Estimation of Total Water Losses in a Munak Canal, Panipat

[1]Bhupender Singh, [2]Sandeep Kumar

[1]Assistant Professor [2]Assistant Professor
[1]Civil Engineering Department [2]Civil Engineering Department
[1]Panipat Institute of Engineering and Technology, Panipat, India [2]Panipat Institute of Engineering and Technology, Panipat, India

Abstract: The losses from canals need to be minimized to ensure the efficient performance and effective utilization of water. The seepage loss from the unlined canals can be extremely large, even lined canal never seems to eliminate water loss through side and bottom, but by lining we can reduce the water loss. Seepage and evaporation loss are the major components of water loss from canals. In this project water loss is calculated between the Munak canal and Khubru Head by taking the data of the water discharged from Munak Canal and data of the water reached the final stage i.e., Khubru Head. There were total of seven distributaries and data of rainfall and evaporation were also taken into account while calculating the water and seepage losses.

I. INTRODUCTION

Water is a precious natural resource. It is required by human in doing different daily activities. This precious resource while travelling through the canal is lost from the canals through seepage from the sides and bottom of the canals and by evaporation from the top of the canals, i.e. conveyance loss (the ratio of water reaching form turnouts to that released at the source of supply from a river or reservoir). The seepage loss from the unlined canals can be extremely large, even lined canal never seems to eliminate water loss through side and bottom, but by lining we can reduce the water loss. Water loss from these canals has major impacts on surface water supplies and needs management, and should be minimized, if not altogether be eliminated. Perhaps this is most cost effective method for augmenting water supplies. The main causes responsible for water losses are high density of vegetation, sediment deposition, siltation problem, leakage, lack of maintenance, sharp curves. Water losses comprises of both evaporation and seepage loss. The evaporation loss is the function of temperature, humidity and wind velocity. Practically, evaporation loss can't be controlled but seepage loss can be controlled by providing impervious medium such as brick, concrete, asphalt, geo-synthetic material etc. between porous soil and water flowing in the system. Seepage loss in a canal is a major reason of water loss from the canal as compared to the other form of water losses. So, it becomes important to reduce this seepage loss for increasing conveyance efficiency i.e. the reason why lining have become a choice for reducing this water loss.

1.1.Different Types of losses in canal: -

There are two Major types of losses in the canal area are: -

1.2.1. Loss Due to Evaporation: - As canal water is exposed to the atmosphere at the surface, loss due to evaporation is obvious. It is of course true that in most of the cases evaporation loss is not significant.

1.2.2. Loss Due to Seepage: -The water lost in seepage may find its way finally into the river valley on enters an aquifer where it can be utilized again. But many times the seepage water is not recoverable.

The loss due to seepage is the one which is most significant so far as irrigation water loss from a canal is concerned.

1.2.Aim of Project: -

- The aim of our project "Estimation of Total Water Losses in a given Canal Area".
- The present study is to determine the seepage and evaporation losses in the canal which are major cause of loss of water in canal area.

2. About Site: -

The Munak Canal is a 102 kilometer long that is part of Western Yamuna Canal in Haryana and Delhi states in India. The canal conveys water from the Yamuna River at Munak, Karnal district, Haryana and travels in a southerly direction, terminating at Haidarpur, Delhi. It is one of the primary sources of drinking water for Delhi. A memorandum of understanding was signed between the Haryana and Delhi governments in 1996 and the Canal was constructed by Haryana between 2003 and 2012 on payment by Delhi. Originally a porous trench, the canal was eventually cemented due to excess seepage, saving 80 million gallons of water per day.

Our Site is from Munak to Khubru which is 44.272 Kilometers long. In which seven distributaries are taken out of it.

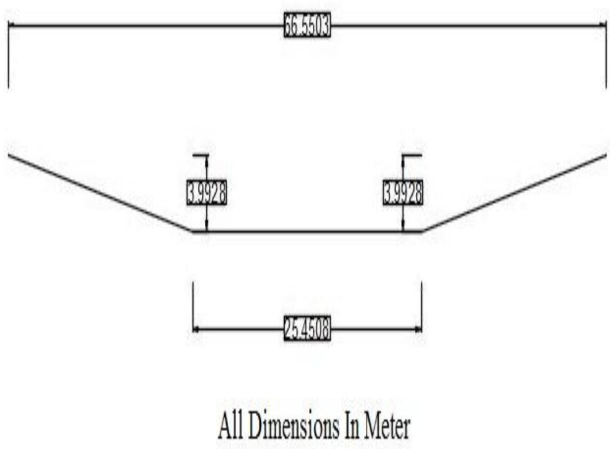


Figure-1.1. Munak Canal **Figure- 1.2. Dimensions of Parallel Delhi Branch Channel**

3. Methodology

3.1. Data Collection: -

Gathering discharge data from the Munak, Panipat canal office and Khubru Head and also collecting a data from CSSRI (Central Soil Salinity Research Institute) in Karnal of Evaporation and Rainfall according the over site.

3.2. Calculating Slope of Canal: -

According to L- Section drawing the canal is design according to lacey theory so,

$$\text{Perimeter, } P = 4.75 * \sqrt{(Q)}$$

$$Q = \text{Discharge (Cumecs)}$$

With the help of perimeter slope is calculated out.

3.3. Calculation of seepage losses: -

Seepage Loss=Initial discharge from Munak + Rainfall in canal area – Evaporation losses in canal – Distributaries taken out – Final discharge at Khubru head

3.4. Calculation of Evaporation losses: -

Evaporation Loss = Evaporation data from CSSRI * Area of canal in which evaporation is takes place.

4. Readings and Calculation

4.1.Calculations for Parallel Delhi Branch Channel: -

1. Data from the L-section Drawing: - From the L-section we come to know that canal is design according to Lacey's Theory. Maximum Discharge (Q) = 157.01691 Cumecs Bed Width =25.4508 m Depth = 3.2491 m Freeboard = 0.7437 m	**2. To Find Perimeter: -** $P = 4.75*\sqrt{(Q)}$ $P = 4.75*\sqrt{25.4508}$ P = 59.52053 m (i)
3. To Find Slope of Canal: - Perimeter of trapezoidal Section $P = 25.4508 + \sqrt{(3.2491^2 + x^2)}$ (ii) Compare (i) And (ii) So, x = 16.72214 m Slope: - 5.2: 1	**4. Area calculation for the Rainfall: -** For the area of rainfall, we have to include full depth of the canal (including the free board). Top width = 25.4508 + (2 * 3.9928 * 5.2) = 66.5508 m Area for Rainfall = 44272.2 * 66.5508 $= 2611660.996\ m^2$
5. Area calculation for the Evaporation Losses: - where, x= depth of water A = Total area of canal for maximum discharge $= (25.4508 * 3.2491) + \frac{2}{2} (3.2491 * 16.72214)$ $= 37.0240994\ m^2$ Q_1 = Discharge carried by canal Q = Total discharge	This implies, $\frac{31.6508x}{137.0240994} = \frac{Q_1}{157.52053}$ Area for Evaporation losses = 44272.2 * {25.4508 +(2 * x * 5.2)}

4.2. Calculations for Carrier Lined Channel

1. Data from the L-section Drawing: -

From the L-section we come to know that canal is design according to Lacey's Theory.

Maximum Discharge (Q) = 79.9384Cumces

Bed Width = 19.812 m

Depth = 2.667 m

Freeboard = 0.7437 m

2. To Find Perimeter: -

$P = 4.75*\sqrt{(Q)}$

$P = 4.75*\sqrt{79.9384}$

$P = 42.4689$ m (i)

3. To Find Slope of Canal: -

Perimeter of trapezoidal Section $P = 19.812 + \sqrt{(2.667^2 + x^2)}$ (ii)

Compare (i) And (ii)

So, x = 11.01 m

⇨ Slope: - 4.2: 1

4. Area calculation for the Rainfall: -

For the area of rainfall, we have to include full depth of the canal (including the free board).

Top width = 19.812 + (2 * 3.429* 4.2)
= 48.6156 m

Area for Rainfall = 44256.96 * 48.6156
= 2151578.665 m^2

5. Area calculation for the Evaporation losses: -

As the different discharge is carried by the canal. So for different discharge the top width of water in canal will be different, which will affect the area for evaporation.

$$\frac{A_1}{A} = \frac{Q_1}{Q}$$

Where,

A_1 = Different area w.r.t Discharge
= area of rectangle + 2(area of triangle)
= (19.812 * x) + 2(x + 4.2x)
= x * (25.012)
where, x= depth of water

A = Total area of canal for maximum discharge
= (19.812 * 2.667) + 2 (2.667 * 11.2014)

= 82.7127

Q_1 = Discharge carried by canal

Q = Total discharge

This implies,

$$\frac{25.012x}{81.7127} = \frac{Q_1}{79.93845908}$$

Area for Evaporation losses = 44256.96 * {19.812 +(2 * x * 4.2)}

5. Graphical Representation of Losses: -

- **July 2016**

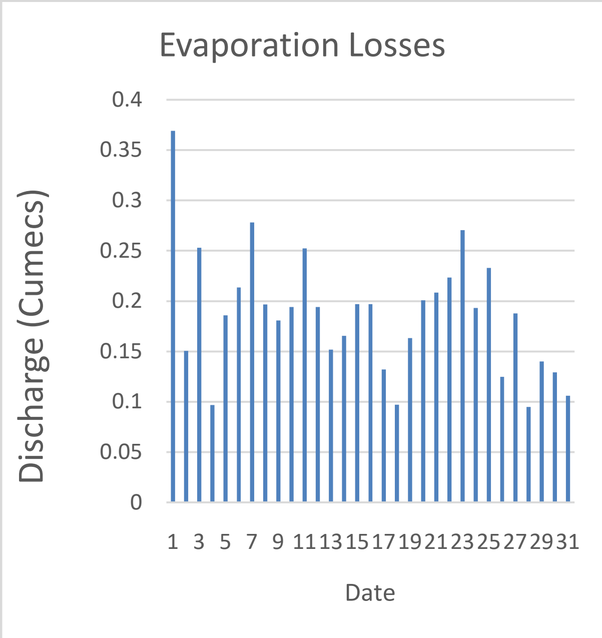


Figure- 5.1. Evaporation Losses in July 2016

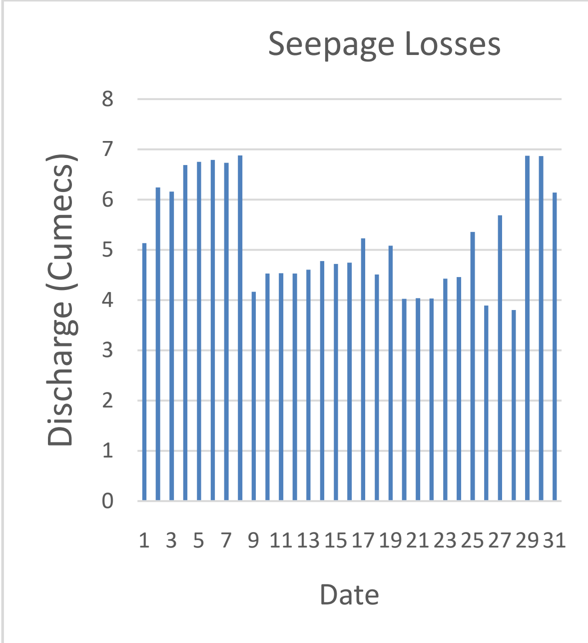


Figure- 5.2. Seepage Losses in July 2016

- **August 2016**

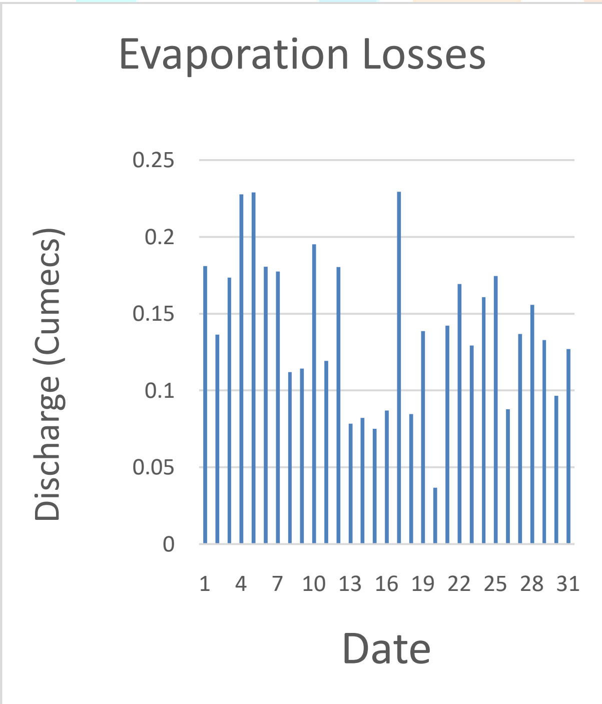


Figure 5.3. Evaporation Losses in August 2016

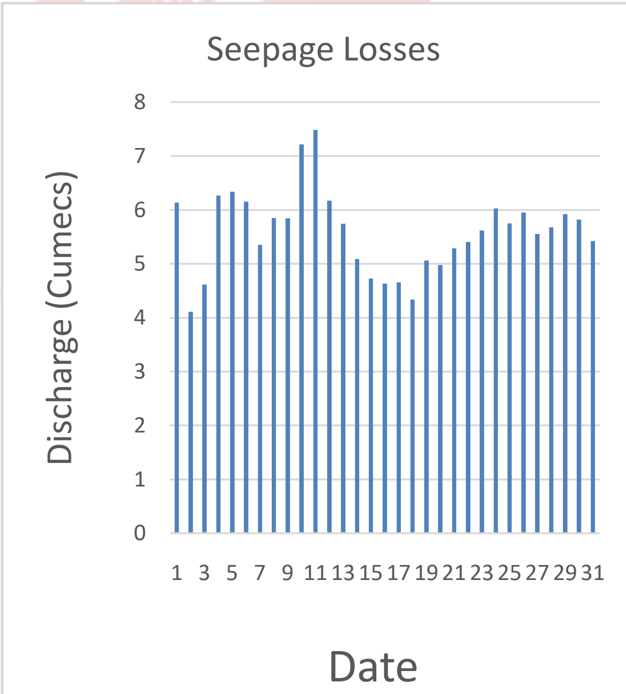
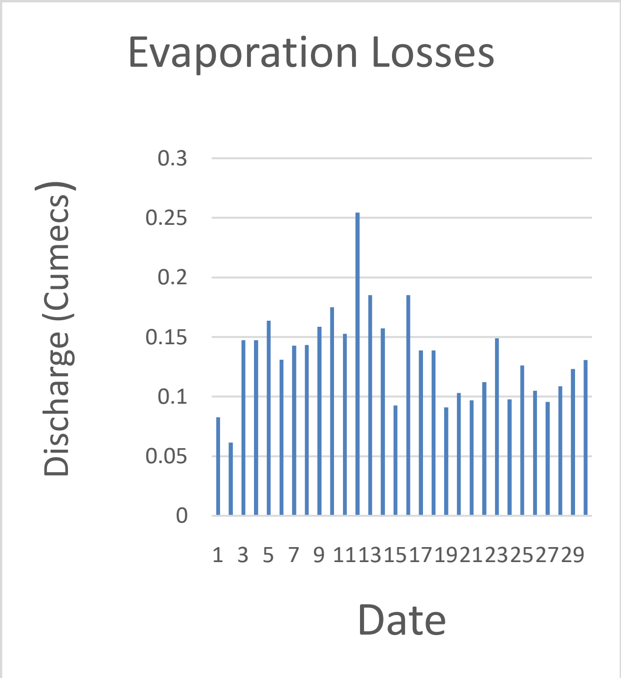


Figure 5.4. Seepage Losses in August 2016

- **September 2016**



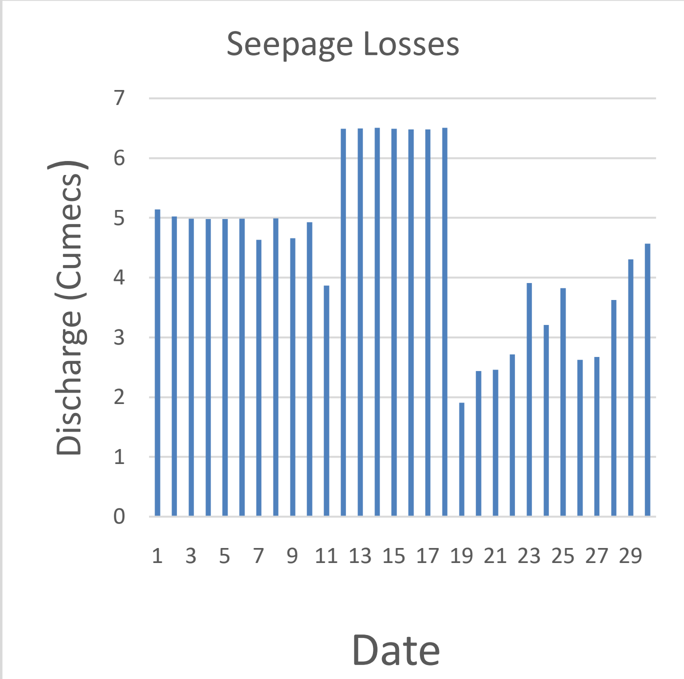
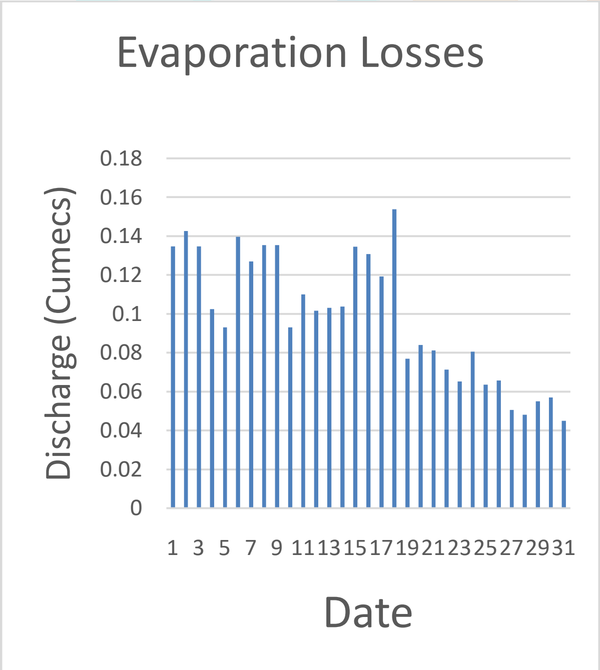


Figure- 5.5. Evaporation Losses in September 2016 **Figure- 5.6. Seepage Losses in September 2016**

- **October 2016**



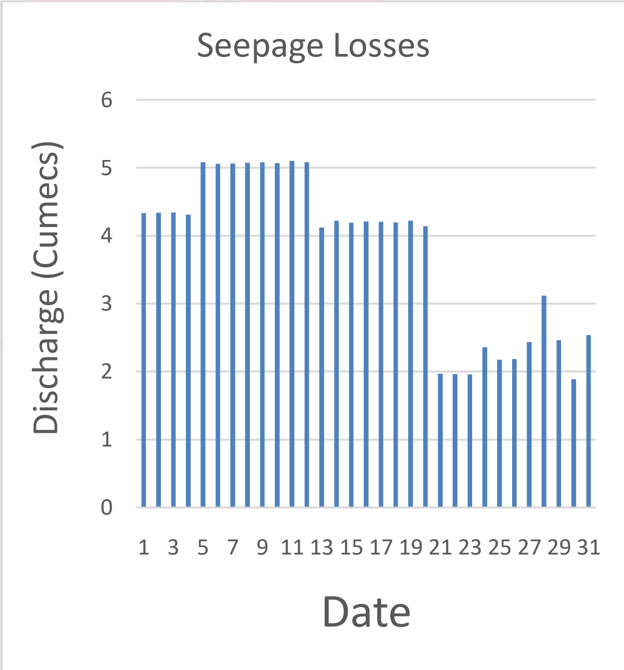


Figure- 5.7. Evaporation Losses in October 2016 **Figure- 5.8. Seepage Losses in October 2016**

- **November 2016**

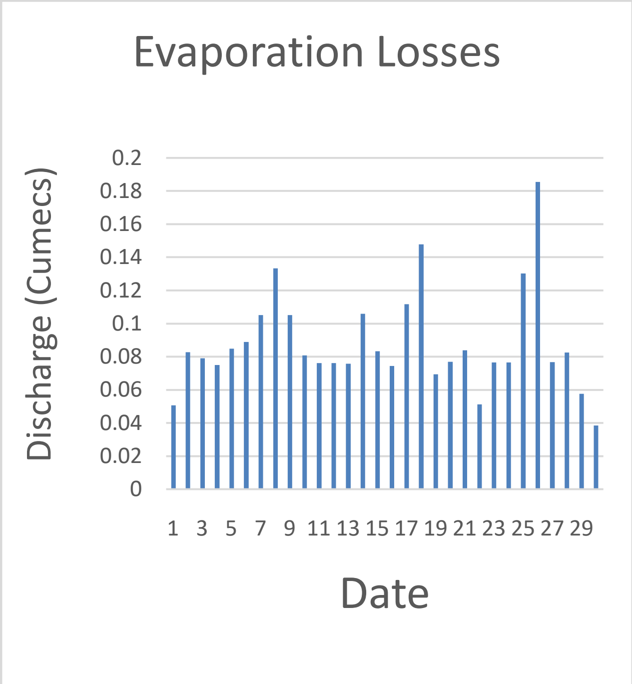


Figure-5.9. Evaporation Losses in November 2016

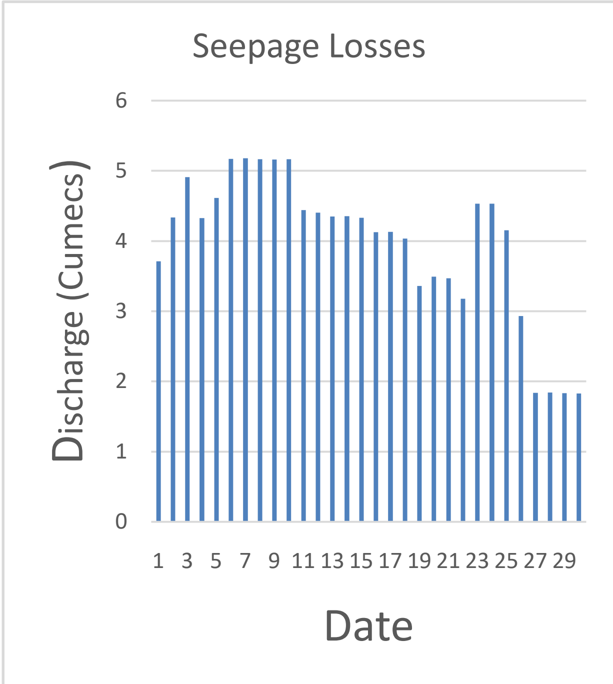


Figure- 5.10. Seepage Losses in November 2016

- **December 2016**

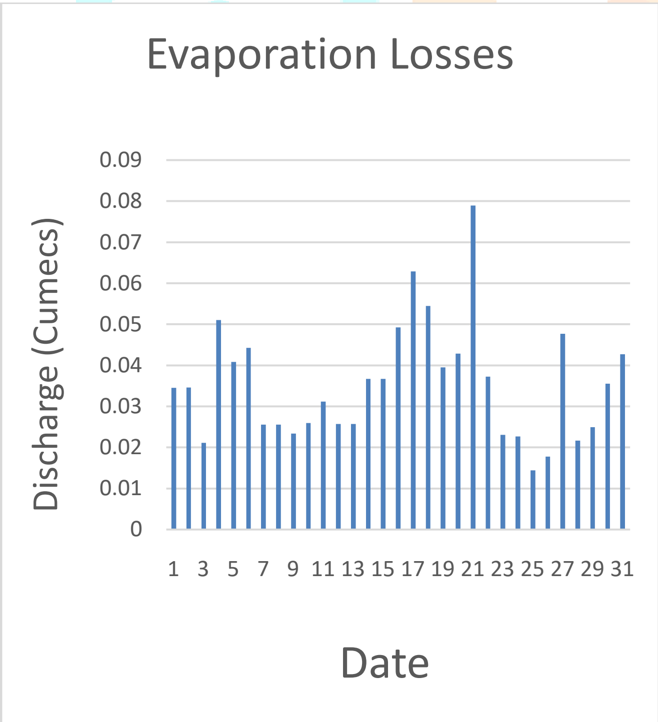


Figure-5.11. Evaporation Losses in December 2016

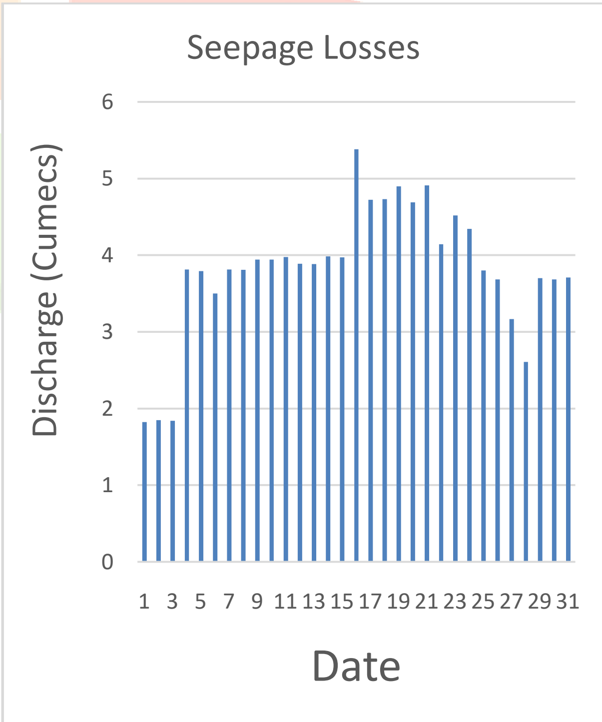


Figure- 5.12. Seepage Losses in December 2016

6. Method of Reducing Seepage Losses and Evaporation Losses

6.1 Reduction of Seepage Losses: -

Lining reduced the water loss on an average by 18% to 19% but some time crack is develop and cause seepage loss. So cracks in lining can be controlled by: -

- HDPE is the geo-membrane whose lifetime is more than any other membrane.
- Concrete with geo-membrane can be used to increase the durability of lining.
- Polyolefin material has high breaking strength and can be used as canal lining because of easy placing, light weight than any other material.

- However, material recommendation for canal lining depends on the locally available material, budget, most importantly soil characteristics to infiltration and the environmental condition of the site.

6.2. Reduction of Evaporation Losses: -

The evaporation losses can be reduced by the following methods: -

- By providing the chemical film layer over the water surface which controls the direct effect of sunlight on the water surface and hence leads to less formation of vapours and which leads to decrease in evaporation losses.
- It is economically favourable to implement solar panels over the canals to prevent losses and produce power.

Conclusion

A project entitled, "To estimate total water losses in a canal area" was undertaken at the site of Munak Canal. Followings conclusion could be drawn from the findings of the present study: -

- Velocities of flowing water were found to be maximum in lined canal which destroy the lining of the canal and ultimately increases the seepage loss in the canal.
- Overall seepage loss was found to be 4.4524%.
- Maximum seepage loss was found to be 6.881496cumecs and minimum seepage loss was found to be 1.822601cumecs.
- Average seepage loss was found to be 4.491184cumecs.
- Overall evaporation loss was found to be 0.1126%.
- Maximum evaporation loss was found to be 0.2531cumecs and minimum seepage loss was found to be 0.0211cumecs.
- Average evaporation loss was found to be 0.101211 Cumecs.

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