Application Note

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Checking Software on Residual Treatment Ability & Aeration Energy Saving: WWTP/Check

Introduction

In relation to the growing attention to issues of process efficiency and energy optimization under the wastewater treatment, linked both economic issues and rules, this application note introduces the software code WWTP/Check to determine the Residual Treatment Ability (RTA) and the Aeration Energy Saving (AES).

Why?

The interest in calculating the residual treatment ability in a wastewater treatment plants has increased since the l. d. 152/99 (art. 36) has regulated its use in an official manner.
It is emerged from the beginning the need to define this "tool" in the absence of specific technical standards, to use wastewater treatment urban plants of medium-great size to compensate for the deficiency in Italy and especially in the center-south, of platforms for the disposal of wastewater.
Abroad, this practice is not widespread because obviously there are many more dedicated facilities for disposal of wastewater and production activities are equipped with dedicated treatment facilities.
So, they were born different schools of thought that have explored this "tool" that in addition to being an utility in the management phase, can be used as an instrument under the controls of a wastewater treatment plant.
Now, the use with the l.d. 152/06, (art. 110) of "residual treatment ability" for the treatment of wastewater compatible with the purification cycle actually turns the wastewater treatment plant from "terminal facility" of the sewer to "useful structure" in the service even of a territorial district.
According to current regulation, treatment of liquid waste by wastewater treatment plants should be authorized upon the following conditions:

- The wastewater treatment plant is over-dimensioned and hence offers a spare treatment capacity;
- The liquid waste is compatible with the treatment process and its processing would not cause discharge limits to be exceeded.

In the other side, aeration systems for conventional wastewater activated sludge plants typically account for 45 to 60% of a treatment facility's total energy use. The ability to define what improvements will be most cost effective begins with understanding how to create a simplified model of the system.
Air or oxygen is introduced to the reactor to provide the inflow wastewater the oxygen to sustain the necessary level of biological activity.
The demand of oxygen within a biological reactor can be met in various ways, but most aeration devices currently being used in activated sludge process may be classified as either diffused, dispersed, or surface aeration systems.

So, the proposed code allows to calculate the residual treatment ability of a wastewater treatment plant, according to current regulation, and to calculate the aeration energy saving, resulting in an economic saving.

Principles

The WWTP/Check code determines RTA and AES considering that:

1. wastewater treatment plants are typically designed according to prefixed hydraulic and pollutant load, often not corresponding to operational reality (developmental characteristics of the basin area). This can make a difference (positive or negative) between the designed purification capacity of the plant and that available. If you consider the advantage of providing additional (through tanks) of wastewater from industry, while the existing legislation (Legislative Decree 152/06 and adj.) requires the operator to assess and demonstrate that the plant has a sufficient and compatible residual treatment ability to treat delivered wastewater, we deduce the importance of the proposed calculation procedure;
2. 70% or more, the energy consumption of a wastewater treatment plant, especially if it has the phase of nitrification of ammonia, is spent in the process of blowing air into the section of biological oxidation-nitrification: therefore, the determination of

AES allows to optimize the energy consumption of the plant;

3. the application of remote control systems and automation of the purification process requires the ability to operate on RTA and AES with the necessary flexibility, with respect to variations in operating load.

Advantages and Innovation

The definition of RTA and AES is the dynamical result of different contributing factors of design, process and management type. This factor are characteristic of each plant and the possible uses are:

1. Plant managers who must evaluate the residual treatment ability and the possibility of energy savings;
2. Designers and installers of process control systems and automation.

The proposed calculation procedure allows to evaluate the difference between the influential daily maximum wastewater load that the plant can treat to return a compliant effluent with the law limits of the particular delivery, and the average daily wastewater influential load currently treated.

The determination of Aeration Energy Saving allows to optimize the energy consumption of the plant, resulting in substantial savings from an economic point of view, and also benefits for environmental saving.

Conclusion

WWTP/Check is a software for the calculation of Residual Treatment Ability and the Aeration Energy Saving, able to take into account the process efficiency and energy optimization under the wastewater treatment, linked both economic issues and rules.

Its principal characteristic are:

- flexibility, by using heuristic algorithms, in addition to the traditional ones;
- the use of data and input normally available (hydraulic load, pollution load, …);
- the calculation of purification efficiency in terms of Nitrification, Denitrification and Clarifier;
- the calculation of energy efficiency in terms of aeration and of economic recovery.

References

Peng Y., Gao S., Wang S. Bai L. “Partial Nitrification from Domestic Wastewater by Aeration Control at Ambient Temperature”, Chin. J. Chem. Eng., 15(1) 115-121 (2007).

Wett, B., Buchauer, K., Fimml, C. (2007) “Energy self-sufficiency as a feasible concept for wastewater treatment systems”, IWA Leading-Edge Conference on Water and Wastewater Treatment, Singapore.

Jeyanayogam S., Venner I., “Wastewater Process Design with Energy Savings in Mind” Florida Water Resources Journal, January 2007.

Bolles S., “Modeling Wastewater Aeration Systems to discover Energy Savings Opportunities”, Process Energy Services, LLC.

Kadar Y., Siboni G., “Optimization of energy Economy in the Design and Operation of Wastewater Treatment Plants”, Mekorot Water Company, Ltd. And DHV-MED, Ltd., Tel-Aviv, Israel.

Moro G., Rosa A., Prestigiacomo M., Brigante G., “La capacità residua di un impianto di depurazione di acque reflue urbane. Parte II: l’applicazione del software *Care* a casi studio rappresentativi”, IA Ingegneria Ambientale vo. XXXV n. 10/11 ott-nov 2006.

Fiocchi N., Ciappelloni F., Ficara E., Canziani R., Farina R., “Metodiche a titolazione per la stima della capacità di trattamento dei rifiuti liquidi negli impianti di depurazione delle acque di rifiuto”, IA Ingegneria Ambientale vol. XXXVI n. 5 maggio 2007.

Siragusa A., “La capacità depurativa residua: Verifica con i metodi disponibili e valutazioni impiantistiche per l’upgrading gestionale, finalizzato al trattamento di rifiuti liquidi”, Giornate di studio – 14° incontro su: “Upgrading e gestione degli impianti di trattamento delle acque di scarico” Esperienze nazionali a confronto – Perugia, 4-5 Novembre 2010 – Villa Umbra, Loc. Pila.