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REDUCE EVAPORATION LOSSES FROM OPEN RESERVOIRS

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ABSTRACT

The primary object of this invention is to reduce the evaporation losses of water in reservoirs and other water storage facilities in a low cost, efficient, easily-practiced. The loss of water by evaporation from open reservoirs is a serious problem throughout the world. This problem exists in certain parts of the which suffer from water shortages, especially those sections where the water supply is acutely short.

Reduction of evaporation by controlling the rate at which water vapour escapes from water surfaces. The need for water saving is greatest in areas of little rainfall and low runoff. Water losses by evaporation from storage reservoirs must be minimized for greatest utility of limited supplies. 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 Due to high temperatures and arid conditions in about one third of the country, the evaporation losses have been found to be substantial. Therefore, it is imperative to minimise evaporation losses in the storages/water bodies.

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 utilizable.

The need for prevention of enormous evaporation losses assumes greater significance, in view of the predictable scarcity of water; the country will be facing in future. It has been assessed that against the utilizable water resources of the order of 1123 BCM, the requirement by 2025 AD to be met from surface water resources will be around 1093 BCM, thereby surplus by just 30 BCM

Due to intense agricultural practices, rapid increase in population, industrialization and urbanization etc., scarcity of water is being increasingly felt. The situation becomes grave in the arid and semiarid regions especially during droughts, when general scarcity of water is compounded by high evaporation losses from open water surfaces of lakes and reservoirs. During severe drought conditions of 1987, the water scarcity in Gujarat and some other parts of the country was so severe that even drinking water had to be carried by trains to the affected areas. In the present scenario of utmost strain on the water resources, of the country, it becomes necessary to conserve water by reducing evaporation losses. National Water Policy-2002 under para 19.1 emphasises that evaporation losses should be minimised in Drought-prone areas.

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.

1.1 Factors Affecting Evaporation

Evaporation is a process by which a liquid changes into vapour form. Water molecules are in constant motion and some have the energy to break through water surface and escape into air as vapour. 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.

- Water Surface Area
- Temperature
- Vapour Pressure Difference
- Wind Effect
- Atmospheric Pressure
- Quality of Water

OBJECTIVES

1. Determining the method to reduces evaporation in satisfactory amount.
2. Determining any adverse effect of polypropylene balls on water body.
3. Considering the cost and feasibility of method of reducing evaporation losses of water through reservoir.

Problem Statement

• 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. • As per available records, assessment of evaporation losses in the country was first made by L.A. Ramada's and presented in Symposium of Evaporation control in 1966. 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 Sq.km.. The evaporation loss from the above area 6,000 MCM

METHODOLOGY

METHODS OF DETERMINING EVAPORATION

Evaporation can be determined by several methods.

The following methods and their modifications are generally used by different scientists:

i) The Water Budget or Storage Equation

ii) Measurement in an Auxiliary Pan

iii) The Evaporation Formulae or the Empirical Formulae

iv) Mass Transfer Method or the Humidity and Wind Velocity Gradient Method

v) Energy Budget Method or Insolation Method

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 : (i) Short term measures and (ii) Long term measures. 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 Evapo Retardants (WER).

Calculate water losses by evaporation in Open Reservoir

Total geographical area=1000 sq.m
Length=50meter.
Breath=20meter
Depth=10 meter
Barren and uncultivable land = 1 Ha.
Land put to non-agricultural uses= 4 Ha.
Cultivable waste land =2 Ha.
Net area sown = 4 Ha.
Area sown more than once = 3Ha.
Total cropped area= 10 Ha.

Formula Used

Pan Evaporation Loss = Daily Lake Evaporation*Number of Days in a Month

$$E_{pm} = E_L * n$$

Example:

January Month

51 Millimetre - Evaporation Loss

Formula Used:

Evaporation Loss = Daily Lake Evaporation*Number of Days in a Month

Calculation:

E_{pm} =2*30

E_{pm} = 60mm

RESULT AND DISCUSSION FOR OPEN RESERVOIR

CALCULATION

Month	Evaporation rate (mm)	Daily Evaporation Loss (mm)
January	60	2
February	66	2.2
March	69	2.3
April	72	2.4
May	60	2

Average Monthly Evaporation (January – May) (in mm)
= 60+66+69+72+60
= 327 mm

RESULT AND DISCUSSION FOR PLASTIC BALL METHOD

CALCULATION

Month	Evaporation rate (mm)	Daily Evaporation Loss (mm)
January	54	1.8
February	60	2
March	63	2.1
April	66	2.2
May	54	1.8

Average Monthly Evaporation (January – May) (in mm)
= 54+60+63+66+54
= 297 mm

RESULT AND DISCUSSION FOR THERMO COAL SHEET METHOD

CALCULATION

Month	Evaporation rate (mm)	Daily Evaporation Loss (mm)
January	57	1.9
February	63	2.1
March	66	2.2
April	69	2.3
May	57	1.9

Average Monthly Evaporation (January – May) (in mm)

= 57+63+66+69+57

= 312 mm

CONCLUSION

Based on the experimental work, the following conclusion is drawn:

Month	Evaporation in Open Reservoir (in mm)	Evaporation with plastic ball Method (in mm)	Evaporation with Thermo Coal Method (in mm)
January	60	54	57
February	66	60	63
March	69	63	66
April	72	66	69
May	60	54	57
Average	327 mm	297 mm	312 mm

The review of methods of estimating open water evaporation identified by Two Methods; Plastic Ball method, Thermo Coal method.

As per above conclusion, Evaporation with plastic ball method is more suitable as compared with thermo coal method.

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