Particle displacement due to splash - analysis based on glass bead deposits

Rafał Mazur¹, Magdalena Ryżak¹, Agata Sochan¹, Karolina Marciszuk², Michał Beczek¹, Krzysztof Lamorski¹, and Andrzej Bieganowski¹

¹Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland
²Institute of Physics, Maria Curie-Sklodowska University, pl. Marii Curie-Skłodowskiej 1, 20-031 Lublin, Poland

Splash, which is the first stage of the water erosion, is a dynamic and complex phenomenon. The ejection of soil particles occurs within fractions of a second after the impact of a drop. The diameter of the deformation formed on the surface can be measured in millimeters. The complicated nature of the phenomenon necessitates the use of advanced equipment (high-speed cameras or surface scanners) and models for simplification of the subject of the study to analyze selected aspects of the splash.

The work presents the results of research in which glass beads were used as a soil model. The aim of the experiments was to determine the influence of the initial position of the deposit elements on their displacement as a result of a droplet impact.

A water drop with a diameter of 4.2 mm falling freely from a height of 1.5 m was used in the study. The beds were placed in aluminum rings with a diameter of 40 mm. The measurements were based on the initial and final position of the beads used as markers; these beads differed in color from the rest of the deposit. The source of data included pictures taken with a digital camera before and after the impact and control recordings made with high-speed cameras to correct possible errors. Additionally, some of the samples were scanned with a microtomograph, which allowed characterizing the surface deformation. Taking into account their structure, the beds used in the measurements were divided into two groups. The first one was used to analyze the influence of drops on individual elements - symmetrical patterns from colored beads were prepared on the sample surface; the second group was used to analyze the influence of drops on groups of elements - layers of beads with the same color were prepared on the surface of these samples.

Based on the experiment results, the movement of the deposit elements was divided into three types: displacement inside the area wetted by a drop, ejection, and placement on the crater rim. The initial location of the beads displaced over the greatest distances was a narrow ring covering the area from 4 to 8 mm from the point of the drop impact. It is worth noting that this area was associated with strong surface deformation. The use of "monolayers" helped to indicate that 97% of the beads ejected outside the ring with the deposit originated from the bed surface layer.
References
The study was partially funded from the National Science Centre, Poland in the frame of project no. 2014/14/E/ST10/00851.