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Bed Evolution under One-Episode Flushing in a Truck Sewer in Paris, France

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Abstract : Sewer deposits have been identified as a major cause of dysfunctions in combined sewer systems regarding sewer management, which induces different negative consequents resulting in poor hydraulic conveyance, environmental damages as well as worker's health. In order to overcome the problematics of sedimentation, flushing has been considered as the most operative and cost-effective way to minimize the sediments impacts and prevent such challenges. Flushing, by prompting turbulent wave effects, can modify the bed form depending on the hydraulic properties and geometrical characteristics of the conduit. So far, the dynamics of the bed-load during high-flow events in combined sewer systems as a complex environment is not well understood, mostly due to lack of measuring devices capable to work in the "hostile" in combined sewer system correctly. In this regards, a one-episode flushing issue from an opening gate valve with weir function was carried out in a trunk sewer in Paris to understanding its cleansing efficiency on the sediments (thickness: 0-30 cm). During more than 1h of flushing within 5 m distance in downstream of this flushing device, a maximum flowrate and a maximum level of water have been recorded at 5 m in downstream of the gate as 4.1 m3/s and 2.1 m respectively. This paper is aimed to evaluate the efficiency of this type of gate for around 1.1 km (from the point -50 m to +1050 m in downstream from the gate) by (i) determining bed grain-size distribution and sediments evolution through the sewer channel, as well as their organic matter content, and (ii) identifying sections that exhibit more changes in their texture after the flush. For the first one, two series of sampling were taken from the sewer length and then analyzed in laboratory, one before flushing and second after, at same points among the sewer channel. Hence, a non-intrusive sampling instrument has undertaken to extract the sediments smaller than the fine gravels. The comparison between sediments texture after the flush operation and the initial state, revealed the most modified zones by the flush effect, regarding the sewer invert slope and hydraulic parameters in the zone up to 400 m from the gate. At this distance, despite the increase of sediment grain-size rages, D50 (median grain-size) varies between 0.6 mm and 1.1 mm compared to 0.8 mm and 10 mm before and after flushing, respectively. Overall, regarding the sewer channel invert slope, results indicate that grains smaller than sands (< 2 mm) are more transported to downstream along about 400 m from the gate: in average 69% before against 38% after the flush with more dispersion of grain-sizes distributions. Furthermore, high effect of the channel bed irregularities on the bed material evolution has been observed after the flush.

Keywords : bed-load evolution, combined sewer systems, flushing efficiency, sediments transport
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