Flume and Rainfall Simulator for Overland Flow Studies

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**Technical Specifications**

- **Flume**
  - Length (L): 3.0 m
  - Width (w): 0.5 m
  - Depth (d): 0.04 m
  - Slope: 0 to 15°
  - Upper Stopper: $L = 0.20, w = 0.5, d = 0.04$ m
  - Lower Stopper: $L = 0.15, w = 0.5, d = 0.04$ m

- **Flow Velocity**
  - Velocity Measurements: Water-trace Technique
  - Dye Used: Lycopene
  - Test Length: 1.24 m

- **Flow Rate Measurements**
  - Flow Rate: 33 to 1033 cm³/sec

- **Water Supply**
  - Water-meter

- **Water Depth**
  - Depth Measurements: 2 Point Gauges
  - Accuracy: 0.1 mm

- **Rainfall Simulator**
  - Nozzle Lechler 461.008: 71 mm/hr
  - Nozzle Lechler 460.788: 36 mm/hr
  - Height above Flume Bed: 3.0 m
  - Area Covered: 2 m²

- **Available Sediment**
  - Median Grain Size ($D_{50}$): 0.233, 0.536, 0.719 and 1.022 mm

- **Bed Roughness**
  - Roughness Measurements Laser Scanner
  - Accuracy: 1 mm
  - Scan Area: 1 m²

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**Applications**

The flume and other available equipments can be used for following studies:

- Overland flow studies
- Hillslope studies
- Soil stability studies
- Interception studies
- Calibration of field equipment
- Sediment detachment and transport studies
Evaluation of Sediment Transport Equations Under Overland Flow Conditions

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Background

- Empirical and physically-based equations are used in most water erosion models for soil detachment and sediment transport.
- Most equations were derived for streamflow conditions due to non-availability of experimental data for overland flow conditions.
- But hydraulic and sediment transport conditions in streamflow are different from overland flow conditions (depth, velocity, slope, etc.), which makes the use of streamflow transport equations questionable.

Methodology

- Seven well-known and widely-used sediment transport equations are critically analyzed and a literature review of previous tests has been made.
- 1214 flume experiments are being carried out to collect the hydraulic and sediment parameters under four different conditions:
  1. Smooth bed
  2. Rough bed
  3. Smooth + Rainfall
  4. Rough + Rainfall

Study Objectives

- To study the effect of bed roughness, rainfall amount and intensity on sediment transport capacity in the laboratory under different flow conditions.
- To evaluate the performance of existing soil transport equations using the laboratory data, and identify the best-performing transport equations.
- To adapt the best performing transport equations by including the effects of bed roughness and rainfall effects.

Preliminary Results

- Interaction of detachment and deposition along flume is dependent on the discharge at same slope.

Soil Type 719 μm
Slope 7.5 degree

<table>
<thead>
<tr>
<th>Detachment or Deposition Rate (g/mm²/s)</th>
<th>Flume Length (mm)</th>
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<tbody>
<tr>
<td>5 litres/min</td>
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<tr>
<td>10 litres/min</td>
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<td>15 litres/min</td>
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