BS ISO 23044:2020

BSI Standards Publication

Guidelines for softening and desalination of industrial wastewater for reuse

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National foreword

This British Standard is the UK implementation of ISO 23044:2020.

The UK participation in its preparation was entrusted to Technical Committee B/505/50, Water reuse.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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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.

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).

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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 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.

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Introduction

With the development of society and economy, the contradiction between water shortage and industrial growth is becoming increasingly acute. Industrial wastewater reclamation and reuse could be an effective way to alleviate this contradiction by improving the water utilization efficiency[4]. Industrial processes such as oil extraction, chemicals production, printing and dyeing, pharmaceuticals manufacturing and food processing[5] produce the wastewater containing total dissolved solids. In order to reuse these wastewater, total dissolved solids need to be removed by using water softening and desalination technologies[6].

Currently, wastewater softening and desalination processes are based on chemical precipitation, ion exchange, nanofiltration (NF), evaporation, reverse osmosis (RO), electrodeionization (EDI), electrodialysis (ED), membrane distillation (MD), and so on, see References [7] to [10]. Each technology has different applicable conditions and operational costs. The absence of an international standard to provide guidance on the selection of wastewater softening and desalination processes makes it difficult to determine the most appropriate softening or desalination technology for industrial enterprises. Therefore, it hinders industrial wastewater reclamation and reuse. Six technologies have been selected for consideration under this document, including chemical precipitation, ion exchange, nanofiltration (NF), reverse osmosis (RO), electrodialysis (ED), electrodeionization (EDI), and there are other technologies that could be similarly considered for future updates. It should be noted that mechanical vapour recompression (MVR) and multi-effect evaporation (MEE) are mainly used for evaporation and crystallization to acquire salts, not for the purpose of water reuse.

Based on the specific inorganic ion species and their concentration in influent, appropriate effluent quality can be obtained using the recommended technologies that meets the requirement for hardness, alkalinity and salinity for potential reuse applications.

This document is an innovative standard in the field of industrial wastewater reclamation and reuse. It can help enterprises, engineers, operators and other stakeholders, who engage in designing or operating in industrial saline wastewater reclamation and reuse, choose the technologies applying in the process, and evaluate the treatment effects. As a result, the reuse of industrial saline wastewater can be promoted and utilization of water can be improved.

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Guidelines for softening and desalination of industrial wastewater for reuse

1 Scope

This document provides guidance on, the evaluation and comparison of wastewater softening and desalination processes for industrial wastewater reclamation and reuse with specific consideration for the following six: 1) chemical precipitation; 2) ion exchange; 3) nanofiltration (NF); 4) reverse osmosis (RO); 5) electrodialysis (ED) and 6) electrodeionization (EDI). This document provides guidance on the characterisation of both influent and effluent quality (e.g. hardness, alkalinity, etc.) and the effects of these processes on those constituents. The purpose of softening and desalination is only for the reuse usages that have requirements for hardness and salinity, such as cooling circulating water, boiler water, production process water, and cleaning water.

This document includes the following sub-processes of wastewater softening and desalination processes:

a) wastewater softening processes based on chemical precipitation, ion exchange and NF, which aim to remove hardness ions, such as Mg^{2+} and Ca^{2+};

b) desalination processes based on ion exchange, RO, ED, EDI and NF, which aim to remove the most of total dissolved solids (TDS).

This document is applicable to:

a) industrial saline wastewater, which has been pre-treated to remove most of the organic matters if necessary;

b) the selection or design of wastewater softening and desalination processes for reuse of wastewater from industries.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20670, *Water reuse — Vocabulary*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 20670 and the following apply.

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

— ISO Online browsing platform: available at http://www.iso.org/obp

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

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