

METHODS TO REDUCE THE SEDIMENTATION AND EVAPORATION LOSSES IN RESERVOIR

Sanket N. Thawri¹, Ashish R. Mahure², Dhanrajsingh G. Thakur³

Deepali K. Tarekar⁴, Prof. R. R. Dighade⁵

UG student, Civil Engineering, YCCE, Nagpur¹⁻⁴

Guide, Department of Civil Engineering YCCE, Nagpur⁵

Abstract- Sediment deposition and Evaporation losses in the reservoir is the major problem in reservoir Yet those challenge wherein can't be absolutely solved however the control of sediments in reservoir could be very essential for this era. To take a look at the sedimentation elimination strategies and to lessen the water loss because of evaporation turns into essential for dam lifestyles span and performance. In view to limitation those losses, the existing paper evaluate diverse technique which may be followed in specific condition. Along with this to undertake the unique technique the principle aspect which ought to appearance. The reviewed technique for the losses is beneficial to offer a capability sustainable solution.

INTRODUCTION-

Deposition of sediments in reservoir is the process of filling of sediment load that carried by streams and river, it directly affects process of water management, flood control and production of energy. Reservoir sedimentation is complex process, because it is influenced by factors like hydrological fluctuations in water, fluctuations in sediment inflow, size of sediment particle varies, reservoir operation cycle, size and shape of the reservoir^[4]. While designing and planning any reservoir, sufficient capacity for storage of sediment particles should be considered, so that accumulation of sediments will not affect the function of dam. For existing reservoirs, comprehensive plan and actions with regard to assessment and management of sediment-induced problems are desirable given the fact that these problems are associated with life and safety of not only infrastructures but also inhabitants. This report gives the better methodology that can be adopted while designing reservoir. Evaporation is the processes in which liquid converted into gases state^[5]. Evaporation losses from ponds are especially critical in dry periods when this loss in not compensated either by rain falling directly into ponds or by runoff. It directly affects factors like high wind speed, high temperature, low humidity. Every year, a large quantity of water is lost from reservoir storage capacity. Loss of water due to evaporation from large water bodies influences the hydrological cycle. Scarcity of water is increasing day by day, because of intense agricultural practices, rapid increase in population, urbanization, industrialization, etc^[6].

METHODOLOGY-

FOR SEDIMENTATION REMOVAL

CHECK DAM-

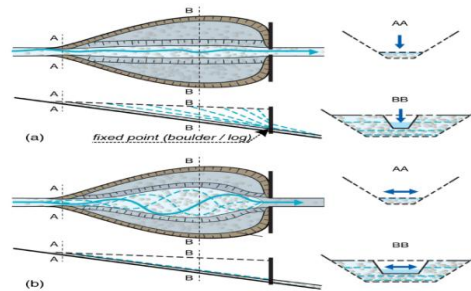
A check dam is a small barrier which is constructed across a river tributary, drainage ditch or channel to slow down the velocity of flow. The reduced velocity results in the settlement of sediments near upstream side which can be removed out during maintenance work. The check dam can be made up of stone, wood, sandbags filled with gravels, concrete^{[1][12]}.



CONCRETE CHECK DAM

Following steps are recommended in designing of the check dam for the sediment trap:

1. Determine the objective & scope of structure (i.e. its functioning to restrict the volume of sediments) to get the final size of check dam.
2. To select the appropriate location for check dam (most of the cases it is selected in valley region of upstream river tributary).
3. Determine the flood discharge and effect of stresses due to flood and its potential damage (i.e. boulder accumulation in a given section) on various location of catchment.
4. Determine Channel hydraulic capacity due to deposit & transport of solids.
5. Choice of basin bottom slope and maintenance practices.



BASIN BOTTOM SLOPES

6. Determine the slope of deposition of soil solid (generally taken as half of natural upstream soil surface).
7. Calculate the average depth of deposited sediment in catchment.
8. Design appropriate dimensions of check dam so that it does not fail in various conditions. (see companion research paper of design purpose).
9. Determine the height of check dam.
10. Designing of downstream piles (using lacey's scour depth equation).
11. If height and lateral dimensions are restricted then the designer must decide whether it is more relevant to increase the basin area or to design multiple sediment traps.
12. Maintenance & regular removal of deposits should be done for proper functioning of check dam.
13. There are various types of check dam i.e. Cement Concrete check dam, Brushwood Check Dam, Steel Check Dam.
14. An Invitation to Tender issued by a procurement authority which outlines the scope of a project and invites organisation to submit a formal tender to bid for the work.
15. It is expected that for constructing one Concrete check dam the approximate cost is 2-3 crores.

Following steps are recommended for remove the trap sediment in reservoir

Phase I: Analysis of particle of sediment.

1. Analysis the sediment deposited in different parts of the reservoir.
2. Find the average size of particle which are settle at the bottom.
3. Select suitable method for removal of trap sediment.

Phase II: Removal of sediment material from the reservoir.

4. If particle size is more than gravel size then dry excavation should be adopted.
5. If fine aggregate is present then used wet excavation (pumping).

Phase III: Separation and washing of cobble, pebble, sand, clay etc.

6. Collected sediments are collected and transported at the segregation site.

Phase IV: Packing/Stacking of separated sediments and debris disposal.

7. After sediment are segregated they are packed.

Phase V: Inviting a tender.

8. Tender is released for selling the packed sediment. (It may be work contract method or Trunkey method depending on situation.)

FOR REDUCING EVAPORATION LOSSES

SHADE BALL –

Shade ball basically a small plastic sphere, which is float on reservoir .It used in various environmental reason such as reduction in evaporation prevent sunlight from causing reaction, but mostly it used for reduction of evaporation. The shade balls basically is also known as a high density polyethene balls (HDPE), and also it is in carbon black in colour, to protect the plastic from ultraviolet radiation^[13] . The shade ball is partially filled with water to avoid being blown by wind and size of shade ball is 4 inches (10 cm).In 2014 and 2015 the first shade ball experiment was applied by Los Angeles Department of Water and Power (LADWP), LADWP put 96 million shade balls onto its largest reservoir (Las Virgenes). LADWP report says that the ball saved 1.7 million cubic meter of water of water from evaporating in duration of 2015 to march 2017^[14] .



SHADE BALLS

1. The region in which drought condition observed then shade ball can be used effectively.
2. Area of reservoir should be small so full area can be covered by shadeball with overview with budget.
3. Before leaving the shade balls in any reservoir firstly all wastage such as tyres, pipes, bottle caps are collected from reservoir for better result.
4. The round shade balls, applied to cover 75% of the pond surface area.
5. According to the area of reservoir, number of shadeball are ordered.
6. Cost for whole shadeball is first checked with all producers, then whoever been charges less amount with required quality is selected.
7. Generally color of ball is black because it not react with water. Hence it recommended that other color ball should not be used.
8. They have material carbon black which helps plastic to last for longer time.
9. Durability of shadeballs is around 10 years.
10. Near about 26 rupees is the cost of each shadeball.

CASE STUDY –**1) FIELD VISIT AT NAVEGAON KHAIRI DAM**

Navegaon Khairi Dam situated in the Parseoni forest and built on 1977. This dam is pick up wear dam that means, it is uses for stored the water. The catchment area of the reservoir is approximately 2600 sq. km and capacity of the reservoir 180Mm³. Length of dam is 1210m and height of dam is 44.50m. From this dam they supply the water to NMC and MSEB with the help of LBC (Left Bank Canal) and RBC (Right Bank Canal). From the LBC, Nagpur Municipal Corporation pumped out 0.5Mm³ water daily and from the RBC, Maharashtra State Electricity Board takes the water.

CURRENT PROBLEM-

For evaporation losses there is no such method is adopted. Near about 34% of water is lost due to evaporation per year. Government isn't taking that much interest in the evaporation losses, because of the high availability of water and also not provide any capital investment.

CURRENTLY METHOD ADOPTED –

They use satellite remote sensing method to analysis the sediment deposits in reservoir^{[7][8][9]}. For Removal of sediment, they adopted flooding technique^[10] in 2020. In the flooding technique, when flood comes the velocity of water is veryhigh. Hence it will take all the sediment from the reservoir. This is natural process.

2) CASE STUDY ON AJI RESERVOIR

The Aji reservoir is located near the Rajkot city in Gujarat state. The length of the dam is 2426 m. The average elevation about R.L 134 m and average precipitation is up to 900 mm. Average temperature varies in surrounding of Aji reservoir is normally varies from 25°C to 40°C and in summer season 40°C to 45°C. Wind velocity in range of 9 km/hr to 15 km/hr. Hence it is best site for study of evaporation losses and its prevention.

MATERIAL AND METHODOLOGY USED:

Hexadeconal (Cetyl alcohol) and octadecanol (Stearyl alcohol) have been studied extensively to determinetheir effectiveness as a film forming agent to reduce evaporation from water surfaces

This material is a white, waxy, crystalline solid and generally available in flakes or powder form. It is relatively tasteless..The monomolecular film formed by a mixture of Cetyl and Stearyl alcohols in 1:1 ratio provides a stronger and more stable film on water surfaces; this film also offers a barrier to prevent water molecules from escaping from the water body due to evaporation. As Cetyl/Stearyl alcohol is dissolved in kerosene or turpentine and applied over the water surface after mixing its solution spread rapidly.

RESULT OF CASE STUDY:

from reading taken by researcher it shown that reduction capacity of chemical is directly affect by temperature. If we used single chemical instead of combination it give better result as compare to combination of these two chemical.

3) CASE STUDY ON MANGALAM DAM

The Mangalam project commissioned during 1957 comprises of a dam across Cherukunnam river, a tributary of Bharathapuzha, located 13km North East of Vadakkencherry town in Palakkad district A straight gravity rubble masonry dam of 162 m length.

METHODOLOGY ADOPTED

Excavate the settled sediment by dry or wet excavation method depending on constituent of that sediment. If fine particles are more, we should use wet excavation or pumping method and if coarse particle is more, we should use excavate by using dry excavation. They invite a tender for excavation of sediment and it sell to contractor or to farmer for revenue generation.

CONCLUSION-**TO REDUCE SEDIMENTATION–**

Construction of CHECK DAM should be the good option to reduce the sediment yield before it enters in the reservoir.

- It is adopted because it is better to prevent the sediment before it enters in reservoir rather than its cure.



- Maintenance of check dam is required after particular interval.

TO REDUCE EVAPORATION LOSSES –

- High Density Polythene Shade Balls can be used to reduce the evaporation losses in the region where scarcity of water is observed.
- Near about 80-90% reduction of water is observed.

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