Standard method and online tool for assessing and improving the energy efficiency of wastewater treatment plants

Reporting

Project Information

ENERWATER
Grant agreement ID: 649819
Project website
Funded under H2020-EU.3.3.7.
Overall budget € 1 731 087
EU contribution € 1 731 087
Start date 1 March 2015
End date 31 October 2018
Coordinated by UNIVERSIDAD DE SANTIAGO DE COMPOSTELA Spain

 Periodic Reporting for period 2 - ENERWATER (Standard method and online tool for assessing and improving the energy efficiency of wastewater treatment plants)

Reporting period: 2016-09-01 to 2018-10-31

Summary of the context and overall objectives of the project

ENERWATER: STANDARD METHOD AND ONLINE TOOL FOR ASSESSING AND IMPROVING THE ENERGY EFFICIENCY OF WASTEWATER TREATMENT PLANTS was a 44 months CSA running under H2020, addressing the topic “Energy efficiency at wastewater treatment plants (WWTPs)”. Its consortium included partners from four countries, including academia, water utilities, an standardization body and a SME.

The main aim of ENERWATER was to co-create, develop, validate and to disseminate an innovative
standard methodology for continuously assessing, labelling and improving the overall energy performance of Wastewater Treatment Plants (WWTPs). For that purpose, a collaborative framework in the water treatment sector including research groups, SMEs, water management companies, city councils, water authorities and industry was established. By successfully fulfilling its objectives, ENERWATER has been able to tackle the challenge of improving energy efficiency in wastewater treatment plants with an integrated approach:
- Defining appropriate indicators of energy efficiency in wastewater treatment plants;
- Developing a standard method for measurement of energy efficiency in WWTPs, facilitating benchmarking among plants and/or at different time periods as well as effective communication (Figure 1);
- Demonstrating the monitoring of energy efficiency of 50 WWTPs in Spain, Italy and Germany;
- Providing data treatment tools that can be used for diagnosis of the operational factors impacting energy efficiency.

Achieving consensus has been our priority and this has been promoted by the organization of several stakeholder events, one per country included in the Consortium to reach more easily the local, regional and national stakeholders, with the main goal of disseminating and gathering feedback on the project activities. So, it was identified that the ENERWATER methodology should aim not only at labelling the energy efficiency but also at assisting on the diagnosis of the plant efficiency. Hence, the ENERWATER methodology is oriented both to provide a method for standard benchmarking and to diagnose the causes of efficiency differences. To facilitate its application by different users, two versions were developed: i) the ENERWATER Rapid Audit methodology that provides a label and a water treatment energy index (WTEI) using only routine measurements and energy bills; and ii) the ENERWATER Decision Support methodology that requires energy monitoring per process and internal analyses, and provides a diagnosis and identification of energy hotspots at the WWTP sections. Besides, energy measurements can be entered in the on-line platform (Figure 2) where this information is merged with the KPIs information and respective weightings and calculations, and the WTEI and ENERWATER labels can be obtained for any WWTP.

Concerning standardization activities, it was first confirmed the absence of specific normative documents in the framework of energy efficiency in WWTPs and the CEN/TC 165, Wastewater engineering, was identified as the most relevant technical committee for ENERWATER. A fluent communication was established with it, in particular with its WG 40, leading to the proposal of a Technical Report that is currently being discussed as a basis for a future standard on energy efficiency estimation in WWTP.

On the academia area, besides the presentation of partial and complete results of ENERWATER in several international conferences, a cooperative paper providing an overview of the literature of WWTP energy-use performance and of the state-of-the-art methods for energy benchmarking and their advantages and disadvantages was published. Co-authored also by several partners of the consortium, a second paper describing the ENERWATER methodology has been submitted. Furthermore and delving on the need of the provision of data treatment tools that can be used for diagnosis of the operational factors impacting energy efficiency, other research activities focused on the development and application of data analysis methods and several scientific papers are now...
ENERWATER has the potential to bring long-term social, economic and environmental benefits to Europe, where there is a growing concern on energy use in an attempt to mitigate climate change, optimization of energy efficiency and decrease the dependency of external energy imports. A strong political will has produced momentous plans, programs and new regulations to prevent energy misuse setting efficiency objectives and obligations (Directive 2012/27/EU on energy efficiency). Legislation is becoming more specific in order to address certain relevant sectors like such as buildings and households appliances. EU members have released national energy plans setting reduction objectives for 2020 and strategies towards their consecution (Energy 2020 - A strategy for competitive, sustainable and secure energy (2010), EU Energy Efficiency Plan 2011 (EEP)). At a particular level many companies and industries have also committed implementing energy management systems following voluntary standards (ISO 50001:2011 - Energy management systems). In this way, standards and legislation have become the main instrument to demonstrate commitment and address issues on energy efficiency.

The ENERWATER benefits are a consequence of achieving energy efficient wastewater treatment, which has a significant impact on the European population, as consumers of water, water bodies and the environment. One of the major costs of the water utilities, whether they are public, private or in any mixed partnership, is the energy expenditure. Even though the price of water provision is often regulated to a certain extent, the energy cost in wastewater treatment should in principle be transferred to the consumers.

Water governance is very heterogeneous in Europe. Nonetheless, the most common scheme features the public administration as responsible for the wastewater treatment as well as water distribution and production. In many cases, the administration delegates the public service through a leasing arrangement to a public or private operator with a tender repeated every 10/20 years and open to other operators. The ENERWATER method, aiming at being a standard energy audit tool, allows public administrations to benchmark, on a fair comparison basis, the energy efficiency of operators thereby providing an important criterion for the tender with the ultimate goal of reducing the water bill and the environmental impact.

The state of water bodies, in particular rivers, lakes, groundwater and coasts is a great concern for EU citizens as described repeatedly by Eurobarometer polls. The Water Directive (Directive 2000/60/EC) established a complete framework for protecting water bodies and sets the goals for wastewater treatment. The limits for discharge of N, P or organic matter represent a trade-off between the ecological requirements of the water bodies and the energy and resources needed to clean the wastewater further. ENERWATER gives the possibility of considering stricter discharge limits as it allows deeper control and understanding between tighter control over the effluent discharge and energy required to it.

Finally, EU citizens as water consumers will benefit of lower water tariffs and better information about the performance of wastewater treatment in their municipality or region as ENERWATER establishes the correct bases for comparison and operation of WWTPs.
**Summary**

- **Sample**: Migel Mauricio Iglesias
- **Date**: 19/10/2018 17:08
- **Size PE**: 1500
- **Design Size (PE)**: 230
- **GHG Emission (CO₂/year)**: 721.92
- **Electricity consumption (kWh/year)**: 2675
- **Overall energy consumption (kWh/year)**: 2675
- **Interval (year)**: 0
- **Scenario**: Silver
- **Samples (n/y)**: >12
- **Country**: Italy
- **gCO₂/kWh**: 431

**Calculation & Ranking WTEI**

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<thead>
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<th>Stage</th>
<th>GSS</th>
<th>NET</th>
</tr>
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<tbody>
<tr>
<td>Stage 1</td>
<td>G</td>
<td>G</td>
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<tr>
<td>Stage 2</td>
<td>G</td>
<td>F</td>
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<tr>
<td>Stage 3</td>
<td>D</td>
<td>F</td>
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<td>Stage 4</td>
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<td>F</td>
</tr>
<tr>
<td>Stage 5</td>
<td>F</td>
<td>D</td>
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</tbody>
</table>

**Energy Consumption**

- From kWh/year: 2675

**General**

**Characteristics**

**Technical values**

**Wastewater**

**In/Out Values (By Stages)**

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<thead>
<tr>
<th>Stage</th>
<th>TS IN (mg/L)</th>
<th>TS OUT (mg/L)</th>
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<tr>
<td>Stage 2</td>
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<td>96</td>
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<table>
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<tr>
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<th>N IN (mg/L)</th>
<th>P IN (mg/L)</th>
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<tr>
<td>Stage 3</td>
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<td>3.91</td>
</tr>
</tbody>
</table>

**E. coli In (UFC/100 mL)**

**E. coli Out (UFC/100 mL)**