EFFICIENCY OF HYDROLUIS DRAIN PIPE-ENVELOPE COMBINATION ON SUBSURFACE DRAINAGE SYSTEMS

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ABSTRACT

Various filters and envelope materials have been produced in order to prevent siltation and blockage in subsurface pipe drainage systems. These are organic and inorganic materials, ready rough wound materials, synthetic and organic fibres. It was determined that Hydroluis pipe-envelope combination showed a great performance in terms of penetration resistance according to the first year's results of the study conducted in order to determine its potential to be used in subsurface drainage systems as a material that prevents penetration of plant roots into the pipe and that drainage waters carried 34 g m^{-3} of silt.

INTRODUCTION

It is expressed that the life of subsurface drainage systems is hundred years in average if no blockage and deformation occur in pipes (FAO, 1990; Stuyt et all., 2005). Blockage of the pipes generally occurs due to the reasons such as sanding, siltation, chemical and biological settlement, penetration of plant root into the pipe, accumulation of compressed filling soil in drainage trenches (in very wet environments), improper installation of individual piper and dysfunction of the filter (Eggelsmann, 1987).

In order to prevent entry of sediments into drain pipes and blockage, pipes are wound by jacketing materials selected according to the characteristics of the soil where they will be installed and sold ready to use in recent years. Sand-gravel, pre-wound organic fibers, synthetic fibers, synthetic fabrics are widely used envelope materials. A practical application that will prevent penetration of plant roots into the pipes until now is to increase installation depth.

In soils that are problematic in terms of siltation, it is very important that penetration of soil grains into the drain pipe to be prevented (Zaslavsky, 1978). The material wound around the pipes in order to prevent sediment penetration into pipes must have the feature that does not increase penetration strengths (Wesseling and Homma, F., 1967).

Load losses that occur due to the compression during the entering of water into the drains, reduce efficiency of the systems. Increasing hole widths and consequently hole areas of plastic drain pipes decrease resistance values (Cavelaars, 1965). Robert et all., who tested different envelope options (1987), achieved the greatest flow rate and lowest siltation in their study conducted in horizontal sand tank and fine sand loamy soil, in the pipes where geotextiles were used.

In fact, the materials that will perform all functions that are expected from the drain envelope are sand gravel materials that are obtained from natural sand gravel pits and designed according to the characteristics of foundation soil. However this is not functional as it is very expensive and material pits are not uniform and designed wrong.

Although there are many studies and publications (Bahçeci et all., 2001) claiming that there is not need for envelope for the filter (Vlotman, 1990) in matured, structurally developed, stable soils that contain certain amount of clay, no non-filtered drainage areas in drainage systems established have been found in irrigated areas in our country.

Recently developed **Hydroluis** pipe-envelope system has been designed in a way that penetration of plant roots and rough materials into the pipe is prevented. In this system, there is a pipe-envelope combination in a way that top-external surface of corrugated plastic pipes are covered by a plastic layer track welded inside. Plastic pipes for application are manufactured without holes and holes are drilled starting from about 2/3 of the pipe to upwards during installation and coated **Hydroluis** cover.

In the mentioned pipe-envelope system, a known approach has been benefited. As it is known, about 70% of water entry to drain pipes takes place with radial flow underneath the pipes. In ordinary drain envelope system, water flows fast or slowly into the pipe through the holes around corrugated plastic pipes depending on the hydraulic load upon rising of underground water. Penetration of fine materials around the pipe into the pipe takes place depending on the hydraulic load on the pipe and water penetration speed into the pipe and soil structure. Water entry to drain pipe takes place as the result of rising of water through the channels between the covering material and corrugated pipe and its flowing into it. Thus, during its flowing into the drain pipes, particles heavier than buoyancy force of water cannot enter inside the pipe as they settle. As those, which rise with water and carried into the pipe on the other hand, are in weigh that can be carried easily with water again, siltation problem is eliminated or minimized.

On the other hands, as pipes are covered with Hydroluis plates, plant roots cannot penetrate into the pipes. Plates not only prevent penetration of roots into pipes, but also prevent spread of humidity due to capillarity, especially in arid periods and consequently prevent diversion of plant roots to the pipe side, by functioning as a barricade between the top soil and pipe.

With the recently developed **HYDROLUIS** pipe envelope system, it is aimed to prevent siltation and penetration of plant roots into the pipe.

4. MATERIAL AND METHOD

The study was conducted at GAPTAEM research station in Harran Lowland. Soils are deep profile and have more than 40% clay and 10-15% lime content. They are structurally developed and have high water conductivity.

Harran Lowland is hot and arid in summers and cold and rainy in winters. Mena annual precipitation is 365, average temperature is 17.2 °C and open water surface vaporization is 1850 mm. Distribution of precipitation in seasons is; 56% in winter, 30% in spring, 13% in autumn and 1% in summer. Average number of rainy days is 70 and number of days covered with snow is 3.

Hydroluis pipe envelope combination

In this system, drain pipes are manufactured without holes and holes are drilled while winding the pipe around at the same time during installation. Thus, it is ensured that holes coincide to the top and sides of the pipe. Since, lower parts of the pipe, which contact to soil are hole-free, no water penetration from these areas take place. Plates wound on the pipe also increase solidness of the pipe by providing a mechanical support.

Figure 1 Hydroluis pipe envelope combination

Method

In the study, **Hydroluis** Drain pipe envelope system was compared to other pipe-envelope systems. Following subjects were handled in field trial set up in trial station.

Subjects:

A- Hydroluis pipe envelope combination
B- Sand-gravel filter envelope wound drainage pipe
C- Non-filtered drainage pipe
D- Fiber wound pipe envelope material (Geotextile envelope)

Measurement and assessment

Simple method was used for measurement and assessment. This method is useful for irrigation areas. Although the entire area where the absorber is active feeds the drain in rainy areas, the area fed by the absorber drain in irrigated areas is variable. There is a continuous variability between the irrigated drain length (L) and drain interval. Thus, calculating the qu value in the equation correctly is very difficult and even impossible in field conditions.

Table 1 Drain performance criteria for different drain envelope combinations

Assessment criteria		Entre resistance	Drain performance
K r_e/L	$h_3/(h_2+h_3)$		
<0.4	<0.2-0.3	Normal	Good
0.4-1.5	0.3-0.6	High	Medium-Weak
>1.5	>0.6	Much	Very Weak

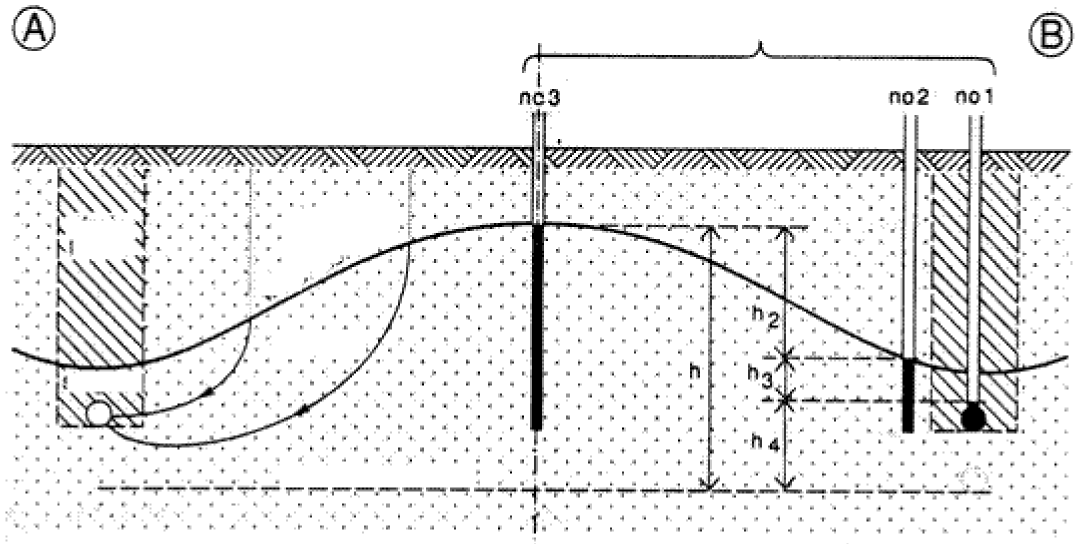


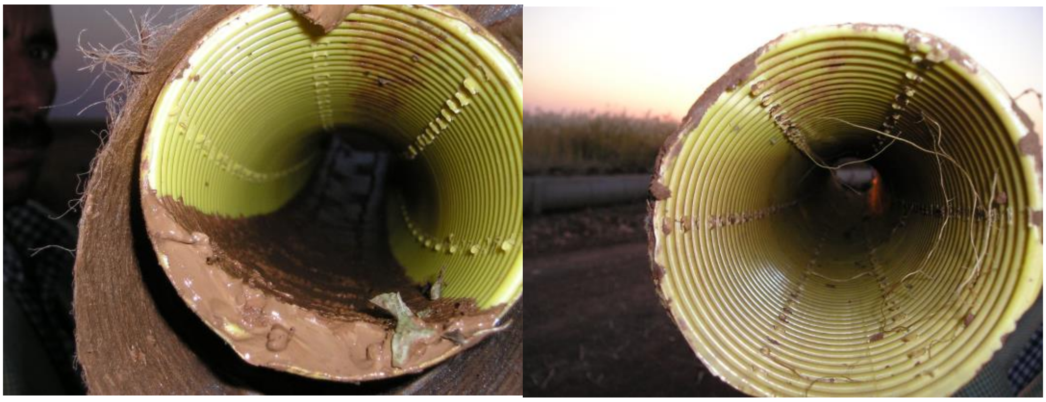
Figure 1 Schematic view of the piezometers located for determining entry resistances

FINDINGS AND DISCUSSION

In order to compare effects of different envelope materials on entry resistances under same soil conditions, water table heights inside the water, just outside the drain trench and central point of two drains on the irrigation period when the water table rose, were measured. Different pipe envelope combinations, load losses incurred and entry resistances were determined from water level measurements (Table 2).

Table 2. Drain performance values for different drain envelope combinations

Envelope pipe combination	$h_3/(h_2+h_3)$	Drain performance	pH	EC dS/m	Silt (g m^{-3})
D1 (geotextile	0.38	Medium-Weak	7.50	0.985	35
D2(no envelope)	-	-	7.20	1.029	46
D3 (sand-gravel)	0.25	Good	7.19	0.955	26
D4 (Hydroluis)	0.28	Good	6.95	0.971	34



Roots and Sediment Effects in Geotextile Envelopes

As seen from Table 2, according to the simple method applied for the irrigated areas, drain performance in sand-gravel and hydroluis pipe combination is found good while geotextile took part medium-weak group.

Hydroluis drain envelope combination took the 3rd place in terms of silt content of drainage waters. Sand-gravel drains carry 26, hydroluis carry 34, geotextile carry 35 and envelope-free drains carry 34 gm3 of silt. It can be said that hydroluis coating material has lower filtering feature than sand-gravel but higher than geotextile and non-filtered drains.

However, these siltation values are not high when they are evaluated in terms of irrigation water.

On the other hand, Ph, Ec and Silt analysis were performed by taking drainage water samples. There is no considerable difference between pH and EC values of drainage waters and it was understood from these values that pipe envelope combinations do not have a distinguishing effect.

CONCLUSION

Hydroluis pipe envelope combination showed performance close to sand-gravel in terms of siltation and entre resistances. Prevention of penetration of plant roots into the pipe makes this material advantageous. Furthermore, Hydroluis pipe envelope combination has outstanding features when compared to sand-gravel which is a similar material. It has features that prevent or reduce deformation in pipes by providing mechanical support. Fair production costs, transportation and installation easiness also increase potential of using Hydroluis pipe envelope combination.

However, in order to get solid results, trials to be made in laboratories and different land conditions are necessary.

Adventage And Characteristics of Hydroluis® Drainage Envelope showed us;

1. First Anti-Plant roots Drainage pipeOn the world. (It does not emit moisture from the pipe holes).
2. Anti-bacterial (Iron Oxide was effecting Iron Ochre, Calcium carbonate and sulfate was effecting biofilm clogging problems on other drain pipe envelope).
3. First drainage pipes saving the underground water in drought seasons. Works only when water table rises above specified levels.
4. Best performance flowing andminimum sediment enterance than all system during land fit period.
5. Eliminates requirement for annual maintenance or internal cleaning of drainage pipe and guarantees the strength life cycle and operational performance of plastic.
6. Showing longer-term operating performance in all types of soilconditions as compared to competing drainage systems.
7. Long term operating costs of the drainage pipe proves to be the mostcost-effective. After laying the system, disadvantages of growing plant roots are turned in advantages as this system increases water flow in the direction of drainage pipe.

8. Usable in shallow impermeable grounds, i.e., near the plant roots.

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