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PERFORMANCE EVALUATION OF FILTERUSED IN MICRO-IRRIGATION SYSTEM

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ABSTRACT
Water is a key input for all agricultural practices. It plays a vital role in progress of agriculture in form of irrigation. This research conducted has the objective to evaluate filtration efficiency on water quality. The filtration efficiency was determined for the known concentration of impurities i.e. 100, 200, 300 and 400 ppm for sand, screen and disc filter at three constant flow rates viz. 1.5 lps, 2 lps and 2.5 lps. The pressure drop characteristics were monitored at inlet and outlet of the filters. The result of experiment depicts that the filtration efficiency decreased with increase in levels of concentrations of impurities. The efficiency of the disc filter was found maximum, followed by the screen and sand filter. The pressure drop across the filter increased with different levels of concentration of impurities with elapsed time and flow rates. It was found that the time required to develop 5 m of pressure drop across the disc filter was minimum, followed by the screen and sand filter.

Keywords: Filtration efficiency, filters, water quality, pressure drop

INTRODUCTION
Drip Irrigation is best suited to scarcity areas and regions where irrigation water quality is marginal or low. Drip irrigation becomes a significant part of the farming which is used on a wide variety of crops. The objectives of drip irrigation are to save water, enhance the yield, improve the quality of produce, reduce the disease spreading and save fertilizers. Drip irrigation can deliver water and nutrients in precise amount and at controlled frequencies directly to root zone of plants. Efficiency of drip irrigation is high (more than 90 per cent) as compared to other irrigation methods. Total geographical area of Maharashtra is 307.58 lakh ha, out of which only 16.9 per cent area is under irrigation. Total area under drip irrigation is 5 lakh ha (Economic survey of Maharashtra 2007-08). But, the suitability of any irrigation system mainly depends upon its design, layout and performance. The performance of drip irrigation system depends on filter efficiency and emitter discharge uniformity. In absence of proper filtration unit, some problems come across the system particularly those related to the clogging of emitters which affects the performance of drip irrigation

system. Therefore, for efficient use of irrigation resources there is need to adopt modern irrigation techniques like drip irrigation, sprinkler irrigation etc.

MATERIAL AND METHODS

The experiment was conducted at the Department of Irrigation and Drainage Engineering, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola which is situated in Vidarbha region of Maharashtra State and comes under subtropical zone. The tests were conducted from the month of September 2011 to March 2012.Water samples from farm ponds, reservoirs, open wells, bore wells were collected and by using volumetric method, contaminants were calculated. According to impurity in water samples, concentrations were decided.

Silt deposited in the river bed and algae was collected. Sieve analysis of silt was performed .The biological contaminants (algae) was grind in mixture to form the slurry. The silt material passed through 400 micron sieve and biological contaminants (algae) was used to prepare the impure water with different concentrations of 100, 200, 300, 400 ppm for the study. For each concentration silt and algae were taken in 90:10 proportions. The water with different concentration of impurities was pumped with 5 HP pump and passed through the sand, screen or disc filter. A by-pass arrangement was provided with the control valve to maintain the flow rate through the filter. The by-pass outlet was extended up to the base of the tank. Thus this by-pass flow act as agitator in the tank and avoid settlement of impurity at the base of the tank. The water meter was provided at the inlet of the filter assembly to measure the flow rate. The pressure gauges were provided at inlet and outlet of the filter assembly to measure the pressure drop across the filter for each trial with different flow rates and concentration of impurity with the objective to evaluate the performance of filters used in micro-irrigation system.

RESULTS AND DISCUSSION

The study was conducted in the Department of Irrigation and Drainage Engg., Faculty of Agricultural Engineering and Technology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2011-2012. Experimental setup was installed to compare filtering efficiency and pressure drop across the sand, screen and disc filter respectively. The results of filtration efficiency of sand, screen and disc filter was studied for three flow rates 1.5 lps, 2 lps and 2.5 lps with different concentrations of impurities. The representative data of 2 lps flow rate is presented in Table 1.

Table 1shows that the filtration efficiency was in the range of 83.1 to 54.8 per cent for sand filter, 84.7 to 60.1 for screen filter and 88.1 to 67.0 per cent for disc filter, respectively at 2 lps flow rate. Maximum efficiency was found to be 83.1, 84.7 and 88.1 per cent in sand, screen and disc filter, respectively.The data is also presented in Fig. 1(a), Fig. 1(b), Fig. 1(c) and Fig. 1(d) depicts that there was decreasing trend in filtration efficiency with time. Maximum efficiency was found in disc filter, followed by screen and sand filter, respectively.Similar results were obtained for 1.5 and 2.5 lps flow rates. Pressure drop characteristics of sand,

screen and disc filters were tested by passing the water having different concentration of impurities of 100, 200, 300 and 400 ppm with different flow rates viz. 1.5, 2.0 and 2.5 lps.The data pertaining to pressure drop across sand, screen and disc filter with time for concentration of impurities of 100, 200, 300 and 400 ppm and flow rate of 2 lps is presented in Table 2. From Table 2 it is observed that, in sand filter the pressure drop increased gradually from 0 to 5.0 m in time of 120 min. for 100 ppm concentration, 90 min. for 200 ppm concentration, 80 min. for 300 ppm concentration and 60 min for 400 ppm concentration. In screen filter time required to develop pressure drop of 5 m is varying from 50 to 20 min. for all four concentrations. Similarly, for disc filter the time required to develop pressure drop of 5 m is varying from 8 to 2 min. for all four concentration of impuritiesThe data depicts that in case of disc filter the rate of increase of pressure drop is faster as compared to sand and screen filter. Similar results are reported by Puig-Bargues*et.al.* 2005. After the pressure drop of 5 m, the filter was cleaned.

Linear equation is best fit equation for the disc filter, which gives coefficient of determination (r^2) 0.9906. For screen filter, linear equation is best fit equation and value of coefficient of determination (r^2) is 0.9915. For sand filter, linear equation is best fit equation and value of coefficient of determination (r^2) is 0.9963 (Table. 3)

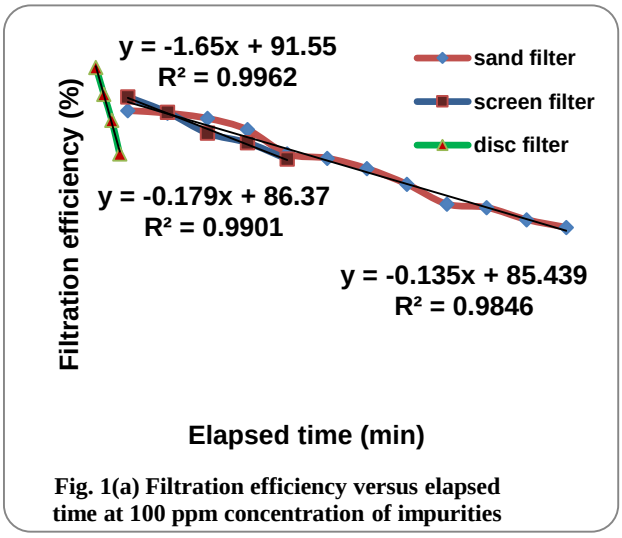

Fig. 1(a) Filtration efficiency versus elapsed time at 100 ppm concentration of impurities

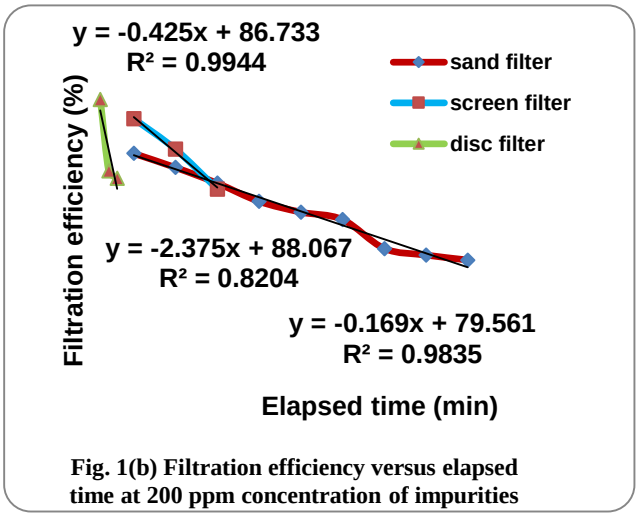

Fig. 1(b) Filtration efficiency versus elapsed time at 200 ppm concentration of impurities

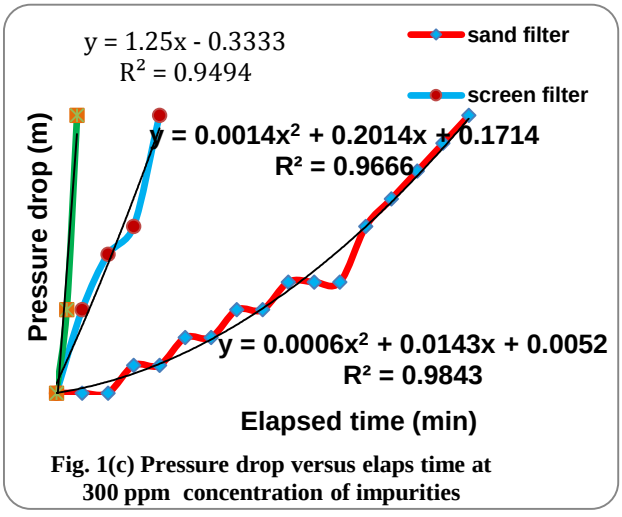

Fig. 1(c) Pressure drop versus elaps time at 300 ppm concentration of impurities

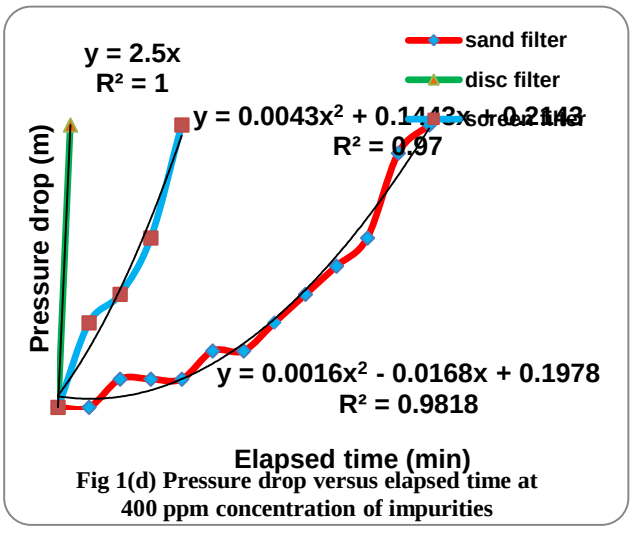

Fig 1(d) Pressure drop versus elapsed time at 400 ppm concentration of impurities

Table 1 Filtration efficiency with elapsed time in sand, screen and disc filter for different concentrations of impurities at 2 lps flow rate

Concentration of impurities																		
100 ppm concentration					200 ppm concentration					300 ppm concentration					400 ppm concentration				
Elapsed time (min)	F.E. (%)		Elapsed time (min)	F.E. (%)	Elapsed time (min)	F.E. (%)		Elapsed time (min)	F.E. (%)	Elapsed time (min)	F.E. (%)		Elapsed time (min)	F.E. (%)	Elapsed time (min)	F.E. (%)		Elapsed time (min)	F.E. (%)
	Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter
10	83.1	84.7	**2**	88.1	**10**	78.1	82.3	**2**	84.6	10	73.0	75.1	**2**	80.1	**10**	63.1	67.0	**2**	79.5
20	82.8	82.9	**4**	85.0	**20**	76.4	78.6	**4**	76.0	20	72.8	65.3	**4**	73.3	**20**	61.4	60.1		
30	82.2	80.5	**6**	82.0	**30**	74.5	73.8	**6**	75.1	30	71.5				**30**	58.2			
40	80.9	79.4	**8**	78.1	**40**	72.3				40	70.8				**40**	56.8			
50	78.1	77.5			**50**	71.0				50	69.5				**50**	55.7			
60	77.6				**60**	70.1				60	68.8				**60**	54.8			
70	76.4				**70**	66.6				70	67.9								
80	74.6				**80**	65.8				80	60.5								
90	72.3				**90**	65.2													
100	71.9																		
110	70.5																		
120	69.6																		

Table 2 Pressure drop with elapsed time in sand, screen and disc filter for different concentrations at 2 lps flow rate

Concentration of impurities																			
100 ppm concentration					200 ppm concentration					300 ppm concentration					400 ppm concentration				
Elapsed time min	P.D. (m)		Elapsed time min	P.D. (m)	Elapsed time min	P.D. (m)		Elapsed time min.	P.D. (m)	Elapsed time min	P.D. (m)		Elapsed time min	P.D. (m)	Elapsed time min	P.D. (m)		Elapsed Time min	P.D. (m)
	Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter		Sand Filter	Screen Filter		Disc Filter
0	0.0	0.0	**0**	0.0	**0**	0.0	0.0	**0**	0.0	**0**	0.0	0.0	**0**	0.0	**0**	0.0	0.0	**0**	0.0
5	0.0	0.0	**2**	0.5	**5**	0.0	0.0	**2**	1.5	**5**	0.0	1.5	**2**	1.5	**5**	0.0	1.5	**2**	5.0
10	0.0	0.0	**4**	2.0	**10**	0.0	0.0	**4**	3.0	**10**	0.0	2.5	**4**	5.0	**10**	0.5	2.0		
15	0.0	0.5	**6**	3.0	**15**	0.0	1.0	**6**	5.0	**15**	0.5	3.0			**15**	0.5	3.0		
20	0.0	1.0	**8**	5.0	**20**	0.5	3.0			**20**	0.5	5.0			**20**	0.5	5.0		
25	0.0	1.5			**25**	0.5	4.0			**25**	1.0				**25**	1.0			
30	0.2	2.0			**30**	1.0	5.0			**30**	1.0				**30**	1.0			

35	0.5	2.5			**35**	1.0				**35**	1.5				**35**	1.5			
40	1.0	3.0			**40**	1.0				**40**	1.5				**40**	2.0			
45	1.0	4.0			**45**	1.5				**45**	2.0				**45**	2.5			
50	1.5	5.0			**50**	1.5				**50**	2.0				**50**	3.0			
55	2.0				**55**	2.0				**55**	2.0				**55**	4.5			
60	2.0				**60**	2.5				**60**	3.0				**60**	5.0			
65	2.5				**65**	2.5				**65**	3.5								
70	2.5				**70**	3.0				**70**	4.0								
75	3.0				**75**	3.5				**75**	4.5								
80	3.0				**80**	4.0				**80**	5.0								
85	3.5				**85**	4.5													
90	3.5				**90**	5.0													
95	3,5																		
100	4.0																		
105	4.0																		
110	4.5																		
115	4.5																		
120	5.0																		

Table 3 Relationship between filtration efficiency at 5 m of pressure drop and concentration of impurities

Type of Filter	**Type of equation**	**Equation**	**r^2**
Sand	Linear	y = -0.0491 + 74.8	0.9963
Screen	Linear	y = -0.0582x + 83.95	0.9915
Disc	Linear	y = -0.0407x + 86.5	0.9906

CONCLUSIONS

The Filtration efficiency decreases for all the three filters with elapsed time for different levels of concentration of impurities and for different flow rates. Filtration efficiency decreases with increase in level of concentration of impurities and with increase in flow rates across all the three filters i.e. sand, screen and disc filter. Pressure drop across all the three filter increases with elapsed time for different levels of concentration of impurities and for different flow rates. Pressure drop across the sand, screen and disc filter increases with increase in level of concentration of impurities and with increase in flow rates.

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