A Water-Saving Anti-Splash Squat Toilet

Liu, Guangyu (School: The Experimental High School Attached to Beijing Normal University)
Zhang, Wenjia (School: The Experimental High School Attached to Beijing Normal University)

Millions of people use squat toilets daily, yet urine splashing remains a common problem, soiling floors and clothing, promoting bacterial growth, and causing unpleasant odors. Beyond hygiene, splashing increases cleaning workload and water usage, raising costs and wasting resources. Based on the fluid mechanics principle that smaller droplet impact angles produce less splashing, this study explores a novel squat toilet design developed using differential equations. To investigate whether the new squat toilet can reduce urine splashing, three methods were employed: urine impact angle mapping, Fluent flow field simulations, and physical experiments. MATLAB-generated cloud maps showed that the novel design produced smaller impact angles than conventional toilets, while Fluent simulations indicated a significantly lower splashing ratio. Physical experiments simulated urination into squat toilets. Qualitative tests used UV imaging of fluorescent urine and top-down imaging of red ink splashing to analyze splash patterns, both showing reduced splashing in the novel design. Quantitatively, by measuring the mass increase of floor-placed absorbent paper, urine splashing was reduced by over 75% compared with conventional designs. The new toilet also reduced water usage during flushing. This study is the first to address urine splashing in squat toilets and demonstrates that reducing droplet impact angles can effectively suppress splashing. The proposed design can improve hygiene, lower disease risk, reduce cleaning costs and labor, conserve water, and support environmental sustainability.

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