

Highlights

- The gravity flow self-supplying O₂ of BhGAC-DBfR was applied for on-site greywater treatment
- Division of saturated and unsaturated zones favors the formation of multifunctional biofilm
- A saturated/unsaturated ratio of 1:1.1 gave the best reactor performance
- Adsorption and biodegradation play distinct roles in the uptake and continuous removal of LAS
- The functional genus and enzymes enabled the efficient removal of organics and nitrogen