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Evaluation of different filter materials used in drip irrigation systems

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Abstract: Emitter plugging is the major problem faced by drip irrigation users. To avoid plugging of emitters, proper operation and maintenance of filtration and chlorination is essential. A screen mesh filter can benefit a drip irrigation system's operation if properly used. The performance of screen filter is dependent on the maintenance it receives and the conditions under which it must operate. In order to assess the filter performance, pressure drop, filtration rate, turbidity reduction, filtration efficiency parameters were studied. From the study, the maximum filtration efficiency was observed in case of steel wire mesh of 120 size.

Key words : Filter performance, Pressure drop, Filtration rate.

ntroduction

In the drip irrigation system, irrigation /ater is applied directly and more frequently t the root zone of the crop through the network f tubings and suitably spaced emitters attached ɔ plastic pipes. In the drip irrigation, the uality of the water being pumped into the rrigation system is the single most important actor. Impurities can lead to physical, chemical nd biological restrictions in the emitters, resulting n uneven water application (Nakayama and Bucks, 1981; Bralts *et al.* 1982). In a world vide survey, Abbot (1985) found that emitter lugging is the major problem faced by drip rrigation users. To avoid plugging of emitter, roper operation and maintenance of filtration nd chlorination is essential.

Chemical water treatment is a costly affair. A screen mesh filter can benefit a drip irrigation ystem's operation if properly used. The erformance of screen filter is dependent on he maintenance it receives and the conditions nder which it must operate. In order to assess he effects of cake deposition on filter performance he following parameters need to be studied: a) pressure drop (b) filtration rate (c) turbidity eduction and (d) filtration efficiency.

Materials and Methods

To assess the filtration efficiency of different ilter materials, a study was conducted during the year 2001-2002 in Soil and Water Conservation Engineering Laboratory, TNAU by using different low cost filter materials. The experimental set up consisted of a sump, suction pipe, pumping unit, gate valve, pressure gauge, screen filter, flow meter and delivery pipe. One thousand litres capacity sump was used in this study. The pumping unit consisted of 3 hp mono block centrifugal pump. The sump water was made turbid by making it's concentration as 1 g L^{-1}. with the help of clay particles sieved through 200-micron sieve. The setup was arranged in such a way that the suction and the delivery of water circulated in the same sump. To monitor the difference in concentration, the water samples were collected in bottles both from sump water and filtered water at every five minutes interval. Eight filtering materials was used in this experiment. The reduction in turbidity of the flow passing through the filter was taken as the basis of evaluating the performance of the filtering materials. The water passing through the filter was noted from the water meter. Eight filtering materials are Steel wire mesh (120), GI wire mesh (80), GI wire mesh (40), Cotton cloth (45), Nylon mesh (60), Nylon mesh (40), Coir rope and Jute rope. Filtering material to be tested was wrapped over the filtering chamber. The pump was operaced continuously for 4 h and the readings were taken at every five minutes interval.

Table 1. Different parameters values for each filter materials

Filter materials	Max. duration of operation in minutes	Max. pressure drop in Ksc	Filtration rate at the end of operation in lps	Max. turbidity reduction in JTU	Max. filtration efficiency in %
Steel wire mesh (120)	9	2.05	3.50	26	18.44
GI wire mesh (80)	197	1.30	5.00	17	12.14
GI wire mesh (40)	240	0.15	6.40	2	1.42
Cotton cloth (45)	240	0.25	5.70	6	4.28
Nylon mesh (60)	240	0.75	5.26	13	9.28
Nylon mesh (40)	240	0.30	5.90	5	3.52
Coir rope	240	0.60	5.70	12	8.57
Jute rope	75	1.20	4.60	15	10.79

Results and Discussion

In order to compare the filtering materials, the relationship between different parametes for each filtering materials are given below.

Flow rate variation with pressure drop

Fig.1 shows the variation of flow rate with pressure drop for each of the eight filtering materials. In all the filtering materias, the flow rate decreased with increase in pressure drop with time of operation, because the pores of screen reduces as time elapsed due to the deposition of suspended particles. The cake formation over the filtering surface increased the pressure drop across the filter, thereby decreasing the flow rate in the filter outlet, because the pores of the screen reduces, as time elapsed due to the deposition of suspended particles. This was reported by Suryawanshi and Panda (1993) that, the filter medium has a relatively low initial pressure drop and particles of the same size or larger, wedge into the opening and create smaller passages, which remove even smaller particles from the fluid. The flow rate in case of Steel wire mesh (120) was minimum with increasing pressure drop, followed by Jute rope, Nylon mesh (60), GI wire mesh (80), Cotton cloth (45), Coir rope, Nylon mesh (40) and GI wire mesh (40). In case of Steel wire mesh (120) the flow rate was decreased to 3.5 lps for the pressure drop of 2.05 Ksc.

Variation of turbidity reduction with pressure drop

The relationship between turbidity reduction and pressure drop for different filter materials is shown in Fig.2. The turbidity reduction was found to increase with increase in pressure drop for all the materials. The turbidity reduction was maximum in case of Steel wire mesh (120) with increasing pressure drop followed by GI wire mesh (80), Coir rope, Nylon mesh (60), Jute rope, Nylon mesh (40), Cotton cloth (45) and GI wire mesh (40). The turbidity reduction was maximum of 26 JTU for Steel wire mesh (120) for the higher pressure drop of 2.05 Ksc. This was because of retaining of the clay particles on the filter material due to small mesh opening.

Variation of pressure drop with time

Fig.3 shows the temporal variation of pressure drop in case of all filter materials tested. The pressure drop was noted to increase with time due to gradual deposition of suspended solutes. The pressure drop was more over the period in case of Steel wire mesh (120) followed by Jute rope, Nylon mesh (90), Coir rope, GI wire mesh (80), Nylon mesh (40), GI wire mesh (40) and Cotton cloth (45). In case of Steel wire mesh (120) there was sudden pressure drop of 2.05 Ksc within 9 minutes. It was due to deposition of suspended solutes over the small opening surface of the filtering material.

Variability of turbidity reduction with time

Fig.4 shows the variation of turbidity reduction with time. The turbidity reduction increases with time for all the materials. The rate of increase was found to be quite prominant initially and subsequently it attains a steady

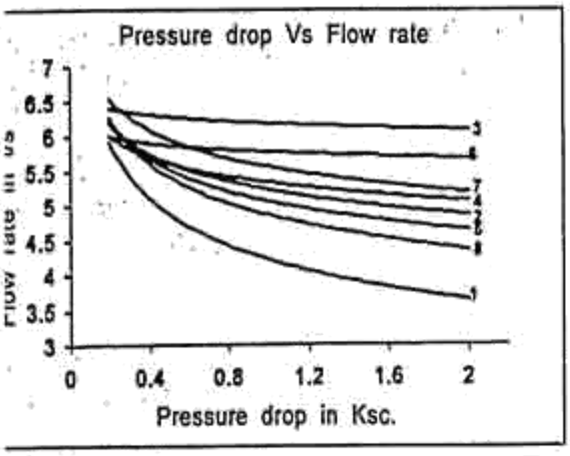

Fig.1. Pressure drop Vs Flow rate

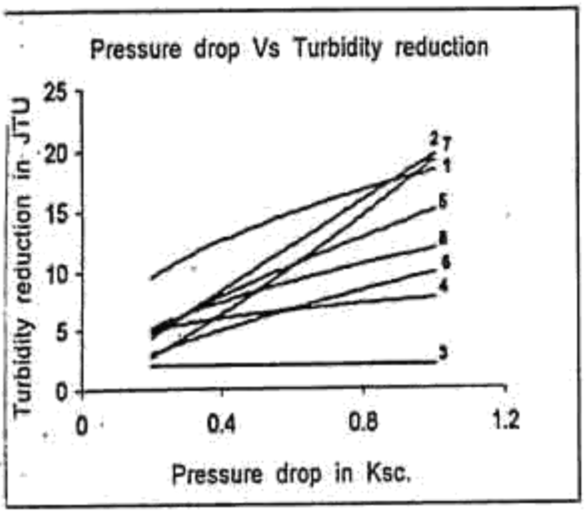

Fig.2. Pressure drop Vs Turbidity reduction

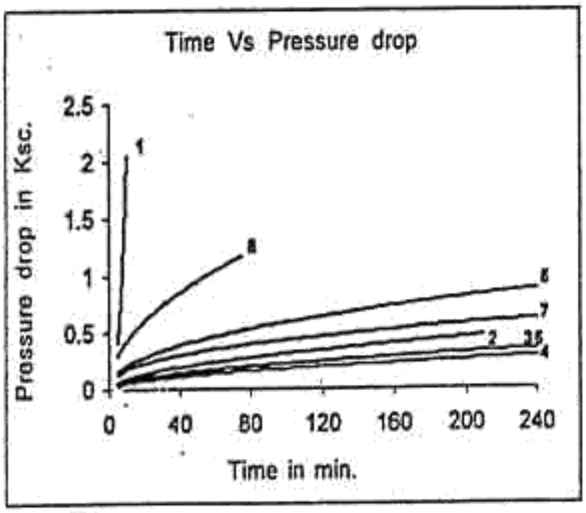

Fig.3. Time Vs Pressure drop

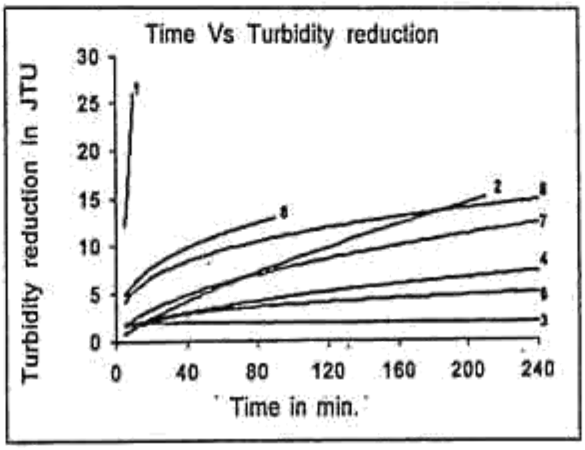

Fig.4. Time Vs Turbidity reduction

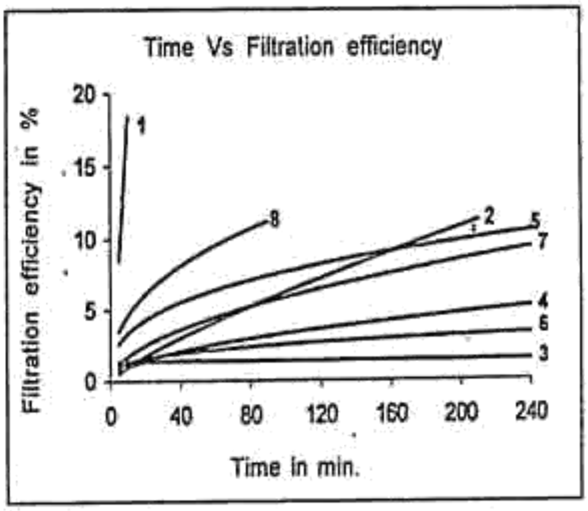

Fig.5. Time Vs Filtration efficiency

state. The turbidity reduction was found more in case of Steel wire mesh (120) over a period of time followed by GI wire mesh (80), Nylon mesh (60), Jute rope, Coir rope, Cotton cloth (45), Nylon mesh (40) and GI wire mesh (40).

The turbidity reduction was found more in case of Steel wire mesh (120) within a short period. The turbidity reduction of 26 JTU for the period of 9 minutes. It was due to the good filtering capacity of the material.

Variation of efficiency in time

Fig.5 indicates the results obtained interms of variation of filtration efficiency, which is the ratio of turbidity reduction to the original turbidity of water at the source. Naturally this increases with time. The filtration efficiency was maximum in case of Steel wire mesh (120) over the period followed by GI wire mesh (80), Jute rope, Coir rope, Nylon mesh (60), Cotton cloth (45), Nylon mesh (40) and GI wire mesh (40). The different parameters values are given for each filter materials are given in Table 1.

Conclusions

The flow rate decreased as time elapsed for all the filter materials due to pressure drop across the filter. The flow rate in case of Steel wire mesh (120) was minimum (3.5 lps) with increasing pressure drop. Turbidity reduction increased with increase in pressure drop for all the materials. Turbidity reduction per unit pressure drop was high in case of Steel wire mesh of 120 size. Pressure drop and turbidity reduction increased with time. Filtration efficiency is directly proportional to the turbidity reduction. Naturally this increase with time. Maximum efficiency was observed in case of Steel wire mesh of 120 size. Locally available materials like Coir rope and Jute rope had more filtration efficiency, filtration rate and less cost, but life of the material is short.

References

Abbot, J.S. (1985). Emitter clogging-causes an prevention. *Intl. Committee on Irrig. Drai* *Bulletin.* 34: 11-20.

Bralts, V.F., Wu, I.P. and Gitlin, H.M. (1982). Emitte plugging and drip irrigation lateral lin hydraulics. *Trans. ASAE.* 25: 1274-81.

Nakayama, F.S and Bucks, D.A. (1981). Emitte clogging effects on trickle irrigatio uniformity. *Trans. Am. Soc. Agric. Eng.* 2 77.

Suryawanshi, S.K., Panda, R.K. (1993). Performan study of low cost fibre materials for dri irrigation filter. *Irrig. Power J.* 50: 33-4

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