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Runoff initiation from falling raindrops – comparison of smooth impervious surface and asphalt pavements. Effects of surface inclination and texture.

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The processes of runoff initiation on smooth impervious surfaces and various asphalt pavements are investigated in laboratory rain simulator experiments and outdoor sprinkling tests. Visual and FLIR observations indicate that runoff initiation is associated with coalescence of drop clusters on the surface and complex changes in micro-connectivity. Depending on surface inclination, several morphological regimes of flow initiation have been observed. In the case of very small inclination the runoff initiation is governed by critical merging of drop clusters on the surface and develops in broad flows (very abrupt, but delayed). For larger inclinations, the runoff occurs in rivulets or strongly directed flow threads.

On asphalt pavements the runoff initiation is also strongly affected by pavement SVF (Surface Void Fraction), texture and even by the asphalt hydrophobicity. A simplified bi-level model of the pavement surface may explain principal differences in the runoff initiation on asphalts with small, intermediate and large SVF values. For small SVF (standard fresh asphalts) the runoff develops on the upper surface level, and filling of the surface voids is not always required (especially for the large inclinations). For intermediate SVF (considerably deteriorated asphalts) the runoff develops as well on the upper surface level, but only after considerable filling of the surface voids. Finally, on severely deteriorated asphalts (very large SVFs) the runoff develops on the “bottom” level of asphalt surface, after only partial filling of the surface voids. Other factors, such as drops splash and splitting, also affect the process of runoff initiation and explain rather considerable differences (sometimes of 2-3 mm rain depth) in the runoff thresholds on various non-porous asphalt pavements.

Similar phenomena can be probably observed on certain types of rock outcrops.