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Effect of shape on the transport and retention of nanoplastics in saturated quartz sand

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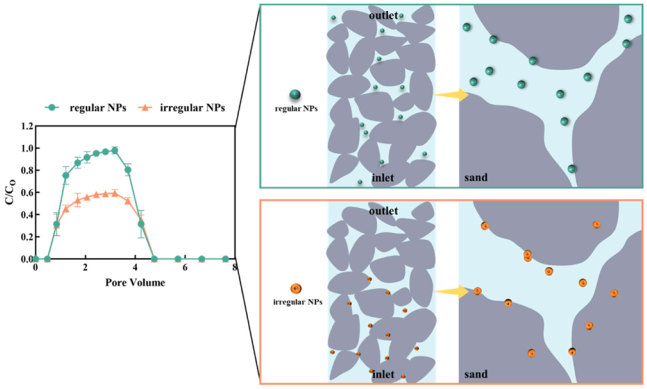
HIGHLIGHTS

- Transport of different shapes of PS NPs were studied in column experiments.
- Toroid-like NPs were employed as irregular flattened ones.
- Decreased transport and increased deposition of irregular NPs were observed.
- Theoretical study also verified more deposition of irregular NPs than regular NPs.
- Lower DLVO barrier and greater margination of irregular NPs to sand was the mechanism.

GRAPHICAL ABSTRACT



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ABSTRACT

Nanoplastics (NPs) pose great challenges to soil-groundwater systems. This study investigated the transport and retention of self-synthesized 0.5-μm polystyrene NPs with different shapes using column experiments. The regular NPs were with spherical shapes, while the irregular NPs were with toroid-like shapes. The toroid-like shapes were the irregular shapes (with low aspect ratio) which have not been studied yet. The explorations were carried out in both 5–25 mM $NaNO_3$ and 1–10 mM $Ca(NO_3)_2$ solutions. Both breakthrough curves (BTCs) and retained profiles (RPs) were monitored. Our findings uncovered a clear disparity in the transport of irregular and regular NPs, with irregular particles exhibiting lower transport ability compared to the regular ones. For example, the

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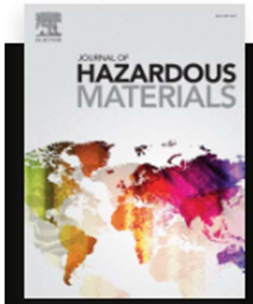

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