Abstract

Potable water available in storages is about 95-100% in rainy season. Due to large surface area of these open storages the evaporation of water is takes place at high rate. About 60-70% water is get evaporated in summer season. And because of this reason there are lacks of storage of potable water. Rather than treating saline water its economical to preserve this potable water storages, which is naturally available. We can save these storages by decreasing a rate of evaporation of potable water. We are going to cover the surface of water by thin film which will decrease the rate of evaporation. This film is eco-friendly and affective to protect the water properties it is not harmful to animals and alive. This film also not going to interrupt in natural cycle.
1. Introduction

Water is one of the nature’s precious gifts, which sustains life on earth. Civilizations over the world have prospered or perished depending upon the availability of this vital resource. Water has been worshiped for life nourishing properties in all the scriptures. Vedas have unequivocally eulogized water in all its virtuous properties. The total water resources on earth are estimated to be around 1360 Million cubic km. Out of which only about (33.5 Million cubic km) is fresh water. India possesses only 4% of total average runoff of the rivers of the world although it sustains 16% of the world’s population. The per capita availability of water in the country is only 1820 m³/year, compared to 40855 m³/year in Brazil, 8902 m³/year in USA, 2215 m³/year in China, 2808 m³/year in Spain, 18162 m³/year in Australia, 3351 m³/year in France, 3614 m³/year in Mexico, and 3393 m³/year in Japan. The total water resources of India are estimated to be around 1,869 BCM. Due to topographic, hydrological and other constraints, only about 690 BCM of total surface water is considered as utilisable.

In the earlier days availability of water was taken for granted. It is now being realized that water, though replenishable, is not an unlimited resource and cannot be produced or added as and when required, by any known technological means. The other important limitation is that the availability of water over the years depends upon the spatial and temporal variation of precipitation. Thus water may be abundant during monsoon season and scarce in non-monsoon season, when most needed. The ingenuity of man, therefore, lies in his ability to modify the pattern of availability of water to suit needs. One of the commonest forms of such modification is storage of water during monsoon season for eventual use in lean season. The traditional methods are big storage in natural or artificial ranks.

2. Factors Affecting Evaporation

Evaporation is a process by which a liquid changes into vapor form. Water molecules are in constant motion and some have the energy to break through water surface and escape into air as vapors. Evaporation in general is a beneficial phenomenon in regulating global water balance through the hydrological cycle and it is the same phenomenon contributing to massive losses from water bodies. Control of evaporation from land based water bodies, has thus remained one of the main planks of water conservation strategies. This assumes greater significance in arid regions, where water scarcities are already a common problem. A number of factors affect the evaporation of water from open water surface, of which the major are:

I. Water Surface Area

Evaporation is a surface phenomenon and the quantity lost through evaporation from water stored, therefore, depends directly on the extent of its surface exposed to the atmosphere.

II. Temperature

The temperature of water and the air above it affect the rate of evaporation. The rate of emission of molecules from liquid water is a function of temperature. The higher the temperature, greater is the rate of evaporation.

III. Vapor Pressure Difference

The rate at which molecules leave the surface depends on the vapor's pressure of the liquid. Similarly, the rate at which molecules enter the water depends on the vapor pressure of the air. The rate of evaporation therefore depends on the difference between saturation vapor pressure at the water temperature and at the dew point of the air. Higher the difference, more the evaporation.
IV. Wind Effect
The greater the movement of air above the water, greater is the loss of water vapor. Experimental studies on the relationship between wind speed and evaporation show direct relationship up to a certain value of wind velocity beyond which perhaps the relationship does not hold good. Factors like surface roughness and dimension of the water body are reported to have an important role to play.

V. Atmospheric Pressure
Atmospheric pressure is very much related to other factors affecting evaporation. It is, therefore difficult to assess its effect separately. The number of air molecules per unit volume increases with pressure. Consequently with high pressure, there is more chance that vapor molecules escaping from the water surface will collide with an air molecule and rebound into the liquid. Hence evaporation is likely to decrease with increasing pressure.

VI. Quality of Water
The salt content in water affects the rate of evaporation. Experimental studies show that the rate of evaporation decreases with increase in salt content in water. In the case of sea water, the evaporation is 2 to 3% less as compared to fresh water, when other conditions are same.

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.

The assessment of evaporation losses had been reviewed by CWC in 1990. Average annual evaporation from reservoirs/water bodies in India varies from 150 cm to 300 cm. The total surface area of existing large and medium storages, tanks and lakes in the country is of the order of 12,000 Sq.Km. This is likely to increase to about 25,000 Sq.Km. at the ultimate stage of development. 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 1987. The assessment was based on the following assumptions:
- 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 2,000,000 Sq. Km. The evaporation loss from the above area 6,000 MCM

3. Methods To Reduce Evaporation
Although evaporation losses in the country are quite substantial, the evaporation retardant methods perhaps cannot be employed to all open surface water bodies, irrespective of their size and shape. In view of this, water conservation management by control of evaporation has so far been limited generally to drought prone and scarcity areas under specified wind speed and temperature conditions of the water bodies.

The methods of evaporation control can be grouped under two broad categories:
A number of approaches have either been applied or considered by Engineers and Scientists in their attempt to reduce evaporation losses from surface of water bodies. Since the basic meteorological factors affecting evaporation cannot be controlled under normal conditions, efforts have so far been restricted to managing the suppression or inhibition of evaporation from water surfaces by physical or chemical means. The methods generally used or being tried are broadly listed below:

i) Wind breakers
ii) Covering the water surface
iii) Reduction of exposed water surface
iv) Underground storage of water
v) Integrated operation of reservoirs
vi) Treatment with chemical Water Evaporation Retardants (WER).

4. Experimental Setup

- Take the known quantity of water in pot.
- Start the lamp and air blown fan which blows the hot air on surface of water.
- After certain time of interval (8 hrs.) calculate the rate of evaporation.
- Make the thin film on surface of water and do same procedure as above.
- Again calculate the rate of evaporation.
5. Experimental Analysis

5.1 Formation of Film on the Water Surface

Film 1: (POLYSTYRENE + TETRA HYDRO FURAN)

Properties of Materials:
- Strong Binding Properties
- Spreding Characteristics
- The Highly Evaporative Solvent
- Stability towards Resisting Wind Force
- Good Floating Properties Due To Light Density

5.2 Experimental Observations

(Assumptions: All values taken as constant)
- Rate of evaporation = Initial volume of water - final volume of water
- Wind velocity = 8 m/sec
- Surface temperature of water = 27 °C
- Atmospheric temp = 38-40 °C

5.3 Experimental Calculations

1) For Tray 1 (Without Film):
   Tray Dimensions:
   - Length = 37cm
   - Width = 27cm
   - Depth = 7cm
   Surface area of the tray:
   \[ A = L \times W \]
   \[ = 37 \times 27 \]
   \[ = 999 \text{ cm}^2 \]
   \[ = 0.999 \text{ m}^2 \]
   Water Initially Taken: 6000 ml=6 lit
   Finally water collected = 1.3 lit
   Water evaporated = Initial – Final
   \[ = 6 – 1.3 \]
   \[ = 4.7 \text{ lit.} \]
   For 40 Days:
   Rate of evaporation of water = \[ \frac{4.7}{6} \times 100 \]
   = 78.333 %
   Water evaporation per day = \[ \frac{0.78333}{40} \times 100 \]
   = 1.95 %
   Rate of water evaporated with respect to surface area = \[ \frac{4.7}{0.999} \]
   = 4.704 lit /m²

2) For Tray 2 (With Film):
   Tray dimensions:
   - Length = 43 cm
Width = 31 cm
Height = 8 cm
Surface Area of tray = 43 * 31
= 1333 cm²
= 1.333 m²

A) Taking Composition = 80:20
- 80 ml of THF (Tetra HydroFuron)
- 20 ml of Polystyrene.

a. Initially water taken = 10 lit
b. Finally water collected = 9.1 lit
c. Water evaporated in 40 days = 10 – 9.1
   = 0.9 lit

After 40 days:
Rate of evaporation of water = 0.9/10 * 100
= 9 %
Water evaporated per day = 0.09/40 * 100
= 0.225 %
Rate of evaporation w.r.t. surface area = 0.9/1.333
= 0.675 lit/m²

Characteristics of first film (composition 80:20):
- Highly stable and continuous on surface.
- Wind resistive and not breakable.
- Degradable will contacting with soil.

B) Taking composition: 75:25
- 75 ml of THF (Tetra Hydrofuron)
- 25 ml of polystyrene
a) Surface area of tray = 1.333 cm²
b) Initial water taken = 10 lit
c) Water finally collected = 9.300 lit
d) Water evaporated = 10 – 9.3
   = 0.7 lit

After 40 Days:
Rate of water evaporated = 0.7/10 * 100
= 7 %
Water evaporation per day = 0.07/40 * 100
= 0.175 %
Rate of evaporation w.r.t. surface area = 0.7/40
= 0.0175 lit/m²

Characteristics of film:
a) Stable and thick in nature.
b) More effective towards wind resistance.
5.4: Experiment Result
- The rate of evaporation in open surface of water is about 60-65%.
- The rate of evaporation in coated surface of water is about 5-7%.
- The film is not harmful for living organisms in proper proportions.

5.5: Disadvantages Of Film
- It is harmful for aquatic life at higher proportions.
- It is not easily biodegradable.

6. Conclusion
Observing above results we conclude that it is most economical and feasible method to reduce the rate of evaporation of open potable water.

7. Reference