JOURNAL OF INDIAN WATER WORKS ASSOCIATION, 1980, Vol XII No. 1 (Jan-March)

Innovations in Water Extraction from Aquifers using Permeable Capsules

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1. INTRODUCTION

In Tamilnadu State, river courses have been exploited for drawing drinking water by means of Collector wells, Infiltration wells, Infiltration galleries and Infiltration basins. A patented device, Permeable Capsule is being tried for extracting water in some of these situations.

2. DESCRIPTION OF THE PERMEABLE CAPSULE

This device consists of inert particles which are bonded to each other by means of a suitable adhesive in the shape of an open container. Usually, a PVC collar is provided at the end. This end can be incorporated in a Tee or a coupler of suitable material such as PVC. By providing tees and couplers at suitable places in a pipe, the pipe can be made permeable at these selected points, and could be used in the aquifers to draw water in sumps or wells. The permeable capsule is a patented device. The assembly of capsule and the PVC pipe, is resistant to chemical corrosion. These pipes have been used by the author in collector wells and are to be tried in infiltration basins.

3. COLLECTOR WELL

The collector wells commonly installed in India are concrete wells with bottoms plugged, and have steel slotted pipes, which are hydraulically jacked into surrounding aquifer horizontally. Later, the fine sand in the region surrounding the slotted pipe is flushed in and drawn out resulting in a coarse particle shroud around. This arrangement yields copious water if the aquifer is good. However, driving the slotted steel pipe needs elaborate machinery and the well has to be constructed to accommodate this. Further, the lateral has a tendency to rise up towards the surface which reduces its capacity. The slotted pipe has to be of steel for reasons of strength and corrosion cannot ruled out over a period of time.

Some of these problems are got over by using the pipes with permeable capsules (Fig. 1). One 4 ft diameter well was installed with 4 arms of 110mm PVC pipes, 20 ft long each, incorporating a total of 32 permeable capsules. The assumption made was that each capsule would yield 5 gpm giving a total of 160 gpm. It was observed that for a draw-down of 3.6 M, the actual withdrawal was 1000 lpm (220 gpm), which was satisfactory. Theoretical calculations show that the yield may be 2000 lpm. The difference in actual yield and theoretical yield may however be due to non-coverage of the entire aquifer by the lateral arms: Probably, had 6 or 8 arms been provided, more water might have been extracted. In this system, the well acts as a collection sump. So, structurally it does not need to be as strong as in the conventional collector well.

The laying of the lateral pipes from the well was done by excavation. Sheet piles were driven in the sand, the material between the sheet piles was excavated. When appropriate depth is attained, the laterals with permeable capsules are laid and connected to the

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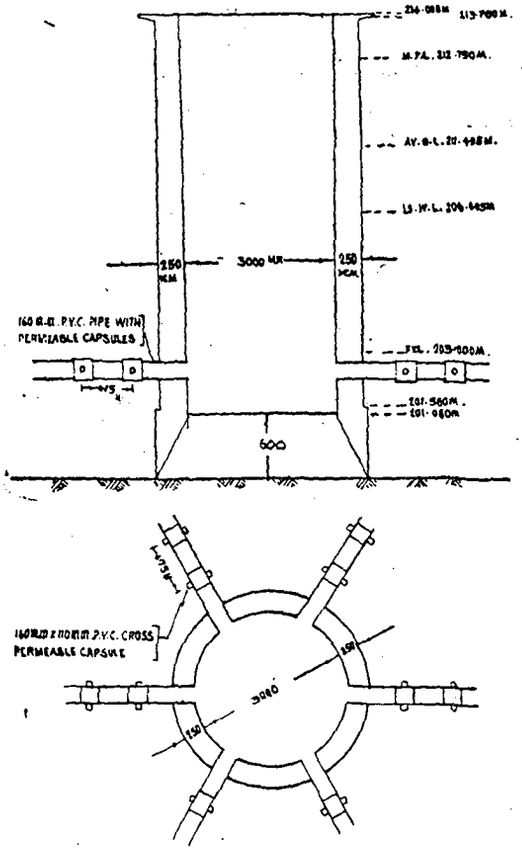

Fig. 1. Proposed type Collector Well.

well. This obviates hydraulic jacking operation. Since the pipe is merely laid, it need not be as strong as steel. So PVC pipe could be used. The corrosion resistance for the PVC pipe set-up is much higher than that of steel, and it is therefore expected to last longer. Since a coarse sand shroud can be provided from outside, development as such is unnecessary. Also the work lends itself to speedy execution.

The first well installed at Muttakadu in 1975 is found to be functioning satisfactorily. A similar system was installed at Thonithurai near Nagarcoil in Tamilnadu where a well on a river bank rested on a clay-layer. Two laterals were laid in the river and connected to the well. The well is now found to yield sufficient quantity of water. In another place, Tada, near Madras-Andhra border only 10' depth of sand with water at 4' depth was available. A clay layer below this, when punctured, gave iron rich water which was totally unsuitable. A 6' diameter well 10' deep was installed. From this, two laterals 50' long and with 10 permeable capsules in each lateral were laid, giving 58,000 gallons per day of good quality water from the top layer.

4. COST

Estimate on the basis of actual expenditure for a collector well with slotted steel pipe and PVC pipe with permeable capsule showed very substantial saving as given below:

Thus it can be seen that a collector well with laterals fitted with permea-

Sl. No.	Particulars	Collector well with slotted steel pipe	Collector well with PVC pipes fitted with permeable capsule
1.	Well	3·5M dia RCC well	3M dia well
2.	Wall thickness	150 CM	30 CM
3.	Length of lateral	240 M	240 M
4.	Bottom plugging	250 cm	60 Cm
5.	Expected yield	1 M.G.D.	1 M.G.D.
6.	Cost	Rs. 7·56 lakhs	Rs. 2.82 lakhs

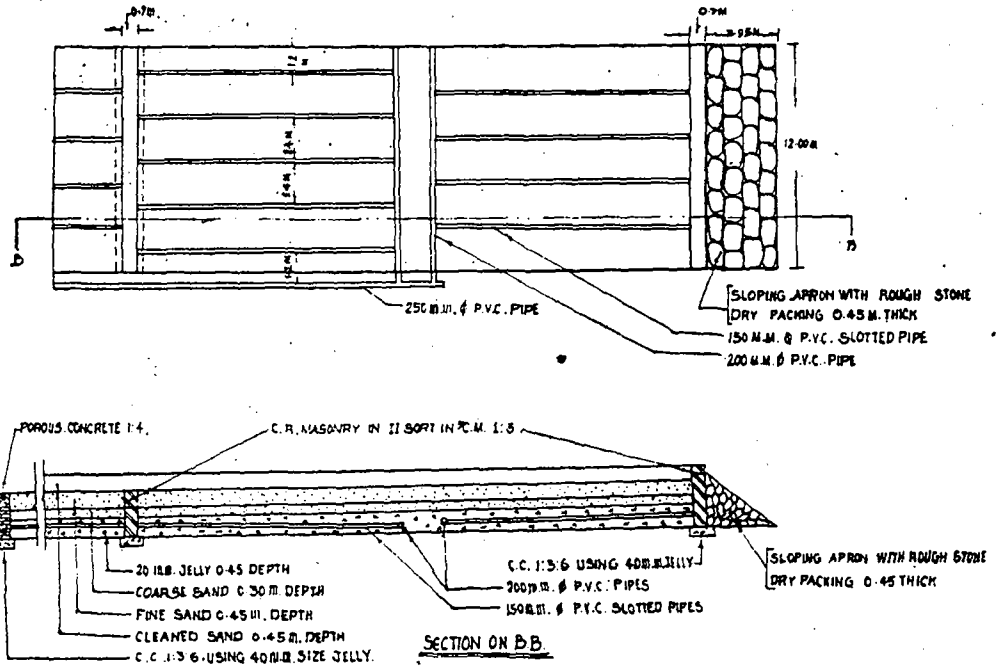

Fig. 2.

ble capsule offers savings in capital outlay for extraction of the same quantity of water.

5. USE OF PERMEABLE CAPSULE IN INFILTRATION BASIN

In water courses where the sand is available in only shallow pockets and where flow is perennial, extraction of water is achieved by infiltration basins. These are beds (Fig. 2) conforming to slow sand filter specification which are laid in the water course itself. Since the extraction of water is limited to 50 gallons of water per sq.ft. per day of the area, the infiltration basins yield high quality water uninterruptedly for prolonged periods. Since, a slow sand filter with a PVC under-drains fitted with permeable capsule is found to be giving satisfactory performance already at Kamayagoundenpatti it is felt a similar system for infiltration basin should also be equally satisfactory in performance.

On this basis, a design for a 10M x 10M infiltration basin at Namagiripettai at Salem in Tamilnadu has been approved. In this case a frame work of PVC pipe is made to cover the area of 10M x 10M (Fig. 3). There are 10 arms of 63 mm OD PVC pipes at 1 metre centre to centre that connect to a common 110mm collector pipe which takes the water to the sump. The 63 mm OD PVC arms are provided with tee joints at every metre so that a permeable capsule can be placed in the open joint of the tee. This will provide one permeable capsule for every square metre of the area and a quantity of 500 gallons per day can easily be drawn from the river, into the pipe grid through the permeable capsule.

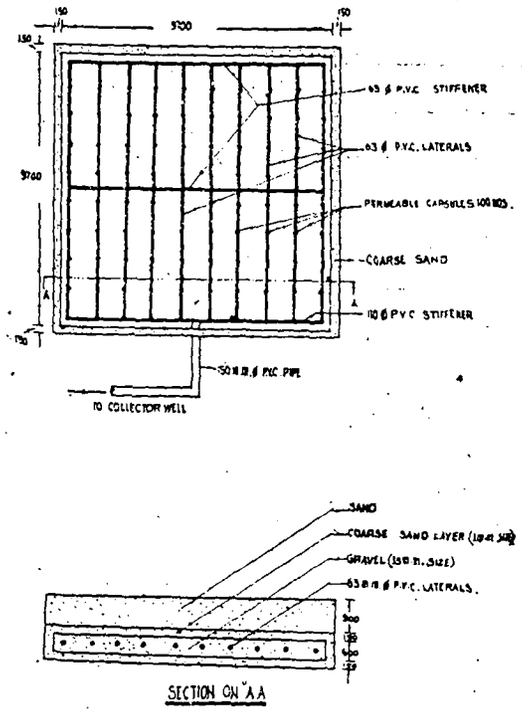

Fig. 3. (Top) Filter Basin. (Bottom) Sectional Plan.

A 15 cm layer of coarse sand and a 60cm layer of fine jelly is used as a shroud to cover the pipe grid. This will act as a reservoir and also provide large area for water to be drawn in. The pipe grid is to be placed about 4½′ (135 cm) below the surface in order to facilitate easy withdrawal of water.

It is seen that there is about 33% saving in cost between the conventional infiltration basin and infiltration basin using permeable capsules. The cost figures are given in Table 1:

Further it is expected that construction can be rapid. Infiltration in river course should also be not difficult. This method should result in substantial time saving also.

6. PERMEABLE CAPSULE AS A WELL SCREEN

The permeable capsule can be cast as a long cylinder with one end open and other closed. Such permeable capsules have been used as well screens for extracting water from shallow aquifers. The advantage over conventional well screen lies in the fact that a completely corrosion resistant set-up can be used. The permeable capsule itself is resistant to corrosion. This can be coupled to PVC pipes which can be used for the tubewell. One such unit was installed at Tholapalli, a small village in North Arcot District of Tamilnadu. In this case, near the village there is a small stream which carries subsurface water all through the year. Since the depth of sand available is only 11′ (maximum), infiltration well could not be considered. An infiltration well say 3.5 M in diameter would need at least a clearance of 1.75M or (6′) from the bottom of aquifer to the well kerb. This would leave insufficient depth of aquifer for exploitation.

TABLE 1.

Sl. No.	Type	Infiltration basin Conventional	Infiltration basin with permeable capsule
1.	Quantity of water drawn	50,000 gls/per day	50,000 gla/day
2.	Area required	100 sq. metres	100 sq. metres
3.	Cost	Rs. 38,000/-	Rs. 25,500/-

In this situation, a permeable capsule 40 cm long with 110 mm PVC collar was used as well-screen. A 6" casing pipe was used to penetrate the aquifer till the bottom was reached. Then the permeable capsule was installed inside the casing pipe. To the permeable capsule a 63mm PVC pipe was attached using a PVC reducer. A non-return valve was inserted in between. After lowering the capsule, the annular space between the capsule and the casing pipe was filled with sieved sand to act as a intermediate layer. Then, the casing pipe was lifted out leaving the permeable capsule, well screen in the aquifer. It is found that on connecting the tubewell to a centrifugal pump directly it was possible to get a yield of about 30 gpm from the system. It is possible to use this system also in a battery of well-screens for a major water supply from a rich aquifer.

7. CONCLUSION

The author feels that the permeable capsule have uses in water extraction from aquifers. These have been used in collector wells, infiltration basins and also as well screens. They appear to work satisfactorily in all these situations. Further, there is saving in installation cost as well as installation time.

8. ACKNOWLEDGEMENT

The authorities of Tamil Nadu Water Supply and Drainage Board have been very helpful in carrying out the schemes mentioned in this paper. The author takes this opportunity to thank them for their encouragement and help.