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Standard method for assessing and improving the energy efficiency of waste water treatment plants

National foreword

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English Version

Standard method for assessing and improving the energy efficiency of waste water treatment plants

Méthode standard d'évaluation et d'amélioration de l'efficacité énergétique des stations d'épuration

Standardmethode zur Bewertung und Verbesserung der Energieeffizienz von Kläranlagen

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Ref. No. CEN/TR 17614:2021 E

Contents

Page

European foreword

This document (CEN/TR 17614:2021) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

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Introduction

Wastewater Treatment Plants (WWTPs) are one of the most expensive public industries in terms of energy requirements, accounting for more than 1 % of consumption of electricity in Europe. Thus, there is a need to stop the current unsustainable energy consumption of the sector in line with the objectives of Europe 2020 and the EU Sustainable Development Strategy (SDS).

The energy consumption must be related with the performance of a WWTP and parameters such as effluent flow, nutrient removal, biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, orthophosphate (PO_4), ammonia (NH_4) and nitrate (NO_3) need to be estimated or determined at various stages of the WWTP for an effective estimation and assessment of energy efficiency in WWTP.

This document presents a methodology to guide water experts and auditors on how to evaluate the energy performance of a WWTP reaching a final energy diagnosis and the calculation of a *Water Treatment Energy Index (*WTEI).

The methodology intends to be a very simple and easy to follow document that can be effortlessly understood and put in practice by operators, site managers, process engineers as well as energy auditors. It includes: planning the estimation of energy consumption at a WWTP; requesting approvals and keeping communication (operators, site managers, process engineers, budget holders and other possible end users) and health safety considerations; compilation of a database describing all equipment on site; selection of equipment for online monitoring and install online monitors according to manual; monitoring site for KPIs; training of people on the online tool and audits; audit, data collection and validation; calculation of the WTEI and classification of WWTPs. Furthermore the application of the methodology was completed to 3 case studies as practical examples.

The methodology included in this document considers two approaches for the determination of energy consumption in WWTPs, namely *Rapid Audit* and *Decision Support*.

Rapid Audit is aimed at a rapid estimation of the WTEI of a particular WWTP using existing information. This method uses existing information including historical data on energy consumption as well as the wastewater influent and effluent. A trained auditor can calculate the WTEI and the obtained values can be compared against a large database.

Decision Support is aimed at establishing the WTEI of a particular WWTP and providing information that can be used as decision support of an energy efficiency diagnosis. It requires online energy data obtained over extended periods of time as well as intensive wastewater sampling campaigns to establish KPIs for each individual treatment stage. The combined information from the online meters and wastewater sampling can then be used to calculate the WTEI using carefully selected statistical tools and energy performance indicators. The methodology described includes guidelines on how to select equipment/processes to place energy monitors, how to monitor the WWTP and how data should be processed and reported. The *Decision Support* methodology can be used to provide an WWTP energy benchmark but also understand impact of seasonal variations, storm events, changes in maintenance routines, implementation of new equipment (e.g.: screens, pumps, blowers, etc.) as well as retrofitting of existing processes as well as implementation of new processes. This methodology can also be used as a tool to identify energy efficiencies and inefficiencies so further actions can be planed and the impact can be measured and verified online. The *Decision Support* methodology can also be used as training tool as well as help water utilities to clearly communicate to operators, engineers and the general public how changes in operation and behaviour that can lead to energy efficiency and reduce energy consumption.

This document is based on the outcomes of the ENERWATER project, a coordination and support action funded by European Commission under Programme H2020 (www.enerwater.eu).

1 Scope

This document defines a methodology for determining and assessing the energy efficiency of Waste Water Treatment Plants (WWTP). The methodology aims at describing, in a systematic way, the various steps required to establish the *Water Treatment Energy Index* (WTEI) of a particular WWTP.

The methodology includes the classification of WWTPs in different types, identification of different stages of treatment, identification of key performance indicators (KPIs), overview of existing energy monitoring standards and the detailed description of the methodology, including a step by step guideline of how to apply and implement it.

The methodology is divided in 2 sub-methods that should be selected and followed according to the following goals:

— The *Rapid Audit* (*RA*) method allows for a quick estimation of the water treatment energy index (WTEI) based on existing information such as historical data pertaining to energy use records along with influent and effluent quality values. The aim of this methodology is to provide a WWTP energy benchmark, a rapid tool to identify energy efficiencies and inefficiencies so further actions can be planned, as well as to evaluate the impact of WWTP retrofitting.

  The *Rapid Audit* methodology is detailed step by step in Clause 4 of this TR and can be used as a standalone document. The application of the Rapid Audit methodology to one real WWTP is shown in Annex A.

— The *Decision Support* (*DS*) method requires intensive monitoring across a WWTP of energy usage and water quality parameters that provides an accurate and detailed calculation of WTEI for each stage as well as its overall value for the plant. The goal of this assessment is to serve as a diagnosis of the functions/equipment in a plant that may lead to poor energy efficiency performance.

  The *Decision Support* methodology is detailed step by step in Clause 5 of this TR and can be used as a standalone document. The application of the Decision Support methodology to one real WWTP is shown in Annex B.

2 Normative References

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

• ISO Online browsing platform: available at https://www.iso.org/obp

• IEC Electropedia: available at http://www.electropedia.org/

4 General considerations of methodologies

Both Rapid Audit (RA) and Decision Support (DS) methodologies are structured in a similar way but with a different level of detail. To sum up the procedures, first the type of WWTP according to its functions is established; then, energy consumption and other measurements (flowrate, pollutant concentrations, etc.) are combined to form relevant key performance indicators (KPIs). Guidelines for the estimation of analytical results, in case actual measurements are not available, are also given. Finally, the KPIs are normalized and combined according suitable weights in order to obtain the *Water Treatment Energy Index* (WTEI).