

Operational Problems in Wastewater Treatment Plants

HANDBOOK FOR THE OPERATION OF WASTEWATER TREATMENT PLANTS

Practice Guideline

Troubleshooting and Correction
of Operational Problems

P. Baumann
Kh. Krauth
W. Maier
M. Roth



Sewage Treatment Plant
Widdern 16.000 PE, Germany



Sewage Treatment Plant
Sousa 90.000 PE, Portugal



Main Sewage Treatment Plant
Stuttgart 1.2 Mio PE, Germany

Your partner for optimised sewage treatment plants and process engineering

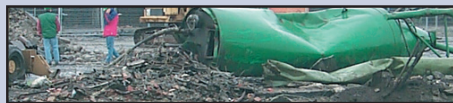
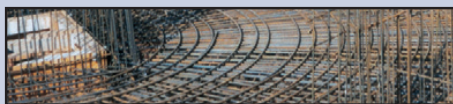
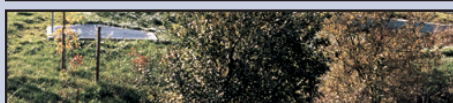
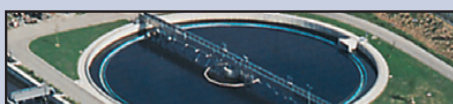
With nearly 100 employees Weber Ingenieure provides a wide range of services in the field of municipal infrastructure. Besides the planning of sewage treatment plants and sewer systems our main focus is on operation consultancy and holistic improvement. This includes energy concepts,

refurbishments (e.g. concrete) and general status reports.

A well experienced staff, represented in seven DWA boards, guarantees economic and innovative solutions in accordance with our client's interests.

Sewage treatment/Sewage sludge management

- Performance and process assessment
- Energy conservation
- Automation and remote control concepts (PLC, SCADA)
- Sewage sludge management
- Expert monitoring (e.g. of third party's performance)
- Operational organization and security management
- Supervision assistance of research plants
- Tender procedures and contests



Storm water treatment

- Advanced treatment processes
- Polluting load calculations
- Decentralized concepts

Sewer construction/ Infrastructure

- Sewer system masterplan
- Infrastructure design
- Sewer rehabilitation

Civil and geotechnical engineering

- Construction rehabilitation
- Restoration of ancient buildings

Health, Safety and Environment

- Risk assessment
- Coordination of safety measures on site
- Operation and maintenance manuals

Weber-Ingenieure GmbH

D-75177 Pforzheim · Bauschlötter Straße 62
phone (+49)7231 583-0 · fax (+49)7231 583-400
www.weber-ing.de · e-mail: info@weber-ing.de

Locations:

Pforzheim · Essen · Dresden · Stuttgart · Heilbronn
Offenburg · Neu-Ulm · Villingen-Schwenningen
Lissabon (Portugal) · Timisoara (Romania)

Practice Guideline "Operational Problems in Wastewater Treatment Plants"

Preface

In 2008, the Practice Guideline "Troubleshooting of Wastewater Treatment Plants" has been published for the first time by the Baden-Württemberg State Association of the German Association for Water Management, Wastewater and Waste (DWA).

The guideline became a useful tool for wastewater treatment plant operators, not only in Baden-Württemberg but in the entire German-language area. For this reason and because of numerous inquiries from international experts this paper has been edited in English.

The booklet can assist wastewater treatment plant operators in optimizing day to day operations and troubleshooting operational problems. Furthermore executives can improve their processes and efficiency with the aid of the guideline. The structure of the booklet is conceived to symptomatic features and therefore offers a fast access to the solution of a problem.

The authors are accepted experts with essential practical experience in the design and operation of wastewater treatment plants.

The guideline is part of a comprehensive series of DWA publications introducing new solutions and process technologies in consideration of a modern and integrative water management.

Special thanks goes to the primary authors for their efforts to provide a comprehensive, clear and systematic presentation of the included topics as well as to all others who have contributed in the development and translation of this guideline.

Stuttgart, August 2012

Wolfgang Schanz
Chairman of the State Association

"DWA Landesverband Baden-Württemberg"

Edition Notice

The German Association for Water Management, Wastewater and Waste e.V. (DWA) is acting in Germany as speaker for all comprehensive questions related to water, and intensively supports the development of a safe and sustainable Water Management scheme.

Being politically and economically independent, the association is professionally working on the topics Water Management, Wastewater, Waste and Soil Protection.

In Europe DWA is considered as the association with the highest number of members in this field and occupies an outstanding standing due to its technical competence in regard to standardization, professional education and public information.

The some 14,000 members represent experts and executives from municipalities, universities, consulting offices, authorities and companies.

The emphasis of the work lies on the working out and keeping update of standardized technical regulation, as well as participation in the development of specific norms on national and international platform. This is not limited to technical-scientific topics, but also the economical and legal aspects of the environmental and water protection.

A central part of the DWA-work is focusing on opportunities for professional education. Especially the sewer and sewage treatment plant neighborhoods need to mention. Two up to four times a year, the operation staff is alternatingly gathering on the different treatment plants or maintenance workshops for exchange of experience and for educational events.

Publisher : DWA Landesverband
Baden-Württemberg
Rennstraße 8
70499 Stuttgart
Phone: 0711-896631 0
Telefax: 0711-896631 111
Mail: info@dwa-bw.de
www.dwa-bw.de

Volume 3, 1st edition

ISBN 978-3-88721-371-8

© DWA Landesverband Baden-Württemberg,
Status August 2012

Author: Prof. Dr.-Ing. Karlheinz Krauth,
Stuttgart

Dr.-Ing. Manfred Roth,
Weil der Stadt

Dr.-Ing. Peter Baumann,
Weber-Ingenieure GmbH, Pforzheim

Dr.-Ing. Werner Maier,
iat – Ingenieurberatung GmbH,
Stuttgart

Editors : DWA Landesverband
Baden-Württemberg
André Hildebrand

Table of Contents

1	Introduction	P.7
1.1	General	P.7
1.2	How to use this trouble shooting guide	P.8
1.3	Literature	P.9
2	Sampling and analysis	P.10
2.1	Sampling	P.12
2.2	Sample preparation and analysis	P.12
2.3	Water quality analysis using online instrumentation	P.13
2.4	Process control	P.15
2.5	Literature	P.15
3	Treatment goal: Carbon removal (BOD, COD, TOC)	P.16
3.1	General	P.22
3.2	Elevated COD in activated sludge effluent	P.22
3.3	High effluent COD from trickling filter and RBC facilities	P.27
3.4	Increased COD concentration in filtered effluent	P.29
3.5	Literature	P.29
4	Treatment goal: Nitrification	P.30
4.1	General	P.38
4.2	High effluent ammonia concentrations in activated sludge systems	P.38
4.3	Elevated effluent ammonia concentrations in trickling filter facilities	P.45
4.4	Elevated RBC effluent ammonia concentration	P.47
4.5	Literature	P.49
5	Treatment goal: Denitrification	P.50
5.1	General	P.60
5.2	Aeration basin effluent nitrate high	P.60
5.3	Trickling filter effluent nitrate high	P.73
5.4	Literature	P.73

6	Treatment Goal: Chemical phosphorus removal	P. 74
6.1	General	P. 78
6.2	Aeration basin effluent TP high	P. 79
6.3	High effluent TP in trickling filter and RBC systems	P. 82
6.4	High TP in effluent filtration	P. 82
6.5	Literature	P. 82
7	Treatment goal: Biological phosphorus removal	P. 84
7.1	General	P. 86
7.2	Increase activated sludge effluent total phosphorus	P. 87
8	Effluent pH excursions	P. 90
8.1	General	P. 90
8.2	pH too high	P. 90
8.3	pH too low	P. 90
9	Nitrite too high	P. 92
9.1	General	P. 92
9.2	Causes for elevated nitrite concentrations	P. 92
9.3	Counter measures for elevated nitrite concentrations	P. 93
10	Organic nitrogen too high	P. 94
11	Operational problem due to bulking	P. 94
11.1	General	P. 98
11.2	Causes for bulking	P. 98
11.3	Control of bulking sludge	P. 101
12	Floating sludge and foaming	P. 104
12.1	General	P. 104
12.2	Impact on plant operation	P. 104
12.3	Responsible microorganisms	P. 105
12.4	Control measures	P. 105
13	Insufficient disinfection	P. 108
13.1	General	P. 108
13.2	Elevated pathogen count after disinfection	P. 108
13.3	Literature	P. 109

14	Solids processing operational problem	P. 110
14.1	General	P. 116
14.2	Thickening	P. 116
14.3	Digestion	P. 117
14.4	Literature	P. 126
15	Mitigation of operational problems related to external causes	P. 128
15.1	General	P. 128
15.2	General approach	P. 128
15.3	Substrate groups (designation and origin)	P. 128
15.4	Recognizable characteristics	P. 129
15.5	Specific countermeasures for substrate group G	P. 136
15.6	Literature	P. 138

1 Introduction

1.1 General

Operational problems at wastewater treatment plants frequently lead to violations of discharge water quality requirements. Such violations can result in impairment of the receiving water body and expose the owner to fines and liability. When operational problems occur that threaten water quality it is imperative to inform and involve all pertinent parties to help reduce or mitigate any threat to public safety. Such parties may include the operation superintendent, utility managers, regulatory authorities, and first responders according to the established emergency response plan.

The term "operational problem" is not explicitly defined. In [1.1] operational problems are described as temporary identifiable events, which will or may affect wastewater treatment performance and effluent quality. In the context of this guideline operational problems are temporary in nature. Potential operational problems should be anticipated during planning and design in order to minimize their occurrence and severity as much as possible. For that it is important to utilize multi-train designs, reliable equipment, provide sufficient redundancy, and to facilitate a well trained and motivated staff. Once in service, regular maintenance, monitoring of commercial and industrial dischargers, and early detection and identification of operation problems must be assured.

This guideline provides recommendations for

- operators of wastewater treatment plants

and for

- the government agencies in case of accidents (handling of public health and safety threats) and as part of regulatory monitoring.

These recommendations enable a systematic approach for identification and correction of operational problems. Special emphasis is placed on a targeted approach to reduce cost and minimize response time for troubleshooting and implementation of corrective measures. However, this guideline cannot replace operations manual or strategy as well as the emergency response plan and should be applied in the context of those. If such documentation do not exist they should be provided as soon as possible.

The authors of this guideline first published "Operational Problems at Wastewater treatment Plants" in 1997. This was published as the Manual "Wasser 4" (Water 4) by the Landesanstalt fuer Umweltschutz (Department of Environmental Protection) Baden Württemberg. After ten years the authors saw it prudent to provide an updated edition.

In this edition only single stage activated sludge process, trickling filter, and rotating biological contactor as well as conventional filtration and disinfection are considered. Multi stage and special processes for biological wastewater treatment (i.e. integrated fixed film activated sludge) have not been considered due to their limited utilization to date.

Treatment facilities that are well designed, operated, and maintained will provide stable treatment performance under normal conditions as long as they are not overloaded. Any particular value of an effluent water quality parameter alone is not an indicator of stable performance. For instance, effluent COD concentration of 70 mg/L – 90 mg/L may represent stable performance at one facility while another may produce 30 mg/L – 50 mg/L. The typical effluent COD concentration here depends primarily on the influent wastewater composition.