

CEMENT PREFABRICATED PIPE MAKING AND ITS APPLICATION ON AGRICULTURE IRRIGATION

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ABSTRACT

The concrete pipe used to distribute irrigation water to the right place now available is commonly made up of cement, sand, earth, pebble, etc. These materials with right ratio and right amount of water were mixed and squeezed through the pipe-making machine called vertical squeezed pipe-making machine, and then a cement prefabricated pipe is produced. This kinds of pipe has been expanding by leaps and bounds. Being little cement contents and low cost, the length of pipe is 1.0m or so with weight of 50 kg, which is easy to be made and to be transported. The demolish pressure of it is 0.2 MPa or so, which meets the needs of agriculture irrigation. The buried pipe irrigation system, has been popularized in Jining Municipal, Shandong Province. By the year of 1995, the irrigation area under pipe conveyance system using this type of pipe has reached 74000 hectares. By calculation, about 27.7 million m³ water, 2.88 million kWh power, 0.167 million man power and 1528 hectares cultivated land will be saved one year, adding value of agriculture output increased by 10 million kg. The total economic benefits amount to 0.92 million US\$ a year. The paper presents the pipe making course and its application on a large scale area.

Key Words: Cement Prefabricated Pipe, Pipe Lines, Water Transfer Irrigation technology, Water Saving Use

INTRODUCTION

Jining, a city in Shangdong province, administers 12 counties and 180 towns, covering an area of 10865 km², with a cultivated land of 551 thousand hectares. The city has a population of 7.27 million, among them 6.34 million are farmers. On an average, there is 0.087 hectares of farmland per capita. Situated in a

complicated geographical position, the city is made up of hilly area, lake region, as well as alluvial plain. The annual rainfall in average is 684.9 mm, in which 73% is concentrated in the flood season. In the plain area of the city, well irrigation has a long history. Since 1950s, greater development has been made in well irrigation. At present, this region has possessed 103.7 thousand tubewells with total installation 767 thousand kW. And well irrigation area has extended to 230.3 thousand hectares. The plain area has now developed into a commodity grain and cotton production base.

However, with the development of agricultural production, the increase of water consumption brings about more and more acute. Especially since 1980s, the continuous dry weather, particularly from 1986 to 1989, resulted in a serious drought with all the rivers, lakes, reservoirs and ponds dried up. The rainfall was 15% to 44% less than usual. All the surface water resources were running dry, which speeds up the exploitation of ground water resources, as a result, causing the imbalance of extraction and supplement of ground water. With the drop of the ground water level, overdraft regions covering a large area of 5 counties occurred in the city. The ground water depth at the cone of water table depression reaches to 20m. At the same time, the backward irrigation techniques led to serious waste of irrigation water. So saving water as well as making better use of water resources have become an urgent matter nowadays.

EQUIPMENT AND METHODS

New Materials Chosen for Pipe-making

There are various kinds of materials for making pipes, which are made of metal; plastics, stone crumb concrete and lime soil, etc. The investigation shows that, it is difficult to popularize the metal pipes as well as plastic pipes in a large scale area due to their high cost. It is not suitable to use plastic soft pipes and lime soil pipes either, even though their price is low, they are easy to be damaged and can only be used in just a short time. So the best choice is stone crumb concrete pipes, which can be used for such a long time as over 20 years. Its main materials concerning stone crumbs, sand, cement and coal cinder are easy to obtain from thermal power plants, sufficient to meet the need of pipe production. Stone crumbs and coal cinder all are the wasted material from factories, meanwhile this work can be considered as the disposal of the wasted materials, which is favorable for improvement of environment. Its price is only half of the plastic pipe's price. So the stone crumb concrete pipe is welcomed by farmers and easy to popularize.

Pipe-making Machine Developing

In order to satisfy the need of large amount of low pressure pipes, we develop and set up three factories to produce pipe-making machines. At present in the city 35 machines have been installed, which can produces 1.8 million meters of low pressure pipes a year. For the purpose to guarantee the pipe's quality, according to the performance of local materials, each factory would be made mixing ratio experience to optimize the mixture ratio of materials for making pipes. The optimum materials of the low pressure pipes produced by Qufu city is shown in Table 1, and the pipe-making machines is shown in Fig. 1.

The quality examination presents that seepage prevention pressure of the low pressure pipe is between 0.1 and 0.2 Mpa; damage control pressure is between 0.3 and 0.5 MPa, which attain the design criteria and satisfy the quality of low pressure pipe.

Design of Pipe System in Line

The design of layout plan of pipes directly affected the investment and irrigation efficiency. The layout plan was required less expenses, higher efficiency, and easy to be operated. According to the topography and water source conditions, there are several types of piping layout as follows:

(1) A tubewell is set in the middle or a corner of a field. When groundwater outflow is larger, both main and branch pipes can be used as shown in Fig. 2(a).

(2) If a tubewell, located in one side of a field, has less outflow, the main pipe can be set as the fixed buried pipe and the branch pipe and the branch pipe as the potable soft pipe as shown in Fig. 2(b). In general, when the slope is $I < 0.001$, diversion water at both sides is used, when $I > 0.001$ diversion water only in one-way can be used.

Quality Control in Construction

Low-pressure pipe irrigation project require not only meticulous design but also careful construction. At present, all the villages and towns have set up professional teams qualified for low-pressure pipe's construction. Concerning to the construction technique, emphases are laid on the following points:

1. A firm channel must be laid for burying pipes. If the bottom earth is loose, ramming work must be done to prevent sinking and damage of pipe. Generally speaking, the width of channel is equal to pipe's outside diameter plus 0.7m, and the depth plus 0.8m.

2. It is very important to deal with the joint while installing pipes. The method of wrapping with gauze is now widely used in the city. First, wash the pipe with clean water; smear cement mortar on the mouth of bell and spigot joint and connect them tightly. Then put a 10 cm- wide and 1 cm thick gauze on a felt with

the same width. Smear cement mortar on it with 1 cm thick. Then wrap the joint with gauze, slightly pat it. With the same method, wrap one more gauze on the joint, and once more smear cement mortar on it.

After the completion of the pipe's construction, operation experiment is necessary to be done beforehand. Check the joint points and pipes to avoid seepage. In order to prevent sinking, the backfill soil should be a little higher than the ground earth.

Management

In the operation management of the pipe network projects, based on the flow of the pipe, it is necessary to make sure the number of branches for rotation irrigation. Before irrigation, the potable pipe on the ground needs to be connected first, then switch on the hydrant, and finally pump the water. It is unallowable to pump water before opening the hydrant. When the first rotation irrigation is almost finished, do be sure to switch on the next hydrant of the other irrigation field before switching off the irrigation hydrant.

In the management of pipe irrigation, pipe irrigation service teams are organized, generally with one village as a unit to take charge of tube wells and appoint the machinists and irrigators. Scientific water management plan has been worked out for reasonable distribution of irrigation water. For the purpose to save water and improve irrigation quality, water fee is in common collected in the city.

RESULTS AND DISCUSSION

In Liuhong Village of Wenshang County, a pilot area of 684 hectares was set up and completed by the end of 1988, burying stone crumb concrete distribution pipes 61399m long, with an average of 89.76m for one hectares. The average input was \$ 123 per hectare. The measurement and investigation on the pilot area show that the low-pressure stone crumb concrete pipes have a lot of benefit which can save water 40%, 4050 m³; electricity 32%, 397 kW; land 1.7%; labor forces 22.5 working days; and increasing production 18% per hectare one year. The comprehensive economic benefits amount to \$102/hectares year.

The main experiences in the development of the pipe irrigation are as follows:
Carry on Active Propaganda, Set up Multi-example for Demonstration

In order to popularize the pilot experiences of pipe irrigation technique in the city, active propaganda work has carried out and a lot of pilot areas have been set up. Local leaders as well as technical personnel from different counties were sent to Wenshang County to learn this new irrigation technique.

Strengthen the Administration's Leadership in an Effort to Popularize the Pipe Irrigation Technique

It is an important reform in farm irrigation to popularize the pipe irrigation technique on a large scale. The special group for popularizing the pipe irrigation in the local government at different levels has been set up and they placed this task on the agenda as the objective responsibility system during their office term. Since the year of 1988, the target has been formally assigned by the municipal administration concerning the popularization of the pipe irrigation area. And the inspection is made at the end of every year. The award for spread of pipe irrigation, comparing and appraising the quality of work is carried out once a season and also a summary meeting is held once a year. On the spot investigations are organized here and there to exchange experiences.

Carrying forward the Spirits of Self-reliance in the Collection of Construction Fund from Many Ways

The construction of low pressure stone crumb concrete pipes requires a large number of constructive fund and materials. The main way is to encourage the spirits of self-reliance and mobilize farmers. The labor forces can be solved by accumulating labor, i.e. according to the rule set by the state, each laborer must work in public water conservancy work for 10 to 20 working days a year. In the aspect of raising fund, we adhere to the principle of collecting fund mainly from collectives and farmers with subsidy from the state. According to the estimation from the 74000 hectares pipe irrigation area, each hectare on an average, needs to be put into an amount of \$164. The proportion of fund is that a country administration subsidizes a sum of about \$41 to \$56 per hectares of pipe irrigation area. Township administration subsidizes an amount of about \$27 to \$41 per hectares. Farmers raise a sum of about \$82, accounting for about 50%. Since the year of 1988, the total collected sum amounts to \$10.9 million. In addition, we put into effect the policy of benefit and responsibility, i.e. the farmer getting benefit from pipe irrigation will bear the financial responsibility; more benefit, more financial responsibility, and of course, no benefit, with no responsibility.

CONCLUSIONS

The buried pipe system using cement prefabricated pipe for irrigation has been popularized in the city. By the end of 1995, the city completed a pipe irrigation area 74,000 hectares, making up one-third of the total well irrigation area of the city. Based on the construction finished work, the economic analysis shows that buried pipe system for irrigation can save water 277 million m³ ; electricity 28.86

million kWh; labor 1665 million working days; enlarge land 1258 hectares; increase grain production 100 million kg; and the total annual economic benefits amount to \$ 9.23 million one year. The period of capital recovery of the project is 1.21 year.

Table 1 The Optimum Ratio Materials of the Low Pressure Pipes

Parameters of Pipe				Ratio			
I.D.* (mm)	Thickness (mm)	Length (mm)	Weight (kg)	Cement (%)	Sand (%)	Coal-cinder (%)	Stone- crumb (%)
150	25	1000	30	20	40	20	20
200	30	1000	46	20	40	20	20
300	40	1000	90	20	40	20	20

* I.D. = Inner Diameter.

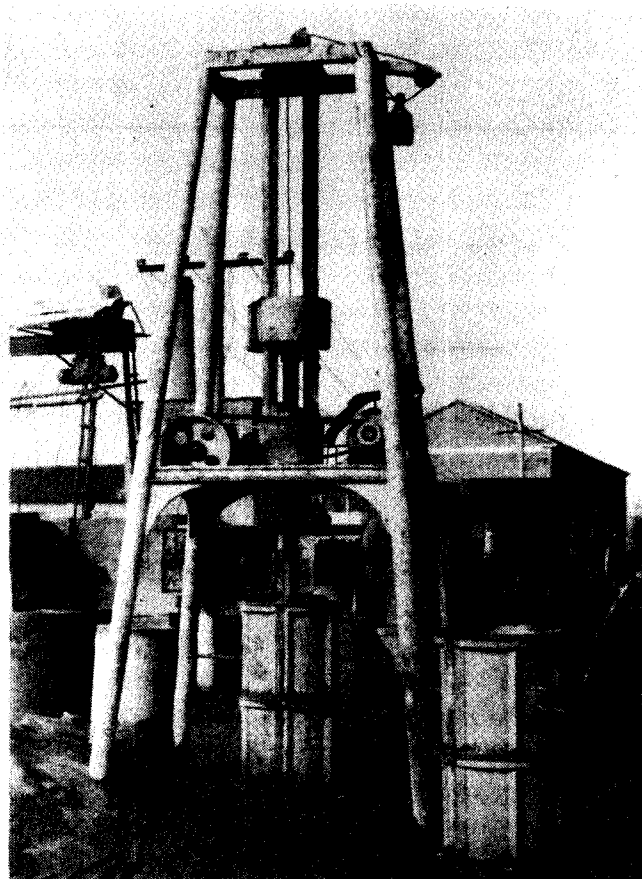
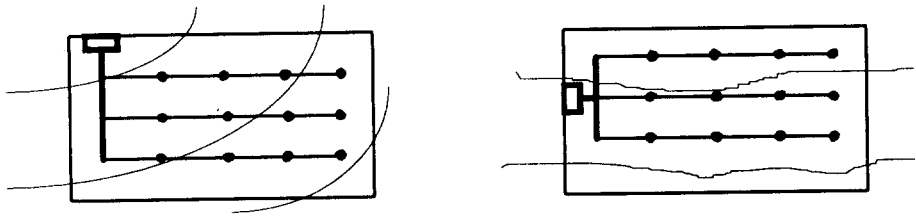
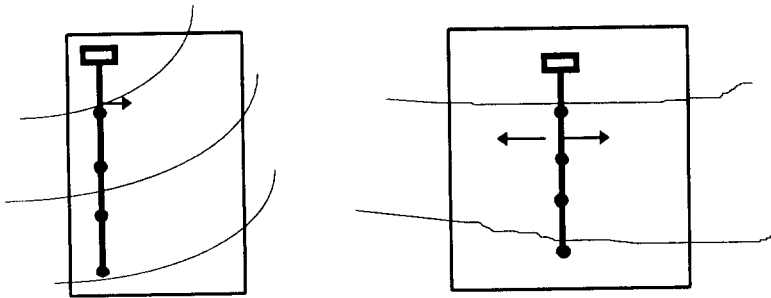


Fig. 1 The Photo of Vertical Squeezed Pipe-making Machine



a) For Buried Pipes



b) For Single-level Buried pipes

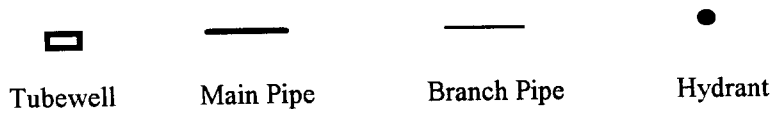


Fig.2 Layout of Buried and Single-level Buried Pipe