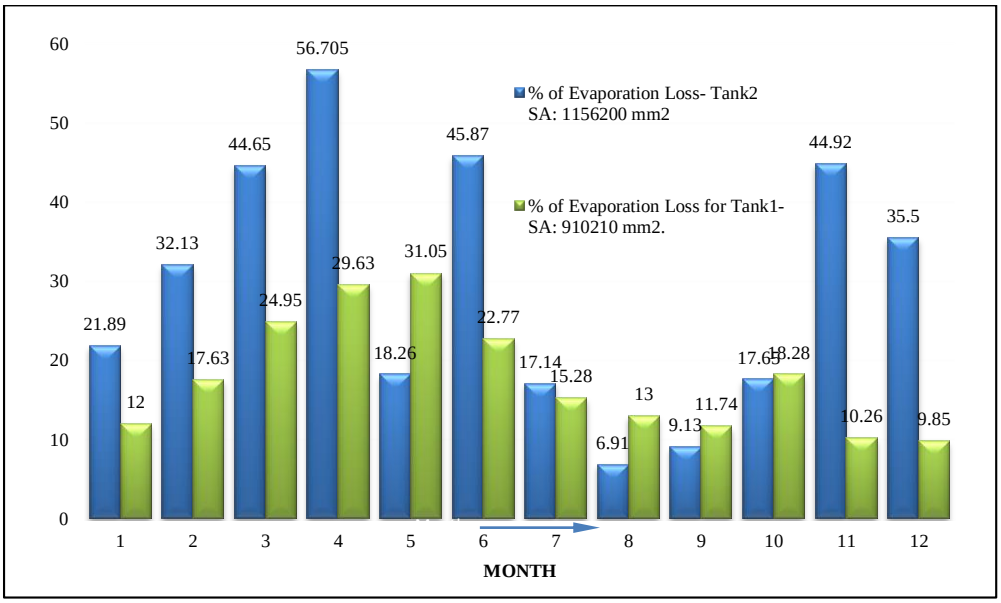

Chart 3 Competition of Tank1 and Tank2

5. RESULTS AND DISCUSSION

Using observed and calculated quantities are given in the Table 02 and Table 03, results were obtained and the same are represented in terms of the Figure 01, Figure 02 and Figure 03.

1. Two Charts are plotted using Excel Sheet in all figures.
2. Figure 01 and 02 consist of two types of chart. In the chart no 01, % of Evaporation Losses on Y axis whereas Months are plotted on X axis and type of chart is bar chart in case of Chart1. Trend line is also plotted. In the chart no 02, the values of t/D are plotted on Y axis and Months are plotted on x axis with line type chart.
3. Data and results of tank 1 are used to plot the both the chart of figure 01 similarly data and results of tank2 are used for both the chart of figure 02.
4. Figure 03 consists of two bar charts, barchart1 with olive green color represent % of Evaporation losses from Tank1(SA: Surface Area =910210 mm2). Barchart2 with blue color represent % of Evaporation losses from Tan21(SA: Surface Area =1156200 mm2).

6. IMPORTANT OUTCOMES

1. Trend line of chart named '% of Evaporation losses' and chart2 names 't/D' are parallel to each other, it means when t/D increases % of evaporation also increases.
2. In t/D ratio, depth is in denominator it means when depth decreases, % of evaporation increases.
3. Similar Results are obtained for tank 2, refer figure 02 and table 03. Here also Trend line of chart named '% of Evaporation losses' and chart2 names 't/D' are parallel to each
other. So, it can be concluded that depth decreases, % of evaporation losses increase
4. Hence for both the tank effect of depth of water on evaporation same.
5. Refer figure no 03, % of Evaporation Losses in case of Tank2 (bar chart with blue color) is higher than tank1 bar chart with olive green color. This result shows that as surface area is higher, % of evaporation losses also higher

REFFERENCE

[1] Assel, R., Cronk, K. and Norton, D., "Recent trends in Laurentian Great Lakes ice cover," Climatic Change, 57(1-2), 185-204 (2003).
[2] ASCE, "Criteria for evaluation of watershed models", J. Irr. Drn. Eng. 119(3): 429-442, 1993
[3] Agarwal, A., Narain, S., "Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems," Center for Science and Environment, New Delhi, India, 404 pp, 2003.
[4] Allan, J.A., " The Middle East Water Question: Hydro politics and the Global Economy," I.B. Tauris & Co. Ltd., London, UK, 382 pp., 2001.
[5] Berthier E, Warrick J, Yu H, "Managing evaporation for more robust micro scale assays," Part 1. Volume loss in high throughput assays, Lab Chip 8:852–859, 2008.
[6] Barnes, G. T. , "Optimum conditions for evaporation control by mono layers," Journal of Hydrology, 145, pp. 165-173 (1993).
[7] C. J. Willmott, S. M. Robeson and K. Matsuura, "A refined index of model performance", Int. J. Climateol., 32: 2088–2094, 2012.
[8] Carlos, R. N.O. ERIC, D., "Salt Weathering: Influence of Evaporation Rate, Super saturation And Crystallization Pattern, " Earth Surf. Process and Landforms 24, pp 191-209, 1999.
[9] Frey, F. W. Power, "Conflict, and Cooperation," Research & Exploration, Water Issue, pp.18-37, 1993.
[10] Ferhat, G., "Water loss through evaporation from water surfaces of lakes and reservoirs in Turkey," Official Publication of the European Water Association, 1999.

[11] G. Dimitrios, A. K. Rashid, G. Karaiskakis, “Study of the evaporation of Pollutant Liquids under the Influence of Surfactant,” AlChE, 2006, vol. 52, pp.2381-2389.
[12] Gundalia, M. J., And Dholakia, M. B.,"Dependence of evaporation on meteorological variables at daily time-scale and estimation of pan evaporation in Junagadh region, " American Journal of Engineering Research, 02(10), pp-354-362, 2013.
[13] K. Khalid, A. K. Rashid, M. Z. Sharifuddin, “Analysis of Diffusion Coefficient using Reversed-Flow Gas Chromatography- A Review,” Am. J. Applied Sci., vol.8, no.5, pp. 428-435,2011.