
Threshold surface concentration of microplastics triggering higher mobility on gravel bed

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Abstract

To study the effects of different surface concentrations of microplastics (MPs) on their mobility, a series of experiments was run in a flume with gravel bed. Different amounts of two types of compact MPs (with densities of 1.1 and 1.4 g/cm³) were released. The surface concentration of MPs spanned between 0.3 and 30 g/kg of surface clasts (corresponding to a surface cover ranging from 0.04% to 4%) and the MPs were allowed to deposit under low flow velocity conditions. As the flow rate was increased, stepwise, exceeding the MPs-specific reference threshold conditions (observed in previous studies of MPs moving on a microplastic bed) two different behaviours were observed: i) low-density MPs mobilised at conditions similar to the reference ones up to approximately a concentration of 3g/kg surface clasts (0.04% surface cover) while, ii) high-density MPs were not mobilised at their reference threshold conditions up to a concentration of 15g/kg surface clasts, corresponding to 2% surface concentration. As the mentioned values were surpassed, both MPs types showed a higher mobility (compared to the reference), meaning lower mean flow velocities triggered motion of a larger number of particles. Preliminary analysis of mean flow conditions and videos of moving particles suggest that a "critical concentration" exists, above which the chosen microplastic particles assume higher mobility, requiring lower flow velocities to get into motion. This higher mobility may be ascribed to the changed morphology of the bed which corresponds to critical concentrations of added plastic particles over the gravel bed. This "new morphology" modifies the near-bed flow characteristics, thus imposing new conditions to the MPs' mobility. Further investigations are needed to confirm such hypothesis, with specific focus on the near-bed flow field.

Keywords: surface concentration, nearbed, bedload, gravelbed, heavy microplastics

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