

Applied process engineering in industrial wastewater treatment

Wastewater Treatment in Selected Industrial Sectors



Weiterbildendes Studium »Wasser und Umwelt«
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Preface

Since 1996, the 'Water and the Environment' ('Weiterbildendes Studium Wasser und Umwelt') continuing academic education programme has become a synonym for continuous and effective collaboration at university level between Lower Saxony and Thüringen in the field of post-graduate training. This collaboration basically follows the principle of 'two universities – one degree', by which existing synergies are exploited while respecting the technical, scientific and organisational independence of the two establishments concerned.

The project began in the early 1980s as a distance learning course culminating in a certificate which was awarded in Hannover. This course covered General Water Management, Aquatic Ecology and Water Conservation, Soil Conservation, and Waste Management as its main areas of study. Weimar then emerged as a partner by developing a complementary distance learning course focusing on Hydraulic Engineering, Environmental and Sanitary Engineering, and Waste Management. Both universities have since continued to develop these courses into recognised (accredited) Master's degree courses. The 'Water and the Environment' postgraduate programme with its modular structure achieves a high degree of flexibility and individual leeway in planning student curricula, while continuing to ensure high academic standards.

This volume 'Applied Process Engineering in Industrial Wastewater Treatment', the second part of the first edition in English, contains the revised and updated material of a technical module from the programme. The joint publication of the textbook by the two universities in question makes the subject matter accessible not only to students in Hannover or Weimar but also to a wider circle of interested parties outside the postgraduate programme. By publishing an English-language edition in two volumes (Volume I: 'Basic Process Engineering in Industrial Wastewater Treatment'; ISBN 978-3-86068-498-6), we now also hope to contribute towards the scientific discourse at international level. At the same time, this publication serves to intensify the quality and scope of collaboration with the German Association for Water, Wastewater and Waste (DWA).

This book is based on the second edition (2009) of the technical module 'Industrieabwasser WW54', which forms part of the 'Water and the Environment' programme offered by the Bauhaus Universität Weimar, led by Prof. Dr.-Ing. J. Londong, Weimar, and Prof. Dr.-Ing. K.-H. Rosenwinkel, Hannover; it was compiled and updated by the authors Prof. Dr.-Ing. habil. Dr. phil. S. Kunst, Prof. Dr.-Ing. R. Gräf, Prof. Dr.-Ing. K.-H. Rosenwinkel, Prof. Dr.-Ing. U. Rott, Dr.-Ing. H. Sixt, Dr.-Ing. U. Menzel, Dr.-Ing. D. Bock, Dipl.-Ing. R. Minke, and Dipl.-Ing. U. Raesfeld.

We wish to express our heartfelt gratitude to all those who worked on the editing of this edition. Besides colleagues from our two chairs (Chair of Environmental and Sanitary Engineering in Weimar and the Institute of Sanitary Engineering and Waste Technology in Hannover), special thanks go to Dipl.-Ing. U. Raesfeld, for restructuring the 'Legal Basis' chapter and revising the text. Thanks also to the members of the Working Group on Water and the Environment in Weimar, in particular Dr.-Ing. H.-W. Frenzel (†), Dipl.-Ing. R. Holzhey, and Dipl.-Ing. S. Büttner, as well as Dipl.-Ing. S. Matthies (responsible for typesetting and design), without whom publication would not have been possible. We would also like to say a big thank you to Maxine Demharter and David Miller for their translation of the text. And of course we thank the students themselves for their interest and diverse feedback, and also our contacts at DWA for their kind support.

Last but not least, special thanks go to the Federal Ministry of Education and Research, whose 'Open Universities' initiative provided the impetus to revise, translate and publish this first English edition via the competition 'Open Universities' within the scope of the Professional Bauhaus project.

May this series from the field of 'Water and the Environment' be warmly received by the experts and may it serve to bring about professional and sustainable use of our environment and water resources.

Weimar and Hannover, August 2013

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1 Introduction

1.1 Classification of industries

Industries are generally sub-divided into sectors that predominantly use organic materials and those that predominantly use inorganic materials, because this criterion crucially influences the subsequent wastewater treatment strategy.

Major industrial sectors that mainly use organic materials and whose primary activity focuses on agricultural products or input materials (food and non-food agro-industry and forestry) are subsumed under the term 'agricultural industry'.

The chemical industry is viewed separately, and the multiplicity of its products means its wastewater is heterogeneously polluted with both inorganic as well as organic substances. This fact is acknowledged in the section of Appendix 22 of the Wastewater Ordinance (*AbwV*) that deals with sectors producing substances with the help of chemical, biochemical or physical processes [Kaltenmeier, 1999].

As a result of the raw materials it uses (such as crude oil, natural gas, coal and waste), heavy industry is included among those sectors that predominantly work with inorganic components.

This chapter looks at several types of industrial enterprise, which can be grouped as follows:

Agricultural industry:

1. Intensive livestock farming and aquaculture
2. Food industry
 - Sugar refineries
 - Starch factories
 - Edible oil and cooking fat manufacturers
 - Potato processing plants
 - Fruit and vegetable processing plants
 - Abattoirs, meat and fish processing plants
 - Confectionery manufacturers
 - Dairy processing plants
 - Fruit juice and soft drinks manufacturers
 - Breweries
 - Winemakers
 - Distilleries and yeast producers
 - Pectin manufacturers
3. Other agro-industries
 - Animal waste recycling
 - Rendering plants
 - Natural gut-processing plants
 - Hide glue and gelatine manufacturers
 - Feedstuff and fish meal factories
 - Paper and cellulose production
 - Cellulose manufacturers
 - Paper and board mills, including de-inking plants

- Textile industry
 - Wool-scouring plants
 - Textile-finishing factories (including textile dyeing)
 - Leather manufacturers
 - Wood-processing plants

Chemical industry:

- Pharmaceuticals
- Organic compounds
- Soaps, detergents
- Plastics
- Inorganic chemicals
- Paints and varnishes
- Cleaning agents
- Adhesives
- Synthetic fibres
- Pesticides
- Fertilisers
- Other

Industries with predominantly inorganic components, industries based on coal, mineral oil, natural gas and waste:

1. Heavy industry, mineral-processing industry
 - Mining
 - Smelting
 - Power generation
 - Non-metallic mineral processing
 - Ceramics
 - Glassmaking
2. Metal industry
 - Metal pickling
 - Electroplating
 - Mechanical engineering
 - Automotive
3. Mineral oil industry
 - Refineries
 - Fuel depots
 - Waste oil reprocessing
4. Other 'inorganic' sectors
 - Waste treatment plants
 - Incineration plants
 - Cleaning of transport containers

Other industrial sectors

- Textile cleaning
- Hospitals