Claims

1. A method for the treatment of wastewater in a biological treatment reactor, comprising the steps of:
   (a) introducing wastewater influent at the bottom part of the reactor while simultaneously decanting treated wastewater effluent at the operational water level in the top part of the reactor;
   (b) an aeration step; and
   (c) a settling step wherein the biomass is allowed to settle;

   wherein step (a) is performed under vertical plug flow conditions achieved by introducing the wastewater influent into the reactor through an influent distributor system comprising two or more distributor pipes, said two or more pipes comprising one or more nozzle outlets, preferably directed downwards, arranged to provide an equal distribution of influent wastewater across the reactor bottom surface, and discharging the treated wastewater effluent through an effluent decanter system configured to discharge the treated wastewater effluent equally across the operational water level in the top part of the reactor;

   and wherein during step (a) the equal distribution of the influent wastewater across the distributor pipes and/or the degree of plug-flow in the reactor is monitored, and when a suboptimal distribution or a suboptimal degree of plug-flow is detected the influent distributor system and/or effluent decanter system is cleaned by removing fouling and/or blockage,

   wherein in step (a) preferably a vertical vent pipe is connected to each distributor pipe, the vertical vent pipe ending above the operational water level of the reactor in order to release air or oxygen entrained in the distributor pipe, and

   wherein a distributor pipe of the influent distributor system is cleaned by entering, at the reactor top, a high-pressure lance, or alternative mechanical or hydromechanical device, through the vent pipe connected to the distributor pipe.

2. The method according to claim 1, wherein the influent distributor system is cleaned by:
   (i) draining the reactor and cleaning one or more of the distributor pipes and their nozzles manually; or
   (ii) lifting up one or more of the distributor pipes for manual clean; or
   (iii) inserting an in-pipe cleaning device, for example a pipe pig, cleaning robot or hydrojet, into the header; or
   (iv) temporarily increasing the flow through the influent distributor system.

3. The method according to any of the preceding claims, wherein a grid with header is routed above water level, optionally with an entry for a cleaning device located in the header.

4. The method according to any of the preceding claims, wherein during step (a) the degree of plug-flow in the reactor is monitored by determining the profile of a suitable parameter across

the reactor from the bottom part to the top part of the reactor, at various times during step (a).

5. The method according to claim 4, wherein the suitable parameter is the concentration of a pollutant, preferably chemical oxygen demand (COD), ammonium or phosphate, turbidity, pH, redox potential, conductivity or temperature.

6. The method according to any one of the preceding claims, wherein in step (a) the equal distribution of wastewater influent across the distributor pipes is monitored by measuring water level and/or pressure and/or temperature or other suitable parameter in the vent pipes.

7. The method according to any one of the preceding claims, wherein in step (a) the equal distribution of the wastewater influent across the distributor pipes results in a degree of plug-flow that enables that a minimum of 30%, preferably more than 50%, more than 60% or more than 70%, of the reactor volume is displaced towards the treated wastewater effluent decanter system without significant breakthrough of untreated wastewater.

8. The method according to any one of the preceding claims, wherein more than 70% of the biomass particles in the reactor have a diameter ≥ 0.2 mm, preferably a diameter in the range of 0.2 – 5.0 mm.

9. The method according to any one of claims 1 – 7, wherein more than 70% of the biomass particles in the reactor have a diameter of ≤ 0.2 mm.

10. A liquid distributor system comprising two or more distributor pipes, said two or more pipes comprising one or more nozzle outlets arranged to provide an equal distribution of influent wastewater across the reactor bottom surface, wherein a vertical vent pipe is connected to each distributor pipe.

11. Use of the liquid distributor system according to claim 10 in a method for the aerobic treatment of wastewater in a vertical plug flow (VPF) biological treatment reactor.

12. Use according to claim 11, wherein the method for the treatment of wastewater is according to any one of claims 1 – 9.

13. An installation for carrying out the process according to any one of claims 1 – 9, comprising a reactor with a liquid inlet system at the bottom part of the reactor, a liquid outlet system at the top of the reactor and a gas inlet at the bottom of the reactor, wherein the liquid inlet system comprises two or more distributor pipes, said two or more pipes each comprising one or more nozzle outlets arranged to provide an equal distribution of liquid across the reactor

bottom surface, wherein a vertical vent pipe is connected to each distributor pipe, the vertical vent pipe ending above the operational water level of the reactor in order to release air entrained in the distributor pipe.

14. Use of the installation according to claim 13 in the aerobic treatment of wastewater in a vertical plug flow (VPF) biological treatment reactor, wherein the method for the treatment of wastewater is preferably according to any one of claims 1 – 9.