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IRRIGATION ENGINEERING

[BTAI 2201]

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Losses of Water in Conveyance

❖ **Evaporation Loss**

❖ **Seepage Loss**

Evaporation is the process of conversion of water from liquid state to gaseous state & its transfer into the atmosphere in this form. It is a natural & continuous process because of falling of incident rays of solar radiation on water bodies. It is a surface phenomenon.

Rate of evaporation depends upon climatic factor like temperature, wind velocity, relative humidity of air , nature and size of water body.

In summer season, these losses may go upto 7% of the total water diverted into main canal.



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It depends on water spread area of canal & is a function of side slope of canal & depth of flow. If side slope of the canal is flatter ,then water spread area will be more and hence evaporation loss will be more. For a given side slope, water spread area depend upon depth of water in the canal. If the depth of water in canal is more, the losses will be less.



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Seepage Loss

Seepage is the most dominant process by which water is lost in the canal.

It is necessary to prevent seepage loss to save costly irrigation water

Seepage loss varies spatially due to different soil types & hydraulic conditions. The bed material of the canal is a dominant factor deciding seepage loss. If the bed material comprises heavy soil, then seepage loss will be less.

Ground water table position also affects seepage loss. If the water table is farther from ground, then hydraulic gradient causing downward flux of seepage will be more. For a newly constructed earthen channel, seepage loss is very high. With progress of time, siltation reduces seepage loss. Seepage loss also depends upon wetted surface area which in turn depends on side slope and depth of flow.



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Computation of Seepage Loss

Inflow-Outflow Method:

In this method, a canal section is chosen which must be as far as possible straight and uniform. F

Flow entering into & going out of the section is measured. Difference of the two readings gives seepage losses in the section.

Allowances must be given to consider the rainfall and evaporation occurring during seepage measurement.

The average wetted area of the section is computed and then seepage rate per unit area is estimated



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Ponding Method

In this method, a selected canal section is blocked with dyke to create a ponding area. Information of the canal geometry and ponding sites is collected.

Water into the ponding area is fed. Water level readings using pre-installed staff gauges for several consecutive days are taken. By knowing the difference of water level that recedes during two consecutive sampling period and cross sectional area of the water in the channel section, the total volume of water lost is calculated.

Subtracting the evaporation loss and rainfall if any from the total loss of water, seepage loss is computed. Then, the unit seepage rate over the wetted area is calculated.



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Advantages of Lining

- ✓ **Water Conservation**
- ✓ **Seepage Control**
- ✓ **Prevention of Water-logging**
- ✓ **Reduced Canal Dimensions**
- ✓ **Reduced Maintenance**
- ✓ **Increase in Command Area**
- ✓ **Elimination of Flood Dangers**



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Disadvantages of Canal Lining

- Initial cost of canal lining is very high. It makes the project expensive with respect to output.
- It involves much difficulty for repairing the damaged section of lining.
- It increases the time period to complete the project.
- If the outlets are required to be shifted or new outlets are required to be provided, it becomes difficult because of dismantling the lined section of the canal.



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Methods to Reduce Seepage Losses

Reducing Wetted Surface Area: Seepage increases with wetted area & so special considerations during design must be given to minimize wetted area per unit of discharge.

This may be achieved by increasing the side slope i.e. steepening the sides of the canal and increasing the depth of water in canal section.



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Use of Sealants

A number of sealants/ lining materials are now available to reduce the seepage loss.

Lining of the canal though costly can reduce the seepage loss and improve the effective flow capacity of the canals. Different lining materials used to reduce the seepage losses are:

Clay Lining: Clay lining can be applied by two methods;
(i) by placing a blanket of relatively impervious clay 15-30 cm thick over or within the permeable bed and sides of the canal

(ii) by dispersing clay in water & having it filtered out and seal off the pores in the permeable lands.



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Cement Concrete Lining

Structures lined with cement concrete are stronger and more stable than lined with any other material. It gives long service. Though the initial investment for lining is more, later on the repair and maintenance costs are less. It has a longer life than any other type of lining.

Concrete mixture usually recommended for lining is 1:3:4 (cement:sand:gravel) and thickness for lining is 4-5 cm (Biswas, 2008). The sides and bottom of the structure should be compacted at suitable moisture content. When concrete hardens, it shrinks and cracking may result. Joint must be provided at a distance not more than 2 m in order to localize and control the cracks.



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Pre-cast Concrete Lining

This type of lining is recommended for canals in full banking. It consists of pre-cast concrete slab of size 60 x 60 x 5 cm which are set along the canal bank and bed. Rebates are provided on all the four sides of the slabs to form proper joint when the slabs are kept side by side. The joints are finished with cement mortar 1:3



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- **Cement Mortar Lining**
- **Lime Concrete Lining**
- **Shotcrete Lining**
- **Soil Cement Lining**
- **Asphalt Lining**
- **Boulder Lining**
- **Brick Lining**
- **Bentonite Lining**
- **Soil deflocculents like sodium carbonate, sodium chloride**
- **Polythene Lining**



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Selection of Type of Lining

- Imperviousness
- Smoothness
- Durability
- Economy
- Site Condition
- Life of Project
- Availability of Construction Material



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