



BSI Standards Publication

A method to calculate and express energy consumption of industrial wastewater treatment for the purpose of water reuse

Part 1: Biological processes

National foreword

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Part 1: Biological processes



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by Technical Committee ISO/TC 282, *Water reuse*, Subcommittee SC 4, *Industrial water reuse*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Biological wastewater treatment is a major process step in many cases of industrial wastewater treatment for reuse.

In the field of biological wastewater treatment, the energy consumption of the process is commonly normalized in order to account for difference in flow and concentration when comparing different treatment options. For example, energy consumption is reported per unit volume of wastewater treated (e.g. kWh/m³) or per unit of pollutant removed BOD₅ (e.g. kWh/kg BOD₅), TN (e.g. kWh/kg TN).

The disadvantages and limitations of these indicators include:

- Neither of the existing indicators are agreed to and accepted as a standard in the industry;
- They do not provide means to compare nitrifying processes to non-nitrifying processes;
- There is no differentiation between design values and measured values, and there are no standard methods to obtain the indicator for each case.

Another approach is to report on the results from standard tests in water as oxygen transfer capacity per unit energy consumed (e.g. kg O₂/kWh).

The disadvantages and limitations of this type of indicator include:

- It is less convenient for the market to apply to its cases, (for example because not all removal is by oxidation, some is by metabolic consumption);
- It only considers oxygen transfer equipment or processes able to dissolve oxygen in water, which does not apply to all biological treatment processes (such as rotating biological contactor (RBC) and trickling filter (TF)).

These issues are discussed in the literature, which compares results expressed in different ways and correspondingly provides contradicting indications (see References [4], [5] and [10]).

Therefore this document aims to create a quantitative measure for universal characterization of the energy consumption for aerobic biological wastewater treatment systems. Such standardization will benefit engineers in specification of systems and comparison of systems. The need arises especially in consideration of life cycle cost of a wastewater treatment system.

NOTE 1 Normalized energy consumption of wastewater treatment systems typically decreases with increasing size of the system, mainly due to higher efficiency of larger electromechanical equipment such as pumps and blowers. Thus, large wastewater treatment plants will have lower normalized energy consumption than small wastewater treatment systems. In order to neutralize the influence of plant size in comparison of energy consumption, a correlation such as published by Silva, C., et al. (see Reference [11]) can be used, regardless of this document.

NOTE 2 Higher effluent quality requirements are generally associated with higher normalized energy consumption. Typically, normalized energy consumption will be compared for similarly performing systems. However, it is possible, for example, to present the normalized energy consumption for different treatment qualities as such.

NOTE 3 This document quantifies the energy consumption, regardless of treatment efficiency that can vary for different types of wastewater. Treatment efficiency might typically be characterized by retention time and/or volumetric loading rate and/or volumetric removal rate or other indicators which are not part of this document.