Analysis of Infiltration Rate by Infiltrometer

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Abstract-**Infiltration rate of soil is a topic of constant interest. In this paper, an effort has been made to find the constant infiltration rates ofdifferent soils under different soil conditions. Field experiments were carried out at three different sites located within Haknakawadi, Latur They include Lake Side, Forest Area, Agricultural land at Mundewasti. The highest infiltration rate obtained was 10.73cm/hrat Lake side and the lowest was 1.73cm/hr occurred at Mundewasti. Soil tests have also been done to know the soil type and howthe infiltration curve varies for each soil type with respect to time.**

Index Terms **- infiltration, double ring infiltrometer, infiltration rate, cumulative time, infiltration curve**.

INTRODUCTION

The procedure through which water enters the soil from the ground surface is known as infiltration. This process is triggered by force of gravity and capillary action. Infiltration capacity may be well-defined as the maximum rate at which a given soil at a given time can engage water and is expressed in cm/h or mm/h or inches/h. The infiltration capacity is reliant on a large number of factors; some of them are characteristics of the soil, vegetative cover, state of the soil surface, soil temperature, water content of the soil, rainfall intensity, etc. Runoff results if the intensity of rainfall surpasses the infiltration rate of given soil. Double ring Infiltrometer is used to determine infiltration of water into the soil. Speed of infiltration is measured after the cylindrical ring made up of stainless steel are partly inserted into the soil and filled with water. Two types of cylinders are taken for this experiment of diameter 15cm and 30cm and height 60cm. The double ring confines the lateral spread of water after infiltration. Double ring infiltrometer is better than single ring infiltrometer because in single ring infiltrometer the water will spread both horizontally as well as vertically, but using double ring infiltrometer the water will enter in one direction that is towards the ground water without much wastage of water.

LITERATURE REVIEW

A number of literatures and research papers have been studied, which deals with infiltration through different types of soils and related investigations. A few of these findings of these papers have been presented. In ASTM1(2003) it's mentioned that double ring infiltrometers is a development of the single infiltrometer method in which the error associated with the single ring method can be reduced because the water level in the outer ring forces vertical infiltration of water in the inner ring. Gregory2 et al., (2005) Infiltration is the process by which water from the soil surface penetrates the soil and this process affect surface runoff, soil erosion, and groundwater recharge. Dr.Avinash S. Kadam3(2016) determine the infiltration rate for site selection of artificial water recharge and discuss the various general physical parameters affecting on it. Wu4 et al., (1997) stated that numerical modelling has shown that falling head and constant head methods give similar results for fine textured soils, but the falling head method underestimates infiltration rates for coarse textured soils. Tarek Selim5(2011) investigated the effect of land use on soil infiltration rate in heavy clayey soil by using double ring infiltrometer. Maheshwari6 (1996) described the advantage of using Double Ring Infiltrometer in estimating infiltration as *it is a straight forward procedure and also the instrument is simple. C. L. Jejurkar, Dr. M. P. Rajurkar7(2012) made an attempt to determine infiltration rates of soil under different land cover conditions and to compare*

validity of different infiltration equations viz. Kostiakov, modified Kostiakov, Horton andPhilip.

MATERIALS

In this study a double ring infiltrometer has been used for measuring infiltration. The instrument essentially consists of:

- Two rings having diameter 15 cm and 30 cm.
- Total height of the infiltrometer is 60 cm.
- A steel rod having 4 cm x 4 cm and 70 cm in length.
- A hammer of 2.5 kg weight.
- A spade to collect the remove the sample from site.
- A measuring scale having 30 cm in length.
- Stopwatch and notebook for writing records.
- A sufficient amount of water for reading.

METHODOLOGY

Double ring infiltrometer is used to conduct the test in certain places of Hakankawadi like lake side, forest area, mundhewasti. Area of 2m by 4m was taken in all the places. The two cylinders are placed inside the soil but the measurement is taken in the inner cylinder only; the outer cylinder helps the water from the inner cylinder to flow vertically downwards and not horizontally. The cylinders are of height 60cm which are been digged up to a height of 20cm inside the soil using steel rod and hammer. Figure 1 shows the infiltrometer that has been used in this experiment with inner diameter 15cm and outer diameter 30cm.Cylinders are kept back 40cm above the ground surface in which the water was filled and the decreasing water level measurement was taken. Water is supplied evenly inside the ring without any disturbance of soil surface. A measuring scale of 30cm is placed in the inner cylinder and the initial water level of the inner cylinder is written down. The measurement was kept going until and unless a constant value of infiltration rate was reached . Two minutes and four minutes time interval and a total of 90 minutes were taken and the decrease in the water l evel was measured. The water level in the outer cylinder is kept at the same level as the water level in the inner cylinder.

Fig. Double ring infiltration

STUDY AREA

Haknakwadi is the Village of Latur District, Maharastra India. Haknakwadi has a humid tropical Climate and it is also a drought regionThe average annual temperature is 36.8°C with extremes ranging from 44.6 °C recorded on 24 May 2022 to 30 °C recorded in January 1964. Latur is a city where the topography, climate, humidity, temperature, altitude, soil behaviour, etc varies from place to place. The three study areas have different location and altitude and as the experiments are conducted in different days so the temperature, humidity and pressure also varied. Table 1 shows the details of the climate profile of our study area.

Table: Table showing the location, altitude, temperature, humidity and pressure of the study area.

Study area	Location	Altitude (m)	Temperature (^{0}C)	Humidity (%)	Pressure (Psi)
Lake side	18.4441586, 77.0950328	53	35	82	14.62
Forest area	18.4312044, 77.0940508	82	37	70	14.68
Mundewasti	18.4323377, 77.0881127	88	40	65	14.50

Figure 2 below shows the complete visual process of carrying out the infiltration experiment in the field. Figure 2(a) shows measuring the drop in water level, Figure 2(b) shows measuring whether the infiltrometer is levelled, Figure 2(c) shows noting

down the readings, Figure 2(d) shows filling the cylinders with water and Figure 2(e) shows the digging of cylinders into the soil. These pictures also show the different sites where the experiments have been carried out and with different soil cover.

Fig. Process of Infiltration Process

Fig.: Some photographs while carrying out the experiment on sites (a) Measuring the drop in water level (b) Measuring whether the infiltrometer is levelled (c) Noting down the readings (d) Filling the cylinders with water (e) Digging the cylinders into the soil

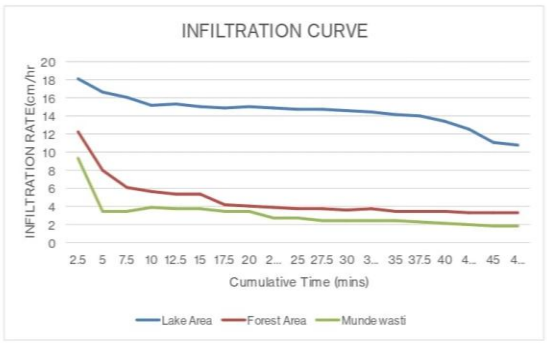

Fig 3 : Infiltration Curve of the three study areas haknakwadi

Fig. Infiltration Curves at three study areas at Haknakwadi , Latur

CONCLUSION

It is found that soil conditions effects infiltration rate from research work. From the graphs of infiltration rate against time it is found that initial infiltration rates were high and decreased with time upto constant infiltration rate. From the graph drawn it is seen that lake side has highest infiltration capacity while mundewasti has lowest infiltration capacity. The application of infiltration method in the study area shows that forest area facilitated by slow-moderate rate of infiltration where as lake side is characterized by moderate rate of infiltration. It is found that, sandy loam soil the type of infiltration is moderate, for sandy soil we get moderate rapid rate of infiltration, for loamy soil type of infiltration is slow moderate. From the sieve size analysis test, we found that soil study area is generally covered by poorly graded soil. The liquid limit and plastic limit indicated that generally the sediments are with low medium plasticity index.

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