INTERNATIONAL STANDARD

ISO
23152

First edition
2021-07

Ships and marine technology — Ballast water management systems (BWMS) — Computational physical modelling and calculations on scaling of UV reactors

Navires et technologie maritime — Systèmes de gestion de l'eau de ballast (BWMS) — Modélisation physique computationnelle et calculs concernant les réacteurs UV

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*.

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

Ballast water management systems (BWMS) are intended to treat ships' ballast water discharges to comply with applicable standards (Reference [14]). Disinfection using ultraviolet (UV) light is common to many BWMS. A key specification for a given model of a BWMS is its treatment rated capacity (TRC), which indicates the unit's rated volumetric flow rate during treatment of ballast water. A base system (with a low range TRC) is empirically validated through land-based testing, while a unit with a larger TRC (ideally at the highest rating) is validated through shipboard testing. The remaining models that are not empirically tested can be validated through scaling, using a verified numerical approach to predict performance at untested TRCs.

Effective 13 October 2019, the type approval of BWMS (both UV and other technologies) requires testing in accordance with the BWMS Code (MEPC 72/17/Add.1 Annex 5)[11], adopted as an amendment to the IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004[14]. The BWMS Code specifies that a manufacturer of BWMS must provide technical specifications for any scaling of TRC. Guidance on scaling is provided by the IMO through its 'Guidance on Scaling of Ballast Water Management Systems' (BWM.2/Circ. 33/Rev. 1)[12]. One of the requirements is for validation of the modelling and calculations through comparison of predicted performance to land-based, shipboard, or laboratory test data as appropriate. In scaled models, parameters affecting performance must demonstrate equivalence to the base model, identify system design limitations (SDL) for each scaled model, and conduct shipboard testing of the most vulnerable model as determined through scaling.

This document is focused on the modelling of UV reactors for scaling purposes, i.e. justifying the applicability of a UV reactor design across a range of TRCs, through the use of validated numerical models and calculations. Numerical models are used to solve equations governing physical characteristics of a computational domain that represents a model of the physical object (i.e. the UV reactor). This requires numerical representation of the geometry of this system, a discretization of the representation into volumetric sub-elements (meshing), and solving for parameters for various scales. Results are submitted to an Administration to justify the type approval of UV reactors having TRC ratings that have not been validated through type approval testing.

Ships and marine technology — Ballast water management systems (BWMS) — Computational physical modelling and calculations on scaling of UV reactors

1 Scope

This document specifies the methodology to conduct computational modelling of ultraviolet (UV) reactor designs for ballast water management systems (BWMS) that incorporate ultraviolet disinfection technology (UVBWMS). The computational modelling is used to calculate the UV reduction equivalent dose (RED) and to compare calculated REDs of the scaled reactor to its base reactor. REDs are determined using organisms with a given dose response.

NOTE   The IMO requires validation of the computational model.

The simulation of a physical UV reactor using a computational model requires that the model be validated (i.e. it performs as intended and reflects the correct physical constraints) and verified (i.e. produces outputs consistent with empirical data). A model developed according to this document is intended to validate the performance of simulated but untested, scaled UV reactors, where the simulation has been verified with test data from base model UV reactors within the product line. As a complete UV BWMS typically incorporates other treatment methodologies such as filters, the impact of changes to external subsystem performance on the overall BWMS is not considered in this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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/

3.1
American Type Culture Collection
ATCC
repository of cell lines and cultured organisms used for research

3.2
base model
ultraviolet ballast water management system (UVBWMS) (3.30) model that has successfully completed land-based testing as defined in the BWMS Code

Note 1 to entry: Typically, a base model is with low range *TRC* (3.28).

3.3
base reactor
UV reactor (3.41) of the *base model* (3.2)