

Evaporation Control Technique in Open Reservoirs: An Overview and Assessment Study

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Abstract: Global warming and the increasing concentration of greenhouse gases in the atmosphere will affect temperature and rainfall. This rise in temperature ultimately results in evaporation losses from storage reservoirs. As water is limited resource and its conservation and management is important, so that there are different method to reduce evaporation from open reservoirs. These methods are mainly categorized as physical and chemical methods. Water losses by evaporation from storage reservoirs must be minimized for greatest utility of limited supplies. Hence in this paper we have focused on evaporation losses from the open reservoir and carried out test on artificial reservoir using low density polypropylene balls as floating cover to predict how much percentage of evaporation losses can be reduce from open reservoirs. From analysis 80-82% evaporation losses can be reduced to actual losses from water bodies.

Keywords: Evaporation, Floating covers, Open reservoir, Polypropylene balls, seepage losses.

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I. Introduction

As per available records, assessment of evaporation losses in the country was first made by L.A. Ramdas and presented in Symposium of Evaporation control in 1966. The assessment was based on the assumptions viz, Area of arid, semi-arid and long dry spell regions of India 2,000,000 Sq.Km. Estimated water area in this region (1%) 20,000 Sq.Km. Estimated area where film application may be feasible 2,000 Sq.Km. The evaporation loss from the above area 6,000 MCM the National Commission on Agriculture (1976) had estimated that the annual evaporation losses from reservoir surfaces will be of the order of 50,000 MCM.

Central Water Commission in their publication "Status Report on Evaporation Control in Reservoirs, 1988" had indicated that on an average there is a loss of about 450 MCM of water every month from an area of 2,000 Sq.Km. which amounts to an annual loss of 5,400 MCM. The Water Management Forum (WMF), a national body of the Institution of Engineers (India), in their publication "Water Conservation by Evaporation Control, 1988" had indicated that on the Indian sub-continent the estimate total loss of water from large, medium and small storages will be to the tune of 60,000 MCM, which according to WMF would be adequate to meet the entire municipal and rural water needs of India by 2000 AD.

II. Evaporation Estimates

Many methods exist for either measuring or estimating evaporative losses from free water surfaces. Evaporation pans provide one of the simplest, inexpensive, and most widely used methods of estimating evaporative losses. The use of pan data involves the application of a coefficient to measured pan readings to estimate evaporation from a larger water body. Pan evaporation is considered an indication of atmospheric evaporative power.

Evaporation from a free surface is related to pan evaporation by a coefficient applied to the pan readings. A pan made of unpainted galvanized iron or stainless steel 4 feet in diameter and 10 inches deep. The pans are supported on low wooden frames and are filled with 8 inches of water.

Also it is necessary to find loss of water due to seepage, which may be significant. Some work has been done in this field in our country. Two research stations namely Irrigation Research Institute, Poondi, Chennai and Irrigation Research Institute, Roorkee, Uttaranchal have made attempts to develop methods of measuring seepage.

III. Materials And Methodology

Materials

1. Low-density polypropylene (LDPP) balls: It is polyethylene thermoplastic made from petroleum. The density of LDPP can range from 0.93 to 0.97 g/cu.cm. It is also harder and opaque and can withstand higher temperatures (120°C).

LDPP is resistant to many different solvents and has variety of applications:

- Swimming pool installation
- Bottle caps
- Food storage containers

2. Tank: The material of tank is cast iron. The dimensions of tank are 2m X 1.25m X 0.5m. The tank is divided into two compartments of 1m length each, and we have made below tank like controlled and uncontrolled condition

3. Metric scale: To measure water loss (30cm).

IV. Methodology



Covering the water surface with floating balls

Procedure:

We have chosen a tank dimensions as 2m X 1.25m X 0.5m and made two compartments. Both filled with water up to 0.31m deep and cover the water surface with 50mm polypropylene balls so that sun rays do not pass through sides of tank. This whole setup kept for 7-8 days in open terrace. In that period readings were taken successively 8 days by corresponding its temperature..

V. Results

Observations at average of temperature 30°C

Date	19 Jan.18	20 Jan. 18	21 Jan. 18	22 Jan. 18	23 Jan. 18	24 Jan. 18	25 Jan. 18	26 Jan. 18
Uncontrolled condition(mm)	313	305	298	293	288	283	279	273
Controlled condition(mm)	313	311	310	309	308	307.5	306	305

Loss in Uncontrolled condition @ 30°C= 40mm

Loss in Controlled condition @ 30°C= 8mm

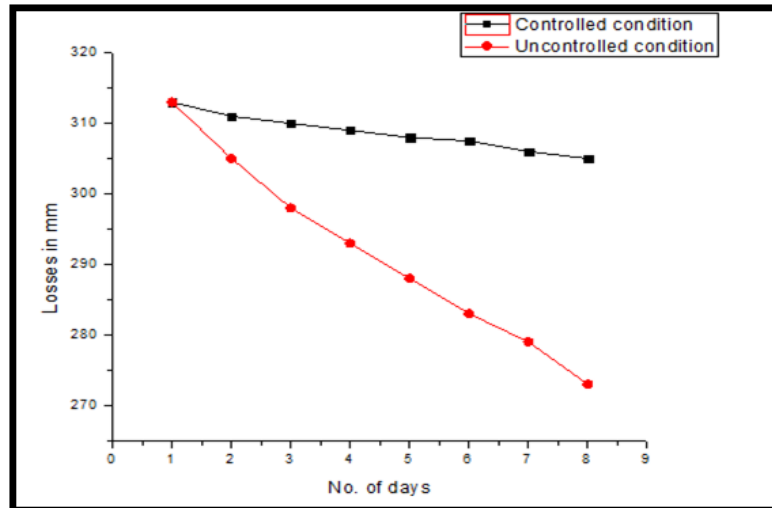


Figure 1: Evaporation losses in first trail @30°C

Observations at average of temperature 35°C

Date	15 Feb. 18	16 Feb. 18	17 Feb. 18	18 Feb. 18	19 Feb. 18	20 Feb. 18	21 Feb. 18	22 Feb. 18
Uncontrolled condition(mm)	313	307	295	286	280	271	262	253
Controlled condition(mm)	313	312	311.5	310	308	306	305	304

Loss in Uncontrolled condition @ 35°C = 60mm

Loss in Controlled condition @ 35°C = 9mm

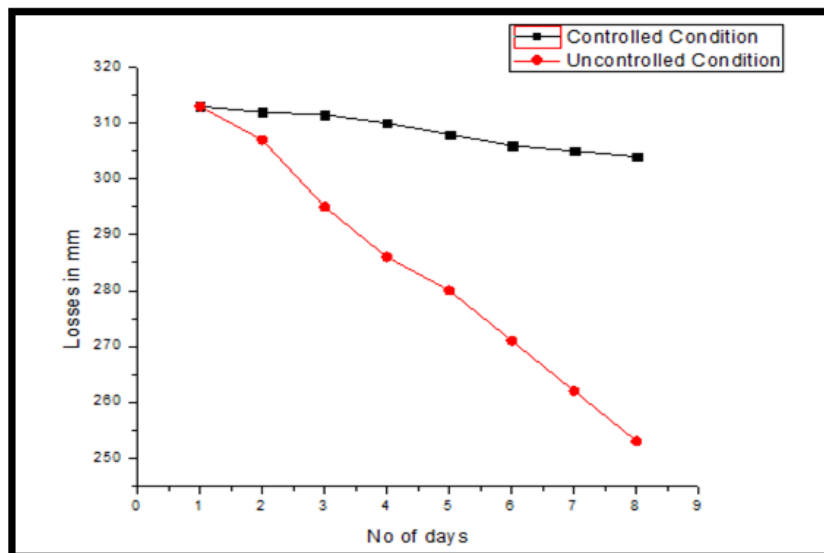


Figure 2: Evaporation losses in second trail @35°C

Observations at average of temperature 40°C

Date	2 March 18	3 March 18	4 March 18	5 March 18	6 March 18	7 March 18	8 March 18	9 March 18
Uncontrolled condition(mm)	313	305	293	283	277	267	258	251
Controlled condition(mm)	313	311	310	309	307.5	305	304	302

Loss in Uncontrolled condition @ 40°C = 62mm

Loss in Controlled condition @ 40°C = 11mm

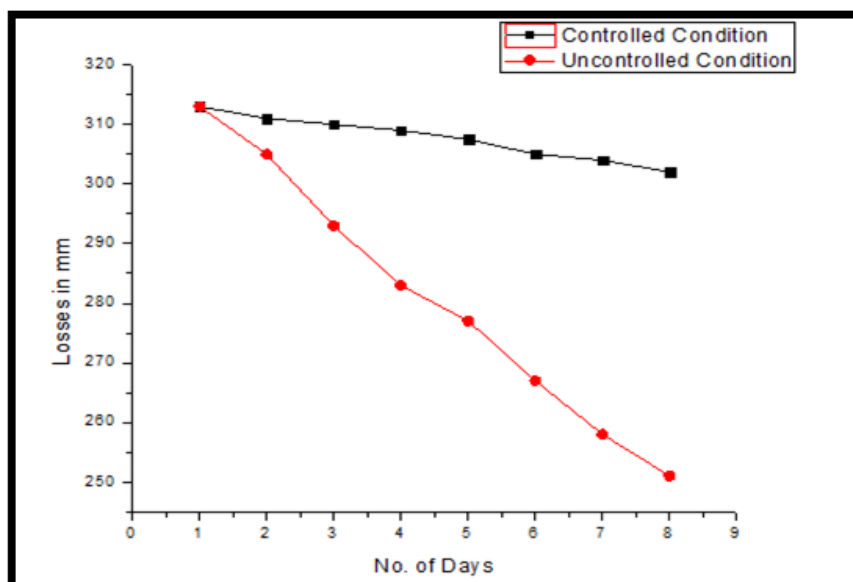


Figure 3: Evaporation losses in third trail @40°C

Water test

Test	Uncontrolled condition		controlled condition	
	First day	After 8 days	First day	After 8 days
pH	6.92	7.30	6.90	7.01
Alkalinity	12 mg/lit as CaCo3	12 mg/lit as CaCo3	12 mg/lit as CaCo3	12 mg/lit as CaCo3
Hardness	82 mg/lit as CaCo3	142 mg/lit as CaCo3	82 mg/lit as CaCo3	130 mg/lit as CaCo3

VI. Conclusions

- By observations we have estimated that 80-82% of water can be saved by using polypropylene balls as floating cover.
- There is no any adverse effect of polypropylene balls on water body under high temperature.
- This method is very economical method to minimize evaporation losses in small and large water bodies.

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