needed for phosphorous removal in the chemical treatment phase.

Summary of the Disclosure

According to the disclosure at least the primary object is attained by means of the initially defined method for managing a wastewater treatment process having the features defined in the independent claim. Preferred embodiments of the present disclosure are further defined in the dependent claims.

Hence, according to the present disclosure, there is provided a method for managing a wastewater treatment process, wherein the influent wastewater contains phosphorous, said method comprising at least the steps of:

- measuring an amount of at least one nitrogen-containing substance in the influent wastewater ($C_{N,\ influent}$), wherein the nitrogen-containing substance is at least one of ammonium-nitrogen (NH4-N), organic nitrogen, ammonia (NH3) and ammonium (NH4+), and
- determining an amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) based on the measured amount of at least one nitrogen-containing substance in the influent wastewater ($C_{N,\ influent}$), based on a predetermined correlation between the amount of phosphorous ($C_{P,\ influent}$) and the amount of said at least one nitrogen-containing substance ($C_{N,\ influent}$) in the influent wastewater.

It has been established that the amount of phosphorous in the influent wastewater is correlated with the amount of nitrogen-containing substances in the influent wastewater. As discussed above, this process parameter has historically been very difficult to determine in a simple manner and at a reasonable cost. Based on the insight that the amount of phosphorous in the influent wastewater ($C_{P,\ influent}$) and the amount of the nitrogen-containing substance in the influent wastewater ($C_{N,\ influent}$) are correlated and that the amount of the at least one nitrogen-containing substance is easily measured by means of a readily available sensor, the amount of phosphorous in the influent wastewater may be straightforwardly determined with great precision. Above correlation has been further investigated in experiments using municipal wastewater from different sites as direct

during this phase opens for reduction of the amount of coagulant used in the subsequent chemical phase.

In an embodiment, the nitrogen-containing substance is ammonium-nitrogen (NH4-N) and the correlation between the amount of phosphorous in the influent wastewater ($C_{P,\ influent}$) and the amount of ammonium-nitrogen (NH4-N) in the influent wastewater ($C_{NH4,\ influent}$) is equal to or less than 1:2 and equal to or more than 1:8, preferably equal to or less than 1:4 and equal to or more than 1:6, most preferably about 1:5. In this context, the correlation 1:5 is representative for municipal wastewaters of most EU-countries.

In a preferred embodiment, the coagulant is cerium trichloride ($CeCl_3$). It has been established that use of cerium trichloride may reduce the amount of the introduced coagulant by up to 30%. This depends at least partly on the fact that cerium trichloride is extremely reactive during first few seconds of its contact with the influent wastewater. Moreover, cerium trichloride is a coagulant that preserves a certain level of reactivity also when bound to the phosphorous-containing substance and settled in the sludge layer.

Further advantages and features of the disclosure will be apparent from the other dependent claims as well as from the following detailed description of preferred embodiments.

Brief description of the drawings

A more complete understanding of the abovementioned and other features and advantages of the present invention will be apparent from the following detailed description of preferred embodiments in conjunction with the appended drawings, wherein:

Fig. 1 is a schematic cross sectional side view of a multi-purpose basin suitable for a SBR-process with continuous inflow of influent, during a chemical

Claims

1. A method for managing a wastewater treatment process, wherein the influent wastewater contains phosphorous, said method comprising at least the steps of:

- measuring an amount of at least one nitrogen-containing substance in the influent wastewater ($C_{N,\ influent}$), wherein the nitrogen-containing substance is at least one of ammonium-nitrogen (NH4-N), organic nitrogen, ammonia (NH3) and ammonium (NH4+), and

- determining an amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) based on the measured amount of at least one nitrogen-containing substance in the influent wastewater ($C_{N,\ influent}$), based on a predetermined correlation between the amount of phosphorous ($C_{P,\ influent}$) and the amount of said at least one nitrogen-containing substance ($C_{N,\ influent}$) in the influent wastewater.

2. The method according to claim 1, said method further comprising the step of:

- removing the determined amount of phosphorous from the influent wastewater ($C_{P,\ influent}$).

3. The method according to any of preceding claims, wherein the step of determining the amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- subtracting a target value for the amount of phosphorous in the effluent wastewater ($C_{P,\ target,\ effluent}$) from the previously determined amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$).

4. The method according to claim 3, wherein the step of determining the amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- adding a difference between the current measured value for amount of phosphorous in the effluent wastewater ($C_{P,\ effluent}$) and the target value for amount of phosphorous in the effluent wastewater ($C_{P,\ target,\ effluent}$) to the previously

determined amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$).

5. The method according to any of claims 1-4, wherein the step of removing the determined amount of phosphorous from the influent wastewater ($C_{P,\ influent}$) further comprises:

- introducing an amount of coagulant during a chemical treatment phase of a reaction phase of the wastewater treatment process, wherein the introduced amount of coagulant is determined based on the previously determined amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$).

6. The method according to any of claims 1-5, wherein the step of determining the amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- subtracting a value corresponding to a biological uptake of phosphorous from the previously determined amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$), said biological uptake of phosphorous occurring during a biological treatment phase of the reaction phase of the wastewater treatment process.

7. The method according to claim 6, wherein said biological uptake of phosphorous is based at least on consumed biodegradable carbon, preferably expressed by means of biological oxygen demand (BOD).

8. The method according to any of claims 1-7, wherein the step of determining the amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- subtracting a value corresponding to an uptake of phosphorous by phosphorous accumulating organisms (PAO) from the previously determined amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$), said uptake of

phosphorous by phosphorous accumulating organisms (PAO) occurring during a biological treatment phase of the reaction phase of the wastewater treatment process.

9. The method according to claim 8, wherein said uptake of phosphorous by phosphorous accumulating organisms (PAO) is based at least on the difference between the value of readily biodegradable carbon present in the influent wastewater and the value of readily biodegradable carbon present in the effluent wastewater under anaerobic conditions, said readily biodegradable carbon preferably being expressed by means of readily biodegradable chemical oxygen demand (rbCOD).

10. The method according to any of claims 6-9, wherein the step of determining the amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- taking into account duration of the anaerobic part of the biological phase of the reaction phase of the wastewater treatment process when determining uptake of phosphorous through biological uptake and/or through phosphorous accumulating organisms (PAO).

11. The method according to any of preceding claims, wherein the nitrogen-containing substance is ammonium-nitrogen (NH4-N).

12. The method according to claim 11, wherein the correlation between the phosphorous concentration of the influent wastewater ($C_{P,\ influent}$) and the concentration of ammonium-nitrogen (NH4-N) in the influent wastewater ($C_{NH4,\ influent}$) is equal to or less than 1:2 and equal to or more than 1:8, preferably equal to or less than 1:4 and equal to or more than 1:6, most preferably about 1:5.

13. The method according to any of claims 1-12, wherein the nitrogen-containing substance is at least one of organic nitrogen, ammonia (NH3) and ammonium (NH4+).

14. The method according to claim 5, wherein the coagulant is a rare earth salt that comprises a cerium ion.

15. The method according to claim 14, wherein molar ratio of cerium (Ce) and phosphorous (P) is between 0.2 and 2, preferably 1.

16. The method according to claim 14 or 15, wherein the coagulant is cerium trichloride ($CeCl_3$).

17. The method according to claim 5, wherein the coagulant is a metal salt that comprises an iron ion.

18. The method according to claim 17, wherein molar ratio of iron (Fe) and phosphorous (P) is between 1 and 4, preferably 2.5.

19. The method according to claim 18, wherein the coagulant is iron trichloride ($FeCl_3$).

20. The method according to claim 1 or 2, wherein the step of determining amount of phosphorous to be removed from the influent wastewater ($C_{P,\ influent}$) further comprises:

- measuring level of biodegradable carbon in the influent wastewater ($C_{N,\ influent}$), and

- subtracting the measured level of biodegradable carbon in the influent wastewater (CN, influent) from the previously determined amount of phosphorous in the influent wastewater ($C_{P,\ influent}$).