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Standard Test for Determination of Infiltration Rate of Soil Using Double Ring Infiltrometer

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ABSTRACT: Double-ring infiltrometers are routinely used for turf grass, soil scientists, and other professionals to measure the infiltration rate of field sites. Measurement of infiltration rate is important improper golf course design development and other scenarios that require estimates of runoff. Soils should be regarded as natural occurring fine or coarse-grained soils or processed materials or mixtures of natural soils and processed materials, or other porous materials, and which are basically insoluble and are in accordance with requirement. Double ring infiltrometers are used to find out the infiltration rate of different types of soil. Infiltration rate is necessary for many uses (Soil Permeability, Soil Water Content, Specific gravity). Field experiment is done in two different places; in garden area and in forest area. The infiltration rate gradually decreases as at the beginning it is quite high as compared to further readings. Several double ring infiltrometer methods are followed- 30cm-60cm, 15cm-45cm, 15cm-30cm & 45cm-60cm ring cylinder for constant head and for falling head method. As also concluded that infiltration rate was affected due to the cracks of plants root, movement of earth & clay desiccation.

Keywords: Double ring infiltrometer, incremental infiltration rate, infiltration rate, ring cylinder.

I. INTRODUCTION

Infiltration is the process of penetration of water into the ground surface and the intensity of this process is known as infiltration rate. The infiltration rate is expressed in term of volume of water poured per ground surface per unit of time. Soil erosion, surface runoff & ground water recharge are affected by this process. At a certain moment the maximum infiltration rate can be indicated by the infiltration capacity of soil. Infiltration of water into the soil can be determined by a simple instrument called Double ring infiltrometer. The cylindrical ring infiltrometer consist of single metal cylinder. These cylinders are partially inserted into the ground and water is filled up to a margin inside the cylinder and after that the speed of penetration of water is measured with respect to the time and depth of penetration of water inside the cylinder.

Four types of cylinders are taken for this experiment of diameter 15cm, 30cm, 45cm & 60cm and they are experimented as 15-30cm, 15-45cm, 30-45cm & 30-60cm double ring infiltrometer. To spread the water vertically after infiltration we use double ring infiltrometer. Double ring infiltrometer is better than single ring infiltrometer. In single ring infiltrometer the water will spread horizontally & vertically both, from which water will not move only towards the ground water but using double ring infiltrometer the water will penetrate in one direction that is towards the ground water without much wastage of water.

II. MATERIALS AND METHODS

a. 4 no. of Cylindrical ring infiltrometer (height=60cm,diameter 15cm,30cm,45cm,60cm)
b. Wooden piece (to drive the cylinder inside the soil)
c. Hammer (to dig the cylinder inside the soil without any disturbance in the soil surface)
d. Measuring bucket of 3no. (12lt, 13lt,20lt)
e. Measuring jar (2lt)
f. Metal plate
g. Long pipe
h. Stopwatch (to know the time interval in which infiltration has to be measured)
i. Tape & scale (the amount of water penetrate inside the soil within a specific time interval)
j. Cover & plastic sheet
k. Stationary use
l. Wash cloths.

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An area at garden and forest on the University of NIT campus, Rourkela was used to conduct the test by using double ring infiltrometer. Area of 4m by 10m was taken in both the place. The measurement of infiltration rate and incremental infiltration rate can be achieved by using the instrument double ring infiltrometer. A pair of both side opened stainless steel rings are used whose diameter are 15-30cm,15-45cm,30-45cm,30-60cm & of height 60cm. one side of the ring will have a cutting edge so that it will drive inside the soil surface easily without any damage to the soil or to the cylinder. Two cylinders will be digged inside the soil where the measurement will be taken in the inner cylinder only and the outer cylinder will help to flow the water vertically & not laterally. The metal plate will cover the soil surface of the inner cylinder so that it can deplete the force of water poured inside the cylinder. The cylinders are of height 60cm which are been digged upto a height of 50cm inside the soil with the help of wooden piece and hammer. Cylinder will be kept 10cm above the ground surface in which the water will be poured and the measurement will be taken out. The measured amount of water will be poured inside the inner cylinder so that the measurement will be taken wrt the time interval and the penetration of water level in the inner ring. The measurement was continued until and unless a steady rate of infiltration was achieved. In one place for continuously 5 to 6days infiltration readings were taken so that the amount of infiltration rate can be known. At a time interval of 5mins or 10mins were taken and the drop in the water level was measured.

Figure: 1. double ring infiltrometer

Water was measured by the measuring jar and poured in the bucket. Then the inner ring and outer ring was filled with water at the same time. 5mins and 10mins interval was taken to measure the drop of water inside the inner ring only. A long scale was used to measure the depth of water infiltration. In this way the garden and forest area readings were taken so that a comparison can be made between the two places. From this it can be concluded that which place will be better for construction work and which place will be better for agricultural work. As forest area infiltration rate is high it can be used for both purposes. If an agriculture land faces problem during the cultivation then at that point of time double ring infiltrometer can be used. By the help of which water can directly percolate to the ground surface and to the all portion of the plant which requires water to grow the plant. In this method water logging area can be taken into consideration. The places which are water logged, the double ring infiltrometer can be used there from where the water will directly percolate towards the ground water and recharge it without any loss or wastage of water.

III. RESULTS AND DISCUSSION

As per the methodology, double ring infiltrometer set up was established in the forest area or deepvegetative area of the National Institute of Technology, Rourkela. The infiltration rate was measured at different time interval of approx. 4 days for the month of December-2018, January-2019 and February-2019. Trend line method is used to predict the future infiltration at that particular area considering the present environmental situation. The extracted equation of 2^{nd} degree from the time series trend analysis was used for the further prediction. The predicted data are given in graphical format as described below. The graphs are self-explanatory.

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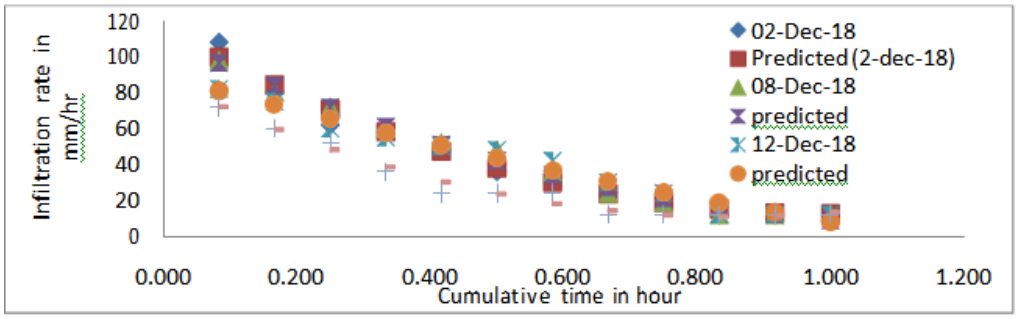

Figure 2: Graphical Representation showing comparison of real time data and predicted data for the month of December-2018

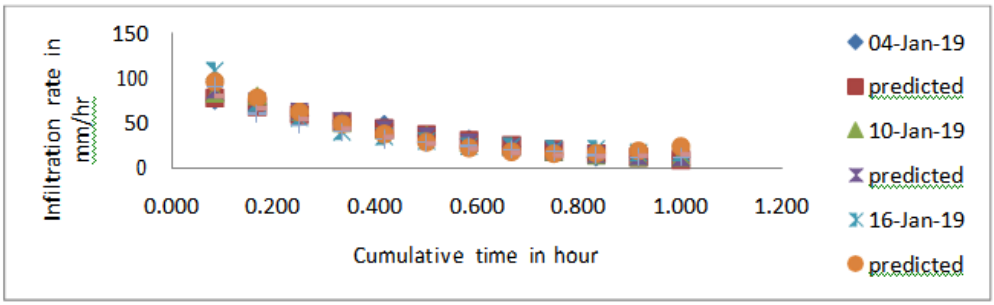

Figure 3: Graphical Representation showing comparison of real time data and predicted data for the month of January-2019

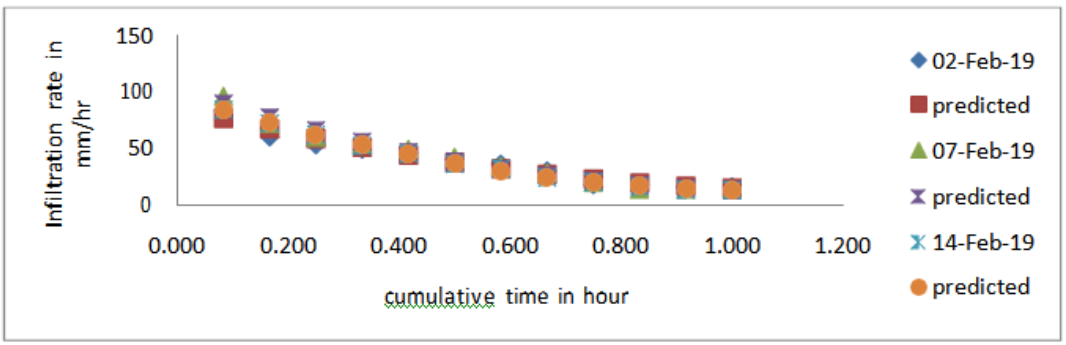

Figure 4: Graphical Representation showing comparison of real time data and predicted data for the month of February-2019

IV. CONCLUSIONS

The institute is established in Rourkela, which is an industrial town of Rourkela Steel Plant having changing atmosphere. But, as the institute is established from last 50 years, the soil gets compacted and for which the predicted data follows same trend as the real time data. From the results and discussion we conclude that the soil gets compacted and the infiltration rate will be constant for next year's considering the present environmental situation, which also prevents the erosion at the particular area.

V. ACKNOWLEDGEMENT

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