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PIPE DISTRIBUTION SYSTEM INSTEAD OF CANAL DISTRIBUTION SYSTEM

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Abstract

Water which is a valuable, finite, renewable and shared required by various sectors must be managed optimally. Stress due to scarcity of water is growing at an alarming rate. To reduce this stresses and to meet water demand of all the sectors , construction of new water projects is essential but it involves large investment and social problems like land acquisition , rehabilitation etc, improving efficiency of existing project, use of advanced technology for water application and recycling of water are some of the solutions Irrigation sector is the biggest consumer of water more than 80% of available resources in India are being presently utilized for irrigation purpose serving at just 25-40% water use efficiency. Thus there is large scope of increasing efficiency in this sector to avoid loss of 60-75% water. The objective of this paper is to emphasis on the use of Pipe Distribution Network (PDN) instead of Canal Distribution Network (CDN) in command area of irrigation project to improve efficiency of water use. By virtue of PDN the water use efficiency can be improved to 70 to 80 % from existing efficiency of 25 to 40 %. Thus there is about two to three times increase in the water use efficiency for irrigation, which means that there will be 55 to 65 % improvement in overall water use efficiency as irrigation itself is 80% shareholder in water use. In this paper, focus is placed on the use of PDN instead of CDN in command area of irrigation project to improve efficiency of water use. By virtue of PDN the water use efficiency can be improved to 70 to 80 % from existing efficiency of 25 to 40 %.

Index Terms: *canal distribution system, pipe distribution system, water use efficiency.*

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1. Introduction

1) Nature has endowed our country with abundant Water Resources. However due to limitations of topography, geology, physiographic, dependability, quality and the present state of technology, only a part of available water resources can be utilized. The utilizable water for irrigation is further limited considering other competing demands for domestic, industrial uses, recreational activities etc. It is a matter of great concern that this is happening at a time when there is an increased demand for various agricultural products due to phenomenal growth in the population. The need of the hour is, therefore, to maximize the production per unit of water, besides effecting utmost economy in water use for agriculture.

2) The major thrust area at present has been to improve the efficiency of irrigation systems, which includes rehabilitation and modernization of existing and ongoing irrigation systems by better operation and maintenance and more flexibility in regulation and scheduling of irrigation water. Modernization and rehabilitation does not necessarily mean only engineering measures such as modifications, improvement in storage, conveyance and distribution components of the project but also includes revised planning of cropping pattern for efficient use of water. However, efficient distribution of water is the prime linking factor in themodernisation and rehabilitation of the projects.

3) Pipeline distribution system, in the context of irrigation water supplies is a network of piped system that transports water over long distance all over the command area

4) Pipes have been used for many centuries for transporting fluids. First pipe line for water distribution through gravity flow was laid down in ancient Rome. In1582 pumps were introduced for pipe line distribution in London. Besides the of pipe line to transport water for municipal supply and sewerage, pipelines are most common means for transporting gasses and oils over long distance. Pipe lines are now used in distribution of irrigation water.

5) Various material suitable for pipeline have been developed starting from bamboo pipeline to cast iron, steel, asbestos,

cement, reinforced and pre-stressed concrete, polyethylene low density and high density, reinforced plastic, fibre glass, fibre reinforced plastic, etc. Selection of pipeline material is based on various factors such as required carrying capacity, ability to resist internal and external pressure, life, durability, maintenance etc but the most important factor is economy as pipes represent a large proportion of huge capital involved in water distribution network.

Advantages:

1) Little loss of farm land compared to open channel network
2) Virtually no water loss
3) Prevention of water logging and weed growth
4) Low maintenance cost
5) Better control
6) No loss of water due to evaporation and seepage
7) Better and flexible to operate
8) No soil erosion
9) Installation is easy and fast
10) Long life and higher project life span
11) Diseases and pest problems are minimum
12) Economy in laying as no culverts or other structures are required.
13) Can be clubbed with advanced techniques/pressurized irrigation method.
14) Requires lesser number of CM/CD Works
15) Can deliver water to upland areas also by pumping arrangements
16) Increase capacity by booster pump
17) Nearly 50% less labour requirement as compare to open channel
18) Pressure Irrigation such as Sprinkler/Drip can be introduced easily

Disadvantages

1) Greater initial investment and higher capital investment
2) Corrosion hazards
3) Require high skill in design and installation also Requirement of skilled manpower for installation
4) Not fit for water which contains large amounts of sediment.
5) Identifying leakages is difficult

1.1 situations adopted for pipeline distribution system

1) Water availability is limited and command is extensive
2) There is steep topography/uneven terrain.
3) Heavy seepage losses
4) Adoption of modern techniques is contemplated
5) Canal requires very deep cutting due to steep/rising topography
6) Topography is sloping more than 1 in 500
7) Terrain is very undulating making canals unfeasible
8) There is need to implement modern technologies
9) There is sufficient funds for initial capital investment
10) The requirement of skilled labour and advanced construction & maintenance techniques can be met easily
11) Limited water availability and extensive command.
12) The steep topography where canal system is very expensive..
13) Adoption of modern techniques for future development.
14) Farmers responses and acceptability.
15) Need for diversification.
16) Availability of adequate fund.
17) When high returns are expected.
18) Timely availability of material, technology, labour, maintenance techniques, construction technology etc.
19) The pipeline (gravity flow) is generally feasible in the case of sloping topography having ground slopes steeper than 1 to 500.

12 Planning requirement

In executing the pipeline distribution schemes in the minor irrigation command areas where the open channel system is already in operation, the Main Pipeline replaces the main canal. This avoids the issue of additional land acquisition which is a very critical issue due to very small land holdings (0.2 to 0.5 ha per family) in regions like Konkan. In new schemes there is a flexibility in choosing the alignment of the main pipeline.
For a given size of an individual pipeline distribution systems the discharge ranges between 130 Ips to 500 Ips and hence the pipe diameters generally lie in the range of 300mm to 900mm. The length of main pipe line is also about 3 to 5 km. Different types of pipes such as RCC, PVC, PVC can be used.

The design pressures are in the range from 5 m to 25 m. Therefore, in general, PVC Class 2.5 pipes can be used conveniently. However in hilly terrain, operating pressures in excess of 2.5 kg/cm2 are not unusual. However, in such cases, use of higher class pipes or steel pipes has to be considered. The pressures in the main pipe line of a minor irrigation scheme is generally upto 10 m and hence RCC pipes of NP2 class are used. For higher heads P1 Class pipes are used. Since the main line generally follows the alignment of the canal (generally along contour), .head drop along the main line is less (about 1 to 5 m loss of head). However, quite frequently there are a number of falls along the alignment and hence the main line can be subjected to 18 large static pressures and hence a P1 class pipe needs to be considered. The allowable heads under each class of pipe may be seen in Table - 1 and Table - 2 for RCC and PVC Pipes respectively. In case where the pressures are higher than 25 m, float valves are deployed to break the pressure to a lower value so that the conventional RCC, PVC Pipes can be used. PVC pipe are formed at site by spirally wound PVC ribbed. Strips. These are generally available in diameters from 150 mm to 1000 mm and in required and manageable lengths. These pipes are light weight. The working pressure depends on the diameter and the type of profile of the strip. But is the range of 0.5 to 2.25 kg/cm2.

1.3 Installation requirement

The pipeline should be allowed to come to within a few degrees of the temperature that it will have after complete

covering prior to any backfilling beyond shading. The pipeline should be installed at sufficient depth below the ground surface to provide protection from hazards imposed by temperatures, or soil cracking. The minimum depth of cover should be as follows -
(i) 450 mm for pipes 25 to 60 mm diameter
(ii) 600 mm. for pipes 75 to 100 mm diameter
(iii) 760 mm. for pipes 125 mm or more in diameter.
Thrust block - Thrust block should be provided as per requirement.

2 Steps to be followed in planning and designing of pipeline system

1) Decide the chak size below an outlet. The chak size should be so selected that it should be between 5 to 12 ha. Mark the boundaries of a chak.
2) Mark the alignment of PVC pipeline. The alignment of PVC pipeline should be so decided that it generally passes through the centre of chak area.
3) Fix the positions of Tee/Chambers on main line and branches of PVC Line. Generally, the Tee is provided for an area of about one Ha. The position of chamber is so selected that the complete area can be irrigated without any hindrance.
4) Prepare the rotational water supply scheduling considering two or three chambers run at a time and period of irrigation is 6 days in a week. From this, decide the discharge that a particular reach has to carry taking into consideration that each chamber will discharge a flow of 10 to 15 lit/sec. The rate of discharge can be varied by considering infiltration rate of soil and slope of ground profile.
5) Knowing the discharge through a particular reach, find out the frictional losses in that reach by using the monogram received from manufacturers. To account for the losses due to Tees, bends etc. equivalent length of 10 m of pipe is considered. As far as possible, the discharge in the line should be modular during all the rotations. This can be adjusted by fixing the seasonal 'ON-OFF schedule as per the water availability and the crop water requirement. With modular discharge, the design and the operations can be made
much simpler.
6) The hydraulic gradient line (HGL) at start of PVC line is taken as sill level of outlet as mentioned above. Thus knowing the H.G.L. at the end of particular reach is worked out by deducting the frictional losses through that reach.
7) Diameter of pipe is so decided that the effective head i.e. (HGL-GL) should not be less than 0.60 m. However, in exceptional cases effective head to the extent of 0.30 m may be allowed.
For laying pipe line distribution system, the plane table survey should be carried out. Before that village maps should be collected, property records of 46 individual farmers shall be verified and checked from the revenue records.
Total command shall be checked on the basis of revenue land records.
The information regarding existing {prevailing at the time of survey) cropping
pattern should be collected from revenue record. For future crop pattern, the
Agriculture Department should be consulted.
Data of strata classification for estimation of earthwork for pipeline laying should be collected.
Relevant climatological data for working out the crop water requirement should be collected.
A market survey for availability of various sizes of pipes along with product price should be conducted.
Block contour plan having contour interval 0. 3 m may be prepared for full command to be covered by pipe distribution system.
To check the adoptability of pipeline distribution system by beneficiaries, a socio-economic survey of the area should be carried out.

3 Guidelines

OPERATION GUIDELINES

After the pipe line system is installed and tested, responsibility of those who have to operate and maintain is started. To facilitate easy operation and maintenance, following instructions and data shall be taken into account:

a) Drawings
b) Test details
c) Equipments Information
d) Operating Schedules & Instructions
e) Spare Part List
f) Pipe and Valve specifications
g) Soil, data G.W.T. etc.

Operation should be such that it should work with full efficiency for wide range of variation in discharge. Sudden closing of valves and opening should be avoided. Sequence of opening and discharges should be as per operation schedule.
For efficient operation, measurement of discharges at various points will be controlling factor

REPAIRS MANUAL

a) General repairs should be carried out by experienced and trained persons.
b) Maintenance personnel should be familiar with the leak detecting tools viz. Pipe locating devices, Repair Clamps, Repair Couplings.
c) Cracks, breaks, debris and infiltration leaks etc. should be located and repaired.

MAINTENANCE MANUAL

1) Current repairs or ordinary repairs and special repairs are generally carried out as and when necessary.
2) Keeping sufficient stock of spares, timely inspection to locate leakages, observation of discharge security and protection of pipe line are main guiding factors for maintenance purpose.

OPERATION MANUAL

For pipeline distribution, the guidelines for conducting successful operation is necessary. Therefore, it is recommended that operational manual should be prepared. It shall include the guidelines for operation system layouts, precautionary measures, the responsibility of operation staff, instructions for various emergency procedure

Problems and precautions

Generally, most concrete pipeline systems will operate without any trouble. But there are always a few failures, generally of the following types:

i. Development of longitudinal cracks in the pipe, principally in the top or in both top and bottom.
ii. Telescoping of sections.
iii. Pipes pushed into the stands.
iv. Development of circumferential cracks.
v. Surging or intermittent flow of water.

The first four types of failures are closely related. The cause of most failures (types, i, ii & iii), and the prevention of some (type iv} stem from the fact that concrete expands when wet, and contracts when dry. Concrete also is affected by temperature, it expands when heated and contracts when cooled. Circumferential cracks are caused by a drop in the water or soil temperatures or by drying out of the pipe. Such cracks may be partially prevented by prestressing the pipe longitudinally. The axial stress set up in pipe by the natural restraint of longitudinal expansions is a partial cause of longitudinal ripping, and also the cause of telescoping and of pipes pushed into structures. The longitudinal rips normally occur within a few days to a week after the pipe is laid. Failure from the above causes can be avoided by proper laying procedure.

If no compromises are made on quality of pipeline and quality of joint, no pipeline shall leak.

Pipeline leaks only if there's a major human negligence, in respect of construction and operation. Some of the precautions are:

i) Use damp soil for the initial backfill when birth the pipe.

ii) Minimize air circulation through a line once birth pipe and once line isn't in use.

iii) Avoid birth pipe in extraordinarily hot, extremely cold or in wet weather.

iv) Furthermore once pipelines leak, the leaking water appears on the ground as a wet patch almost immediately and can be repaired easily. Regular scrutiny to attend to such eventualities is critical.

v) In general, structured network system is much more useful and convenient for the operation.

vi) Distribution chambers to be cleared for silt/debris seasonally.

vii) Ball to be inserted for the silt clearance

viii) Valve/ outlet to be provided at the lowest level of the system to facilitate flushing.

ix) Periodical flushing of the system is necessary.

Surges in pipelines (type v) is one of the common disadvantages of an open type system with overflow stands. Air becomes entrained in the water as it over pours the lip into the down-stream portion of the overflow stand. This intimate mixture of air and water is carried down into the reach of pipe downstream from the stand and because of the turbulence of the flow, the tendency for the air to separate out is minimized. Therefore, after a short interval the upstream portion of this reach of water sometimes becomes lighter than the downstream portion causing a reversal of hydraulic gradient, until the water with entrained air flows back to the stand and the air is dissipated. Thus, forward flow is only in cycles. The line functions at only a fraction of its capacity, and the water is difficult to handle. The following observations have been made with regard to surging;

i) Most trouble occurs at low flow because at near capacity flow there is little, if any, fall of water over the baffles.
ii) Relief is obtained by placing gate valves in the baffle walls (or between the upstream and downstream portions) of overflow stands and closing these gates only enough to create the pressure necessary for operation of upstream hydrants or laterals.
iii) Relief is also obtained by placing an airtight cover over the overflow stand in question.

3. CONCLUSION

Considering the scarcity of water, it is recommended that irrigation in command shall be popularized through pipeline distribution system. Local pipe fabrication industries should be encouraged and given incentives and avoid excessive transportation cost of pipe.

1) Concession in various excise duties should be given to keep less manufacturing cost of pipe.
2) Large scale pipe manufacturing industries should be established.
3) The Planning for deriving maximum benefits from pipeline distribution system should be effectively implemented.
4) Farmer is the primary beneficiary of the system. His involvement should be given prime importance for maximization of production.
5) For accurate climatological data, climatological stations should be installed in the command.
6) For perishable agriculture products, market facilities shall be made available.
7) In case of major and medium projects, instead of the minors and field channels, low pressure pipeline system for irrigation should be adopted.
8) In case of minor irrigation project, entire distribution system may be of pipeline.
9) There is substantial water saving over conventional open channel system.
10) The pipe line distribution system should be preferred where land cost is comparatively high and farmers are reluctant for sparing the valuable land.

For judicious use of water the modern techniques namely sprinkler and drip irrigation can be enlarged. The pipe line

distribution system would be more suitable implementation of advance techniques.

11) It is recommended that in case of excessive seepage and trouble of burrowing animals, the pipeline distribution system should be preferred. Canal falls and steep gradients are most favourable for introduction pipe line distribution system.

12) Operation and Maintenance Cost is minimum compared to conventional irrigation.

13)Advanced material like PVC - RIBLOCK, Fibre Glass-RP is more suitable because of low cost, light in handling and smooth finishing and easy repair facility..

REFERENCES

- Khair, A. and Dutta, S. C (2000). Low cost canal lining for avoiding water losses to achieve efficient water distribution at farm level.
- Indian National Committee of Water Resources (Constituted by Ministry of Water Resources, Govt. of India) (1998). “Pipe Distribution System for Irrigation”.
- Kolhe P. (2012). “Optimal Utilization of Irrigation Water by Use of Pipe Distribution Network (PDN) instead of Canal Distribution Network (CDN) in Command Area”, India Water Week 2012 – Water, Energy and Food Security.
- Satpute M., Khandve P., Gulhane M. (2012). “Pipe Distribution Network for Irrigation – an Alternative to Flow Irrigation”, Section VII Environmental Sciences Proc. 99th Indian Science Congress, Part II