Experimental Evaluation of the Erosion Degree of Menamkulam Coastal Region

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***Abstract*— Kerala, being a state in the southwestern part of India is exposed to different types of natural calamities including floods, landslides, coastal erosions, tsunamis, and cyclones and is considered a multi-hazard-prone state in the country. Kerala has a coastline of about 590km spreading over nine districts of Kerala. In November 2018, a study by the National Centre for Earth Science Studies showed that 60 per cent of Kerala's coastline is under erosion. 23% of Trivandrum's coastal line was affected in the year 2021. Various studies have been conducted on shoreline changes using satellite and remote sensing data. Erosion hotspots were identified using past data. A model was set up in the laboratory to assess the erosion degree of the selected region. Sandy slope was set up in the tank considered for the study. The erosion degree was assessed considering varying velocities. Coir Geotextile was used as a soil cover to prevent the soil from being eroded. The use of coir geotextile was found to provide almost 70% erosion resistance.**

Keywords*— *Coastal erosion, Field soil, Erosion Degree, Menamkulam region, Coir Geotextile, Velocity variation

I. INTRODUCTION

Coastal regions have gotten crucial attention as a result of recent population growth and accelerated development near coasts. 20% of the population and the environment of India reside in the coastal region. Beach erosion is a problem that affects the entire world, according to claims that 70% of the planet's beaches are eroding [2]. The problem of erosion of the coastal reaches brought on by the ocean waves and near-shore currents affects all of India's coastal states. Due to erosion, large areas of land are lost, and priceless homes, businesses, and coastal structures all sustain damage. Though satellite-based studies are being carried out to analyze the changes in shorelines over the years [3,4], experimental studies considering particular areas are limited especially those of the Kerala region. Though eco-friendly measures are experimented for the stabilization of various soil types and erosion control [5,6], the effect of natural fibres on erosion resistance of coastal regions is a lesser investigated area. The current paper tries to assess the erosion degree of Menamkulam region, Kerala, India considering varying velocities and analyze the effect of using coir fibres on erosion resistance

II. MATERIALS

A. Soil

The soil taken for the study is collected from the Menamkulam region of Trivandrum district, Kerala, India. The soil collected is shown in Fig.1. The soil was collected from Arattuvazhi beach of Menamkulam region.

Fig. 1. Menamkulam Soil

The soil was found to be poorly graded sand (SP). The properties of the soil are listed in Table 1.

TABLE I. PROPERTIES OF SOIL SAMPLE

Property	Values
Specific Gravity	2.66
Coefficient of uniformity, C_u	1.77
Coefficient of Curvature, C_c	1.13
IS Classification	SP
Angle of Internal Friction, ϕ (degrees)	31°
Cohesion, c (kg/cm^2)	0.05

B. Coir Geotextile

The coir geotextile (GT) used in the study was purchased from Neyyattinkara Coir Cluster, Trivandrum. The properties of the geotextile collected are listed in Table 2.

TABLE II. PROPERTIES OF COIR GEOTEXTILE

Property	Values
Thickness (mm)	12.69
Tensile strength (N/m)	1006.93
Puncture resistance (mm)	10
Mass per unit area (GSM)	755

III. METHODOLOGY

The literature shows that the erosion rate increases with an increase in slope angle [1]. The soil slope selected for the study was 30˚. The 30-degree slope was modelled in the glass tank considered for the study. The waves were generated using a wave generator at velocities of 0.06, 0.07, 0.08 and 0.09m/s. The study was conducted for a period of 1 hour. The erosion degree, D_e was calculated as given in (1). Erosion degree if unity is the maximum value of stability indicating that the soil is not being eroded. As the erosion degree deviates from unity, it indicates that more amount of soil is being eroded away.

$$D_e = \Theta/\Theta' \qquad (1)$$

The erosion degree of untreated soil at various time intervals was calculated and was done similarly by considering Coir GT as a cover for the soil slope.

IV. RESULT AND DISCUSSIONS

The erosion degree obtained for 30˚ slope in the untreated case and the case with coir GT is discussed. Fig. 2 represents the comparative graph showing the variation in erosion degree with respect to time in four varying velocities.

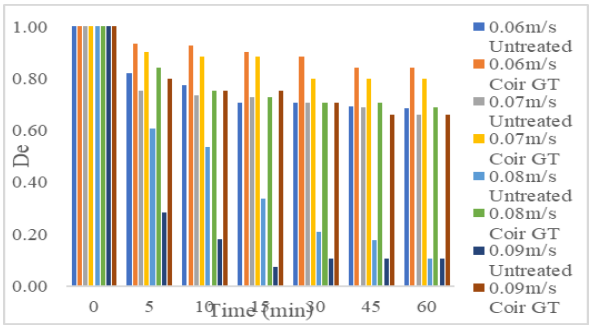

Fig. 2. Comparative graph showing variation in erosion degree with time and velocity

From the data, it can be observed that the erosion degree is lesser at peak velocities indicating that more amount of soil mass is being eroded. The least value of erosion degree obtained is 0.11 in the case of untreated soil in peak velocity. The erosion degree is improved to 0.66 with the use of coir geotextile. This enhanced erosion resistance is due to the interaction between the coir fibres and soil particles. The presence of lignin and cellulose enhances the binding property between the soil particles and prevents soil from being eroded in large quantities.

CONCLUSIONS

The experimental studies are carried out for a period of 1 hour in 30˚ slope and at four velocities. The following conclusions are made from the study:

- Menamkulam soil is found to have erodible soil from experimental test results.
- Erosion degree is found to be the least in peak velocities indicating more soil mass being eroded.
- Coir geotextile offers an erosion degree value of at least 66% in all cases.
- Coir geotextile offers 6 times better erosion resistance than untreated soil in the extreme case considered.

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