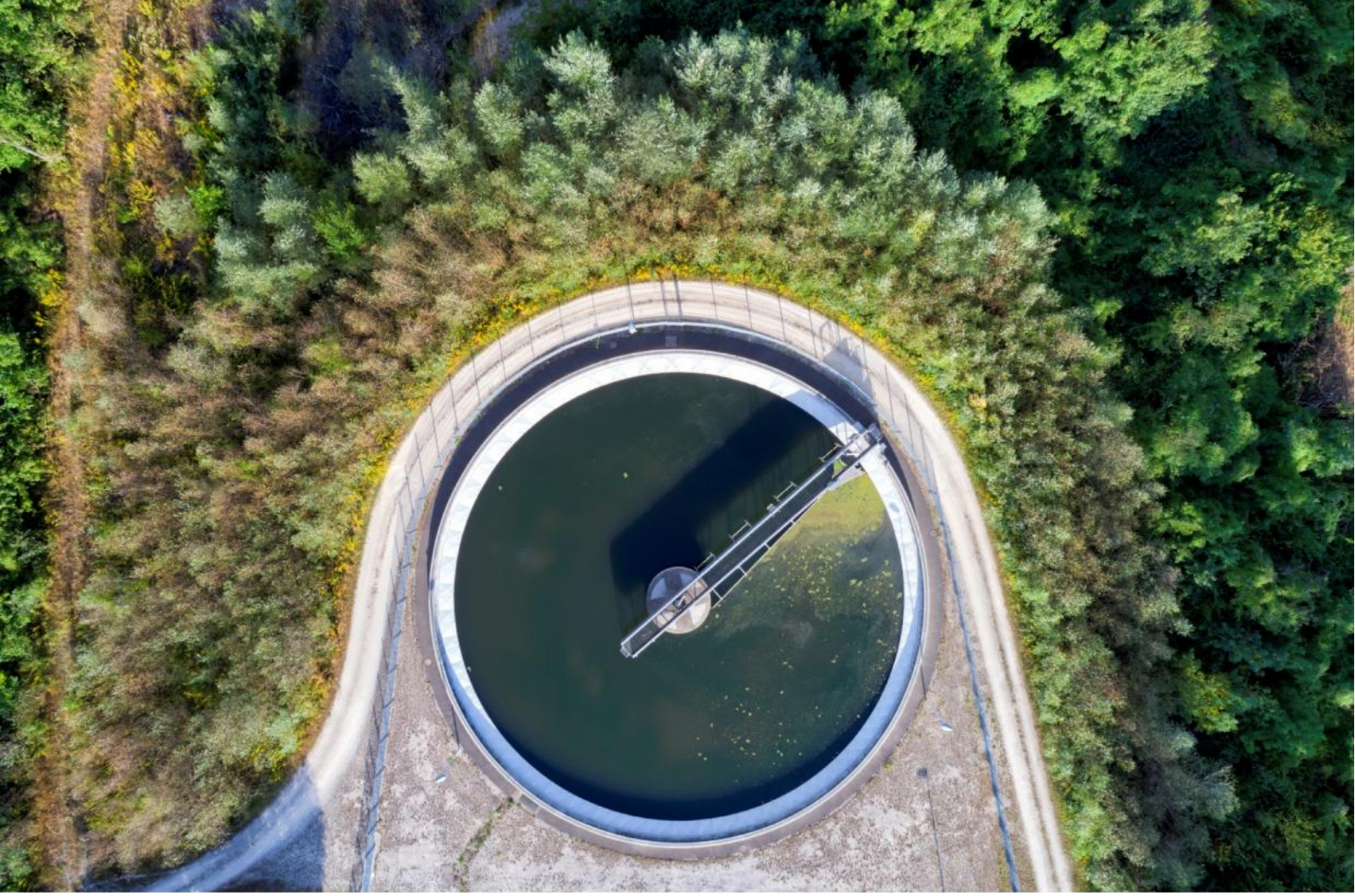

John Nurminen Foundation

Guidelines for the Management of Industrial Wastewaters

Project BEST

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AFRY
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Executive Summary

The project BEST – Better Efficiency for Industrial Sewage Treatment – aims to improve the treatment and management of industrial wastewaters in the Baltic Sea Region and has been co-funded by the European Region Development Fund Interreg Baltic Sea Region Programme.

In this document, the recommendations and guidelines towards the improved management of industrial wastewaters prepared in work package 5 of project BEST are compiled. The guidelines were prepared by AFRY Finland Oy in co-operation with BEST project partners from Estonia, Finland, Latvia, Lithuania, Poland and Russia (Kaliningrad), and with their national groups of experts representing e.g. water utility and industrial associations, environmental authorities, consultants and universities. In addition, the consultant's international expert team provided information from Germany and Sweden.

The guidelines are divided into four categories: guidelines for legislative and institutional developments (Chapter 2), co-treatment and pretreatment of industrial wastewaters (Chapter 3), industrial wastewater contracts (Chapter 4) and cooperation (Chapter 5). The annexes include country specific recommendations for Estonia, Finland, Latvia, Lithuania, Poland and Russia (Kaliningrad).

The key recommendations given in each chapter of this document are summarised below.

Guidelines for legislative and institutional developments

Chapter	Key recommendations
2.3 National legislation	The following principles should be included in national legislation: Industrial operators are responsible for sufficient pretreatment of industrial wastewater and they must be aware of the effects and possible risks of their operations (including wastewater).
	The role of industrial wastewater contracts needs to be defined and highlighted in national legislation. The obligation of keeping contracts updated and, if necessary, the obligation of renewing contracts should be enforced in national legislation.
2.4 Environmental permits	Environmental permits should be granted on a sufficiently high (preferably national or regional) level where there is enough technical knowledge to give relevant limit values and restrictions for industrial wastewater quality, as well as independence from local interests and politics.
	Water utilities and municipal wastewater treatment plants (WWTPs) need to be provided with real influence in permit conditions by requesting their comments during the course of the permitting process. Enough time for commenting should also be provided.
2.5.1 Supervision	Authorities should have sufficient power to intervene in cases where an industrial operator neglects its permit conditions or exceeds limit values set for industrial wastewater quality.
	If misconduct is repeated and the operator does not comply with permit conditions after a given term, authorities should impose administrative fines or even order the immediate closure of the facility.
2.5.2 Monitoring programmes and procedures	The contents of a monitoring programme have to be considered case specifically according to the amount and quality of the wastewater and the pollutants and hazardous substances potentially ending up in the wastewater. More frequent sampling should be required if the quality of wastewater varies a lot. The operator is responsible for the costs of monitoring.

	The monitoring programme of a specific operator shall include hazardous substances that have been detected at relatively high concentrations at the WWTP, are used by the operator or are commonly used in the same industry, or have been detected in previous samples.
2.5.3 Limit values for the quality and quantity of industrial wastewater	Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators of the same industry.
	It is recommended to set the limit values for harmful and hazardous substances on a national level and apply the same limit values throughout the country. However, there should be a possibility for setting stricter limit values if it is necessary for the WWTP or if problems have been detected before.
	MAC-EQS concentrations, emission levels (BAT AEL) and concentrations causing nitrification inhibition can be used as the limit value for hazardous and harmful substances.
2.6 Politics	Transition to more independent regional water utility companies or centralised wastewater treatment is seen as a solution for preventing local economic and industrial policy from affecting the management of industrial wastewaters.

Guidelines for the co-treatment & pretreatment of industrial wastewaters

Chapter	Key recommendations
3.2 Best practice for co-treatment	Co-treatment can be both a cost-efficient and efficient way to treat industrial wastewaters when industrial wastewaters are monitored and there is good cooperation between the WWTP and the operator.
	Successful and optimised co-treatment requires that the WWTP has sufficient capacity, personnel is aware of the specific operational measures needed and the operator immediately informs the WWTP of all exceptional discharges.
3.3 Risk management and preventive measures	Accidental leaks and load peaks must be prevented by risk management planning of operators. WWTPs must prepare for possible problems caused by industrial wastewaters and plan needed actions beforehand such as isolating and by-passing parts of the treatment process.
	Industrial operators can improve the quality of their wastewater by preventive measures like optimising production processes, minimising the use of chemicals and substituting chemicals with less hazardous chemicals.
3.4 Pretreatment of industrial wastewater	On-site pretreatment of industrial wastewater is necessary if the operator is otherwise unable to meet limit values and restrictions.
	If industrial wastewater contains hazardous substances that cannot sufficiently be removed on-site, wastewaters should be collected and delivered to a hazardous waste treatment plant.
3.6 Control of industrial sludges	It is recommended that industrial sludges are to be received only if the quality has been analysed and the WWTP gives permission for unloading.

Guidelines for industrial wastewater contracts

Chapter	Key recommendations
4.2 Process steps of preparing industrial wastewater contracts	Water utilities should systematically map out the sources of industrial wastewaters. It is an important part of the risk assessment of the water utility, and supports justification for preparing industrial wastewater contracts.
	When drafting contractual terms, chemical lists and properties of chemicals used should be examined and BAT reference documents and BAT conclusions considered.
	Starting the negotiation process with a visit to the operator is highly recommended for facilitating negotiations and improving further cooperation.
4.3 Updating existing contracts	Contracting parties need to negotiate the changing of existing contracts. The argument for updating a contract could be e.g. changes in legislation or in the operations of either of the parties, or significant changes in other conditions compared to the original moment of signing.
	New contracts need to include specific terms for changing the contractual terms. It is recommended to set new contracts for a limited time period.
4.4.1 Contracting parties	On the water utility side, the contracting party is the water utility that owns the sewer to which industrial wastewaters are conveyed. If the WWTP is owned by a separate water utility, the representatives of the WWTP must be included in drafting the contractual terms and in the negotiation process.
4.4.2 Terms for monitoring programmes	Sampling procedures and the extent of analyses are agreed upon in the monitoring programme. The contents of a monitoring programme have to be considered case specifically according to the amount and quality of the wastewater and the pollutants and hazardous substances potentially ending up in the wastewater.
	The water utility needs to have the right to inspect the operator's pretreatment, sampling and discharge arrangements and take additional samples without prior notice. The right for visits and procedures for visiting the premises of the operator should be agreed upon in the contract.
4.4.3 Terms for limit values	Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators in the same industry.
	It should be stated in industrial wastewater contracts that the diluting of industrial wastewaters is prohibited for the purpose of avoiding the exceeding of concentration limits.
4.4.4 Wastewater fees for industrial wastewater	Increased industrial wastewater fees are usually used for covering increased treatment costs caused by industrial wastewaters. National calculation formulas are highly recommended to be determined in all BSR countries.
4.4.5 Notification obligation and cooperation	The operator must immediately inform the water utility on exceptional emissions and any other unusual situations affecting the quality or amount of wastewater. Notification obligation should be stated in the contract.

4.4.6 Violations of contractual terms, illicit releases and liability	The consequences for violating contractual terms need to be defined in the contract. A penalty clause is strongly recommended for all contracts.
	The contract should obligate the operator to be liable for any harm or damage caused by the industrial wastewaters, including any additional maintenance costs.
4.4.7 Termination of the contract and changes to contractual terms	It is recommended to set new contracts for a limited duration (e.g. 2–5 years). If a contract is set to be valid until further notice, it needs to include specific terms to enable changing the contractual terms and terminating the contract.
	The contract needs to state clearly the terms for terminating the contract. In addition, water utility must have the right to break off discharge of industrial wastewater to the municipal sewer to avoid immediate danger to network or treatment plant.
4.4.8 Publicity vs. confidentiality of the contracts	Annexes or sections of a contract containing the operator's business secrets may be marked as confidential but it is not recommended to set the whole contract as confidential.

Guidelines for cooperation

Chapter	Key recommendations
5.2.1 Advantages of cooperation	Industrial wastewater contracts should include a chapter on cooperation and an obligation to set up yearly meetings between the contracting parties. In these meetings, possible process changes and the monitoring results from the previous year would be discussed, and any necessary changes to the annexes of the contract could be made.
	The yearly meetings could be combined with an inspection by environmental authorities. Inviting operators for a guided tour on the WWTP is recommended.
5.2.3 Information sharing	It is recommended for the water utility to publish an annual or periodic report on industrial wastewater to share information and improve transparency.
	Information about industrial wastewaters and best practice should be shared on water utilities' web pages and guidelines about best practice addressed to certain industries should be published.
5.3 Cooperation between water utility and environmental authorities	The terms of environmental permits and industrial wastewater contracts should be harmonised. It is recommended to send the contracts to environmental authorities.
	Regular (at least yearly) meetings between the water utility and the environmental authorities are strongly recommended.
5.4 Cooperation between water utilities	It is recommended for all BSR countries to develop national guidelines in their national language for controlling industrial wastewaters. Common guidelines help to harmonise the terms and restrictions set for industrial wastewaters on a national level.

1 Introduction

1.1 Background and objectives

The project BEST – Better Efficiency for Industrial Sewage Treatment – aims to improve the treatment and management of industrial wastewaters in the Baltic Sea Region (BSR). The main objective of project BEST is to reduce the environmental impact caused by industrial wastewaters co-treated with domestic wastewater at municipal wastewater treatment plants (WWTPs). Project BEST has been co-funded by the European Region Development Fund Interreg Baltic Sea Region Programme.

The work package (WP) 5 of project BEST provides recommendations and guidelines towards the improved management of industrial wastewaters. These recommendations and guidelines are documented in this publication. The guidelines are divided into four categories: guidelines for legislative and institutional developments (Chapter 2), co-treatment and pretreatment of industrial wastewaters (Chapter 3), industrial wastewater contracts (Chapter 4) and cooperation (Chapter 5). The annexes include country specific recommendations for Estonia, Finland, Latvia, Lithuania, Poland and Russia (Kaliningrad).

The objective of this publication is to give guidelines for the whole BSR in industrial wastewater management, and to present the best practice collected from BSR countries. The aim is to give guidance to legislative, permitting and supervising authorities at different levels, and water utilities affected by industrial wastewaters as well as industrial operators conveying industrial wastewater to a sewer. Another aim is to identify the most important obstacles for the successful implementation of existing legislation and best practice and to identify the possible solutions to overcome these obstacles. Special emphasis is given to best practice on the issues related to co-treatment of industrial and domestic wastewaters.

The guidelines and recommendations presented here have been formulated by AFRY Finland Oy on the basis of a wide range of baseline material. The most important sources were responses from project partners in BSR countries to an initial survey prepared by Riga Technical University; information and comments provided by project partners and their national expert groups (representing e.g. water utility and industrial associations, environmental authorities, consultants and universities); local inquiries conducted by AFRY's international expert team; and consultants' own experience from a wide range of projects related to the preparation of industrial wastewater contracts and the designing of treatment facilities.

1.2 Definitions and terms

The definitions of industrial and domestic wastewater used in this publication are given below. The definition of industrial wastewater varies between BSR countries.

Domestic wastewater	Wastewater from residential settlements and services which originates predominantly from the human metabolism and from household activities (definition of 91/271/EEC)
Industrial wastewater	Any wastewater which is discharged from premises used for carrying on any trade or industry, other than domestic wastewater and run-off rain water (definition of 91/271/EEC)

The parties related to the management of industrial wastewaters are illustrated in Figure 1-1. Definitions of the parties are given below. Not all parties are relevant for each operator or for each BSR country. Operators may have environmental permits or industrial wastewater contracts or both. Therefore not all parties represented in Figure 1-1 apply for all cases.

Water utility	Provider of water services and owner of a sewer network (contracting partner in an industrial wastewater contract)
WWTP	Wastewater treatment plant, referring to municipal treatment plants in this publication

Operator	Industrial facility or source of industrial wastewaters (often contracting partner in an industrial wastewater contract) (used in 2010/75/EU)
Environmental authority	Legislative, permitting or supervising authority on the local, regional or national level
Property owner	Owner of the property where the operator is a tenant

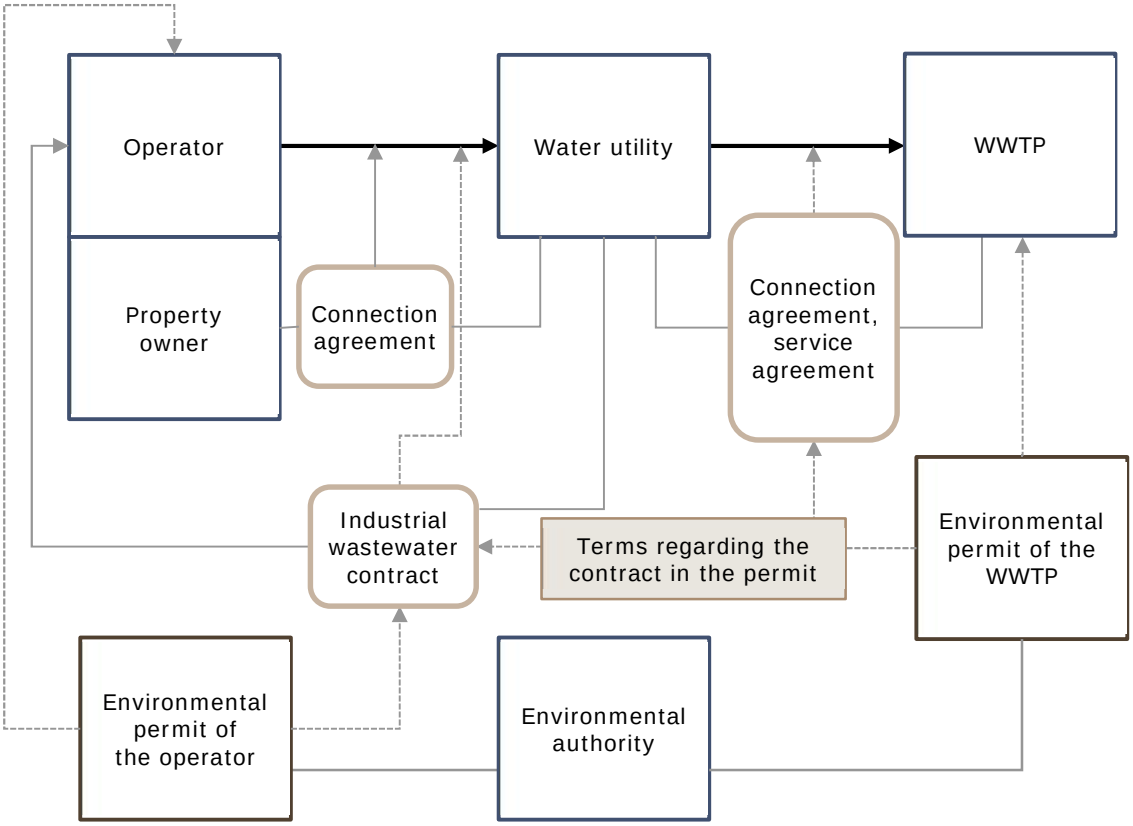

Figure 1-1 Parties related to industrial wastewater contracts, and permits and contracts governing the discharge of industrial wastewaters to the sewer.

2 Guidelines for legislative and institutional developments

2.1 General

The main objective of controlling industrial wastewaters is to improve the operation of WWTPs and the sewer network; to reduce disturbances caused by industrial wastewaters; and, consequently, reducing the pollution load to the environment. Efficient control can be achieved with legislation and environmental permitting, however, very few BSR countries (mainly Germany) have a sufficient level of control of industrial wastewaters through these means alone. Many BSR countries rely on industrial wastewater contracts as the main tool for managing industrial wastewaters. This chapter gives guidelines for legislative and institutional changes to improve the regulation of industrial wastewaters.

2.2 EU and international framework

The national legislation considering treatment of municipal and industrial wastewaters in EU countries is mostly based on the Industrial Emissions Directive (IED, 2010/75/EU), the Urban Waste Water Treatment Directive (UWWTD, 91/271/EEC) and Water Framework Directive (WFD, 2000/60/EC). These directives have been implemented in varying ways in national legislation concerning water services, environmental protection, environmental permits, chemicals, sludge, health protection, industries etc. In Table 2-1, EU and international regulations and agreements are listed that set the framework for the management of industrial wastewaters.

Table 2-1 EU and international regulations and agreements that are relevant for managing industrial wastewaters.

Regulation/agreement	Short description
BAT reference documents (BREFs)	The BREFs provide information on state-of-the-art techniques on the best available methods and technical solutions, and the consumption and release levels which can be achieved by them. (See more FIWA 2018, p.7)
E-PRTR Regulation 166/2006/EC	Obliges the major wastewater treatment plants (PE >100 000) to report releases of certain harmful substances into the air, water or ground. The implementation instruction of the E-PRTR Regulation includes a list presenting all the relevant substances that have been estimated as relevant at the domestic wastewater treatment plants.
HELCOM Baltic Sea Action Plan	The action plan drawn up in the context of implementing the Helsinki Convention on the marine environmental protection of the Baltic Sea area recognises eleven substances or substance groups which are of special concern. (See more FIWA 2018, p.10)
Industrial Emissions Directive (IED), 2010/75/EU	Establishes the main principles for permitting and control of large industrial installations based on an integrated approach and the application of best available techniques (BAT).
REACH regulation 1907/2006/EC	Adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. (See more FIWA 2018, p.8)
Stockholm Convention on POPs (2001)	A worldwide agreement concerning restrictions on POP compounds (persistent organic pollutants). (See more FIWA 2018, p.10)

Urban Waste Water Treatment Directive (UWWTD), 91/271/EEC	Its objective is to protect the environment from the adverse effects of urban wastewater discharges and discharges from certain industrial sectors and concerns the collection, treatment and discharge of (a) domestic waste water (b) mixture of waste water (c) waste water from certain industrial sectors.
Water Framework Directive (WFD), 2000/60/EC	One of the ultimate aims is to achieve the elimination of priority hazardous substances and contribute to achieving concentrations in the marine environment near background values for naturally occurring substances.

2.3 National legislation

SUMMARY OF RECOMMENDATIONS
The following principles need to be enforced by legislation: – Operators are responsible for sufficient pretreatment of industrial wastewater. – Operators must be aware of the effects and possible risks of their operations (including wastewater). – Operators are responsible for covering the costs caused by their operations (the polluter pays principle) such as damage and increased investment, operating and maintenance costs on water utilities. – A water utility must have the right to refuse connection of an industrial facility to the sewer network if the water utility assesses that their operations would be endangered by the quality or quantity of industrial wastewater. – For the cases where industrial wastewater causes imminent danger or serious harm, a water utility must have the right to stop receiving the industrial wastewater that causes the problem.
Legislation needs to set the framework for cooperation between industries, water utilities and environmental authorities.
Industries potentially producing considerable wastewater load or causing risks through their industrial wastewater should automatically need environmental permits or industrial wastewater contracts with limit values and monitoring programmes for pollutants. One option would be to regulate limit values directly in national legislation. Either way, national legislation must clearly define where the limit values are given, and allow authorities to supervise the fulfilment of these obligations.
The role of industrial wastewater contracts needs to be defined and highlighted in national legislation.
The obligation of keeping contracts updated and, if necessary, the obligation of renewing contracts should be enforced in national legislation.

The regulation of industrial wastewaters has considerable variation between BSR countries. Generally, limit values and restrictions to the quality of industrial wastewater are rarely defined in national legislation (excluding Poland and Germany), but rather in environmental permitting or in industrial wastewater contracts between a water utility and an industrial operator.

However, legislation needs to support setting necessary restrictions and limit values to industrial wastewaters either in environmental permits or industrial wastewater contracts or both. Legislation therefore needs to set the framework for cooperation between industries, water utilities and environmental authorities. This does not necessarily mean setting definite limit values or recommendations in law, but rather the procedures which must be followed and documented.

The purpose of regulating industrial wastewaters is to prevent industrial wastewaters causing any harm, damage or other undesirable effects. Thus, the obligation of sufficient pretreatment must be enforced by national legislation to ensure the following:

- Protect the health of the personnel working at a sewage network and WWTP
- Ensure that the sewage network, WWTP and related materials are not damaged
- Ensure that the operation and treatment of the WWTP is not hindered
- Ensure that discharges from the WWTP do not affect the aquatic environment to an unacceptable degree and hinder the achievement of the objectives of the water bodies
- Ensure that sludge from a WWTP can be disposed of in a responsible and environmentally acceptable manner

In addition, the following principles should be enforced by national legislation:

- Operators are responsible for covering the costs caused by their operations (the polluter pays principle) such as damage to and increased operating and maintenance costs on water utilities
- Operators are always responsible for being aware of possible environmental impacts and risks of their operations (including wastewaters), and thus operators must cover expenses from sampling and analysing of industrial wastewaters
- Legislation needs to provide a possibility for water utilities to refuse to connect industrial operators to the sewer network if water utilities assess their operations to be endangered by the quality or quantity of industrial wastewater
- For the cases where industrial wastewater causes imminent danger or serious harm, water utilities must have the right to cut off receiving the industrial wastewater that causes the problem

In some BSR countries, national legislation follows only the “end-of-pipe approach”, often regulating only WWTPs for effluent quality. This leaves the water utility responsible for determining limits for industrial wastewater quality and quantity, even for very large (IED category) polluters. The management of industrial wastewaters falls also to water utilities when:

- An operator is not required to have an environmental permit
- An operator has a permit but it does not include requirements for wastewater
- An operator has a permit with wastewater requirements but these are not relevant or overly lax

In these cases, quality requirements and other restrictions must be determined in an industrial wastewater contract between the water utility and the operator. Water utilities should however be supported by national legislation, so that control of industrial wastewater is not hindered by legislative obstacles.

In Poland, limit values for the quality of industrial wastewater are regulated in “Regulation on the manner of implementing the obligations of industrial wastewater suppliers and the conditions for introducing wastewater into sewage systems” (Ministry of Infrastructure and Development, 28 Sept 2016).

In Germany, the conditions for conveying industrial wastewaters to a sewer are regulated in national legislation. Limit values (concentration and/or loading) for harmful substances are defined in the German Waste Water Ordinance (1997) for industrial wastewaters from 56 different industries. Setting the conditions in national legislation means that equal treatment is given to all operators within the same industry, therefore harmonising industrial wastewater management throughout the country.

However, this approach does not provide a potential for considering local conditions, such as the size and capacity of a WWTP. Therefore, if limit values are set directly in legislation, regulation should provide the option to define stricter requirements e.g. for harmful and hazardous substances on the basis of local conditions. The need for setting overarching limit concentrations for organic matter and nutrients should also be considered, because these substances can be treated at WWTPs and increased expenses can be covered by collecting increased wastewater fees according to the quality of the industrial wastewater.

In other BSR countries (excluding Poland and Germany), however, legislation has a smaller role in managing industrial wastewaters because direct limit values are not established in legislation. Legislation should be reviewed so that it provides better support for water utilities,

and so that industries potentially producing considerable wastewater load or causing risks through specific properties of their industrial wastewater would automatically need a permit or an industrial wastewater contract with limit values and monitoring programmes for pollutants. In many BSR countries, the role of industrial wastewater contracts needs to be defined and highlighted in national legislation.

In addition, the obligation of keeping contracts updated and, if necessary, the obligation of renewing contracts should be enforced in national legislation where the specific criteria would be listed (see Chapter 4.4.7). This would also support the interests of the operators.

In conclusion, sufficient control of industrial wastewaters can be achieved by defining limit values, monitoring programmes and other necessary terms and conditions either in environmental permits or in industrial wastewater contracts or both, but national legislation must clearly specify the role of these options. Either way, (environmental) authorities must have the possibility to supervise the fulfilment of obligations given in either environmental permits or in industrial wastewater contracts. Limit values for hazardous and harmful substances can also be defined on a national level, in national legislation or in national guidelines so that the terms and conditions can be harmonised nationwide (see Chapter 2.5.3).

2.4 Environmental permits

SUMMARY OF RECOMMENDATIONS
Environmental permits should be granted on a sufficiently high (preferably national or regional) level where there is enough technical knowledge to set relevant limit values and restrictions for industrial wastewater quality, as well as independence from local interests and politics.
Water utilities and WWTPs need to be provided with real influence in permit conditions by requesting their comments during the course of the permitting process. Enough time for commenting should also be provided.
Water utilities and permitting authorities should cooperate to assess the impacts of industrial wastewater discharges into a sewer.
For operators that have both an environmental permit and an industrial wastewater contract, it is advisable to harmonise the requirements between the two.
There should be a possibility to change permit conditions in case monitoring has showed certain parameters to be unnecessary for the water utility.
One option to manage industrial wastewaters is to include in the permit the obligation of having and following a wastewater contract and the quality limits set in that contract. In these cases, it is recommended that environmental authorities are involved in assessing the necessary contractual terms, e.g. limit values.

Environmental permits (water permits in Poland) are an important tool in managing industrial wastewaters. However, permits are not obligatory for all operators that produce industrial wastewaters and that can have a considerable impact on a sewer network or WWTP. No permit means that the operator is not required to have contact with environmental authorities, and therefore only the water utility is responsible for regulating industrial wastewater emissions. Small water utilities can especially have significant struggles in getting the operator to follow the polluter pays principle through an industrial wastewater contract.

Presently, permits can also restrain the management of industrial wastewaters if the permit requirements are lax or not relevant, or if industrial wastewaters are even defined as “not relevant” as in Estonia.

To avoid a situation where the environmental permit of an operator does not include requirements for industrial wastewater, or the requirements are not sufficient, there are two solutions:

- Granting environmental permits on a sufficiently high (preferably national or regional) level, where there is enough technical knowledge to give relevant limit

values and restrictions for industrial wastewater quality, as well as independence from local interests and politics. Municipal (environmental) authorities may lack the required competence and/or are more vulnerable to political pressure from industries or local politicians.

- Involving water utilities in the permitting process for industrial operators. Water utilities need to be provided with true influence in permit conditions by requesting their comments during the course of the permitting process (applied e.g. in Finland and Sweden). Enough time for commenting should also be provided.

Furthermore, water utilities and permitting authorities should cooperate to assess the impacts of industrial wastewater discharges into a sewer (expected flows and loads, WWTP capacity, risk for toxic/harmful discharges, etc.), after which the permit conditions can be drafted. Cooperation between water utilities and environmental authorities is further discussed in Chapter 5.3.

For operators that have both an environmental permit and an industrial wastewater contract, it is advisable to harmonise the requirements between the two. One solution is to include in the permit the obligation of having and following a wastewater contract and the quality limits set in that contract. In these cases, environmental authorities should provide their knowledge and backup to the water utility when preparing the terms of the contract. Authorities often have the best knowledge about BAT conclusions and reference documents that should be taken into account when considering necessary limit values.

Additionally, there should be a possibility to change permit conditions in case certain permit requirements are not relevant for the water utility or have been showed unnecessary through monitoring. This is also in the interest of operators. Irrelevant or overly strict requirements in permits should be avoided as well as overly lax requirements.

An important advantage of managing industrial wastewaters by an industrial wastewater contract rather than by a permit is that enforcing liability for damages is much easier with a contract. Even if evidence of causing damage is clear, based on a permit, environmental authorities may have to start a police investigation before the polluter can be held liable, whereas a water utility could claim penalty or compensation for the damage caused by the operator according to the terms of an industrial wastewater contract.

2.5 Supervision, monitoring and limit values

2.5.1 Supervision

SUMMARY OF RECOMMENDATIONS
Authorities should have sufficient power to intervene in cases where an industrial operator neglects its permit conditions or exceeds limit values set for industrial wastewater quality.
If misconduct is repeated and the operator does not comply with permit conditions after a given term, authorities should impose administrative fines or even order the immediate closure of the facility.
The responsibility of monitoring the quality of industrial wastewaters lies with the operator, not on authorities or water utilities.
Authorities and water utilities should be able to carry out inspections and take wastewater samples on a property.
A laboratory or other certificated and independent third party takes representative samples and analyses them.

A major problem in many BSR countries is that enforcing the compliance with environmental permit conditions or industrial wastewater contractual terms is hindered by a lack of resources or knowledge or even due to legislative obstacles. In practice, this means that industrial wastewaters are not monitored extensively enough to identify violations of quality requirements or if violations are noticed, sanctions are not defined or applied. The procedure of sanctioning often takes a long time. This is a major obstacle in the management of industrial wastewaters.

Authorities should have sufficient power to intervene in cases where an industrial operator neglects its permit conditions or contractual terms or exceeds limit values set for industrial wastewater quality. If misconduct is repeated and the operator does not comply with permit conditions after a given term, authorities should impose administrative fines or even order the immediate closure of the facility. In several countries, these procedures are relatively slow and infrequently used. Terms for violations of an industrial wastewater contract are discussed in Chapters 4.4.6 and 4.4.7.

Authorities and water utilities should be able to carry out inspections and take additional wastewater samples especially if there is a suspicion that samples included in the monitoring programme are not representative or in case disturbances in the sewer or at the WWTP have been noticed. Legislation should not prevent authorities or water utilities from sampling industrial wastewaters at relevant locations without prior notice. The aforementioned is forbidden by law e.g. in Latvia, Lithuania and Russia.

2.5.2 Monitoring programmes and procedures

SUMMARY OF RECOMMENDATIONS
Sampling procedures and the extent of analyses are agreed upon in the monitoring programme. The contents of a monitoring programme have to be considered case specifically according to the amount and quality of the wastewater and the pollutants and hazardous substances potentially ending up in the wastewater. More frequent sampling should be required if the quality of wastewater varies a lot. The operator is responsible for the costs of monitoring.
The monitoring programme can include more frequent sampling and more extensive analyses at first (e.g. one year). Some parameters can be analysed more often than others.
The monitoring programme of a specific operator shall include such hazardous substances that have been detected at relatively high concentrations at the WWTP and are used by the operator or are commonly used in the same industry or have been detected in previous samples.
Monitoring samples should be taken and analysed by an external certified and independent party (i.e. a laboratory). It is important that the sampling dates are not known by the operator in advance.
Composite sampling with an automatic sampler is recommended for all samples, alongside samples for analysing substances that do not preserve in composite sampling. Composite samples should be taken over 24 hours or at least over a workday or longer.
A certain time limit can be set in the industrial wastewater contract for letting samplers reach the sampling point counted from the first notification. If this time limit is not met, it is considered as breach of contract.
Online and real-time monitoring is valuable in detecting exceptional emissions, which benefits both the water utility and the operator.

The target of the monitoring programme is to identify typical wastewater quality of the operator during normal operations and loading/pollution peaks and to detect violations of permit conditions and/or contractual terms. Thus, the monitoring programme is crucial for supervising compliance to the terms of the contract and/or the permit, and for the protection of the sewer, the WWTP and the environment. Also, process disturbances at the industrial facility can be revealed through wastewater sampling. When the terms of a monitoring programme are considered, it is recommended to get acquainted with the standard ISO/DIS 5667-1.

The responsibility for monitoring the quality of industrial wastewaters lies with the operator. Thus, the operator is responsible for covering the costs of monitoring. This requirement is in

accordance with the principle that operator is responsible for being aware of the environmental impacts of its operations.

Authorities and water utilities should not be responsible for the regular monitoring of industrial wastewaters. Their duty is to define necessary and sufficient conditions for the monitoring programme that includes e.g. the frequency of sampling and parameters to be analysed. Monitoring programmes are defined by supervising authorities or in environmental permits and/or in industrial wastewater contracts. A monitoring programme defined by a supervising authority is more flexible (easier to change) and thus more recommended, than setting terms in environmental permits.

The monitoring programme should be drawn up case specifically for each operator, considering the amount and quality of the wastewater, and which pollutants and hazardous substances may end up in a sewer based on the raw materials and chemicals used by the operator. All parameters that have limit values (discussed in Chapter 2.5.3) may not be required to be included in the monitoring programme if it can be proved that certain limit values are irrelevant for the operator (e.g. metals in food industry wastewaters). Therefore, limit values exist, but monitoring can be focused on key parameters.

The frequency of sampling should also be determined case specifically. If wastewater quality varies a lot, if it contains hazardous substances or if nutrient loading is remarkable, sampling should be carried out more often. The monitoring programme can include more frequent sampling and more extensive analyses at first (e.g. during the first year), especially if previous water quality data is not available. Based on the results, sampling frequency and number of analyses can be reduced. In addition, other parameters can be analysed more often than others.

In Germany, operators are categorised by risk assessment which determines the sampling frequency needed. According to the evaluated risk, companies in category 1 (highest risk) may be checked up every 4–5 weeks, in category 2 every 12 weeks, and in category 3 every 6–12 months. Companies in the lowest risk category 4 may not be checked up or sampled, but their data remains in the register.

Analysing a wide range of hazardous substances is very expensive and thus monitoring should be focused only on substances that are case specifically relevant. Before requiring hazardous substances to be monitored from the operators, comprehensive analyses from the influent and effluent of WWTP should be carried out. Certain hazardous substances should be included in the monitoring programme of an operator if:

- Concentration of the substance in WWTP exceeds EQS-limits given in WFD (2000/60/EC) or is relatively high compared to other WWTPs or to other reference values and the source of pollution is not known, and
- The substance is used (chemicals, raw materials) or formed in processes of the operator according to their notification, or
- The substance is commonly used or found in wastewaters of the same industry according to literature e.g. in FIWA (2018) (see Annex 1) or in BREF documents or in BAT conclusions, or
- The substance has been detected in previous samples of the operator

In Finland, the project report Hazardous Substances at WWTPs (Vieno 2014) is an important reference that collects information and analysis results about substances that are classified or recommended for classification as harmful or hazardous to the aquatic environment from 64 wastewater treatment plants in Finland. Conducting this type of nationwide research in other BSR countries is recommended in order to enable the creation of a wider understanding of hazardous substances in wastewaters.

Selecting the sampling point is important. The sampling point should be defined clearly in the layout of an industrial facility that also shows the sewers of the property. All industrial wastewaters from the operator should reach the sampling point, so it should be as close as possible to the connection point to water utility's sewer. The sampling point should also be selected so that authorities or the water utility can take additional samples without prior notice. This means that the best place for sampling would be outside the fences of the property. If this is not possible, another sampling point should be located outside the fences where representative additional samples of the industrial wastewater can be obtained.

It is highly recommended that a laboratory or another certified and independent third party takes representative samples and analyses the samples in an accredited laboratory. Using a third party also for additional sampling is recommended for ensuring representative sampling and avoiding conflict with the operator. Furthermore, for the legal protection of both parties, a statement from a certified sampler should be requested to ensure that representative sampling is possible from the selected sampling point, according to the terms of the monitoring programme. Both parties must have the possibility to observe the sampling procedures, especially if there are trust concerns between the operator and authority or water utility.

Composite sampling with an automatic sampler is recommended for all samples, alongside samples for analysing substances that do not preserve in composite sampling. Composite samples should be taken over 24 hours or at least over a workday or over a period of one week for industrial wastewaters with high loading. When planning the sampling, the production hours of the operator should be considered so that representative samples of normal operations can be taken and also loading peaks can be detected. Furthermore, composite sampling may be carried out during several consecutive days for identifying differences between operation days.

A significant problem pointed out by several interviewed water utilities is that operators may change their normal operations before wastewater sampling begins. It is important that the sampling dates are not known by the operator in advance. For practical reasons, the laboratory may often have to contact the operator in advance to get access to the premises, but notice of sampling dates should be given at the earliest the day before. Even a certain time limit for letting samplers reach the sampling point, counted from the time of the first notification, can be set. If this time limit is not met, it is considered as breach of the permit or the contract. The laboratory should be obligated to send the analysis results directly to the authorities and water utility.

Online monitoring is valuable in detecting exceptional emissions and thus benefits both the water utility and the operator. Online monitoring can be applied for certain parameters such as pH and conductivity, for which online monitoring is better than individual samples. Online monitoring for pH is advisable for operators that have varying pH or have pH adjustment. Online monitoring of conductivity detects exceptional wastewater quality, although limit values for conductivity are seldom necessary. The range of cost-efficient and useful online sensors will likely increase in the future. In Poland, real-time data collection is used at the majority of significant industrial facilities.

If necessary, nitrification inhibition test (or other toxicity tests) should be used to examine the impact of industrial wastewater on nitrogen removal (nitrifying) bacteria of the activated sludge process at the WWTP. Inhibition means that the normal activity of the nitrogen removal bacteria is prevented. The nitrifying bacteria is sensitive to many hazardous substances which means that nitrification inhibition is a good indicator to the harmfulness of industrial wastewater. Regular testing of nitrification inhibition should be required especially from operators whose industrial wastewater can contain several hazardous or toxic substances, such as hazardous waste treatment plants. For other operators, testing should be carried out if necessary, e.g. in the event of nitrification disturbance at the WWTP. The analysis of nitrification inhibition is further discussed in the next chapter. In addition, the harmful effect of a certain substance or industrial wastewater can be detected through oxygen uptake rate (OUR, i.e. respiration test) or acute and chronic toxicity tests.

Environmental authorities, local governments and water utilities should have a continuous exchange of information regarding the recorded quality of industrial wastewater and their effects on WWTP performance in order to highlight violations and act on them and keep the terms of a permit and industrial wastewater contract updated. Guidelines for cooperation are further discussed in Chapter 5.3.

2.5.3 Limit values for the quality and quantity of industrial wastewater

SUMMARY OF RECOMMENDATIONS
Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators of the same industry.

Concentration limits are needed for substances that can cause harm or disturbances in a sewer, at a WWTP or to the environment (e.g. heavy metals, hazardous substances, sulphides, pH).
Loading limits can be given to the substances for which the WWTP is designed (BOD, COD, phosphorus, nitrogen). Loading limits should be given based on evaluating what share of the WWTP's design loading can be allotted to a single operator or especially if there is a risk of exceeding the capacity of WWTP.
It is recommended to set the limit values for harmful and hazardous substances on a national level and apply the same limit values throughout the country. However, there should be the possibility for setting stricter limit values if it is necessary for the WWTP or if problems have been detected before.
MAC-EQS concentrations, emission levels (BAT AEL) and concentrations causing nitrification inhibition can be used as limit value for hazardous and harmful substances.

Limit values on the quality and quantity of industrial wastewater can be given in environmental permits or in industrial wastewater contracts. Some limit values can be set in national legislation but other limit values are always case specific.

Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators in the same industry and in the same sewer area because the competition between companies must not be affected by unequal restrictions. However, features of each operator should also be considered when setting limit values and restrictions. When setting limit values for industrial wastewater, the following principles are recommended to be applied:

- If the substance can cause harm or disturbances in the sewer, at the WWTP or to the environment (e.g. heavy metals, hazardous substances, sulphides, pH), a limit value is needed (typically a concentration limit)
- If the substance can be treated at the WWTP but treatment capacity is limited (BOD, COD, nutrients), a limit value is needed for maximal loading
- If the substance can be treated at the WWTP and there is enough capacity (BOD, COD, nutrients), no limit value is needed and the loading is taken into account in the increased wastewater fee stated in the industrial wastewater contract (see Chapter 4.4.4)

If the operator is unable to meet the limit values, pretreatment or equalisation of industrial wastewaters or other sufficient measures are required.

In many BSR countries, there is a concern that local water utilities and authorities do not have sufficient knowledge about the management of industrial wastewaters, leading to insufficient terms of industrial wastewater contracts and environmental permits. Thus, water utilities and authorities should get more support particularly from national legislation and the national water utility association, and e.g. limit values for harmful and hazardous substances should be harmonised nationwide:

- One option is to establish limit values in national legislation, as is done in Germany and Poland. This ensures the limit values are followed throughout the country.
- Another option is to publish national guidelines containing recommendations for limit values. Guidelines should be published on the ministry level, as in Denmark, or by water utility associations as e.g. in Sweden and Finland. In order to ensure maximum benefit, it is recommended to publish guidelines in the national language. Best practice for information sharing is discussed more in Chapters 5.2.3 & 5.3–5.4.

However, the possibility for setting especially stricter limit values must be allowed according to the size and process of the WWTP, local conditions and in cases where problems caused by industrial wastewater have been detected before. Limit values are especially necessary for heavy metals and substances that may have harmful effect on the sewer network, on sewage sludge quality, on the receiving water body or that may cause disturbances to the WWTP. Loading limits for hazardous substances can also be set if the amount of industrial wastewater is significant. Loading limits (kg/d or g/d) are also recommended in addition to concentration limits, especially if the diluting of industrial wastewaters for the purpose of avoiding the exceeding of concentration limits is suspected.

Examples of the concentration limit values that are used nationwide in Finland, Sweden, Denmark and in Warsaw, Poland are presented in Table 2-2. In Finland and Sweden, the limit values are published in guidelines developed by national water utilities associations and water utilities can decide on specific limit values they use in their industrial wastewater contracts. In Denmark, the limit values are published in the Danish Environmental Protection Agency's Guidelines and the limit values are suggestions to be used in connection permits between municipalities and industrial facilities. The presented limit values of Poland are used in the Warsaw Municipal Water and Sewage Management Company. In Poland, a wide list of limit values have also been stated in national legislation.

Table 2-2 Examples of limit (and guiding) values for the quality of industrial wastewaters in different countries. "Not given" means that those limit values are not presented in the referred public sources.

		Finland	Sweden	Denmark	Poland (Warsaw)
Arsenic, As	mg/l	0.1	Not given	0.013	Not given
Mercury, Hg	mg/l	0.01	0.0001	0.003	0.1
Molybdenum, Mo	mg/l	Not given	Not given	0.03	Not given
Silver, Ag	mg/l	0.2	0.01	0.25	Not given
Cadmium, Cd	mg/l	0.01	0.0001	0.003	0.4
Chromium, Cr	mg/l	1.0	0.01	0.3	1.0
Chromium VI, Cr^{6+}	mg/l	0.1	Must be reduced to trivalent chrome	Not given	0.2
Cobalt, Co	mg/l	Not given	Not given	0.01	Not given
Copper, Cu	mg/l	2.0	0.2	0.1	1.0
Iron, Fe	mg/l	Not given	Not given	Not given	10
Lead, Pb	mg/l	0.5	0.01	0.1	1.0
Nickel, Ni	mg/l	0.5	0.01	0.25	1.0
Selenium, Se	mg/l	Not given	Not given	0.008	Not given
Tin, Sn	mg/l	2.0	Not given	0.06	Not given
Zinc, Zn	mg/l	3.0	0.2	3.0	5.0
Sulphate, SO_4^{2-}	mg/l	400	400 (SO_4^{2-} + SO_3^{2-} + $S_2O_3^{2-}$)	500	500
Sulphide, S^{2-}	mg/l	Not given	1.0	Not given	Not given
Magnesium, Mg^{2+}	mg/l	Not given	300	Not given	Not given
Ammonium, NH_4^+	mg/l	Not given	60	Not given	200
Chloride, Cl^-	mg/l	Not given	2500	1000	1000
Cyanide, CN^-	mg/l	0.5	0.5	1.0	0.5 Free cyanides, 5.0 Complex cyanides
Mineral oil, C_{10}–C_{40}	mg/l	100	5–50	20 (Oil and grease: 50)	15
pH		6–11	6.5–10	6.5–9	6.5–9.5
Temperature	°C	40	45	50	35
Electrical conductivity	mS/m	Not given	500	Not given	Not given
Suspended solids	mg/l	Not given	Not given	500	500
BOD_5	mg/l	Not given	Not given	Not given	700
COD	mg/l	Not given	Not given	Not given	1000
Total nitrogen, N	mg/l	Not given	Not given	Not given	220
Total phosphorous, P	mg/l	Not given	Not given	Not given	15
Petroleum ether extractables	mg/l	Not given	Not given	Not given	100
Non-ionic surfactants	mg/l	Not given	Not given	Not given	20
Anionic surfactants	mg/l	Not given	Not given	Not given	15
Sources		FIWA 2018	Svenskt Vatten 2019	Danish Environmental Protection Agency 2006	Maśliński et al. 2019

In Sweden, environmentally hazardous organic substances may not be present in samples, as stated by the guidelines of Swedish Water & Wastewater Association (Svenskt Vatten 2019). Restrictions should be set for volatile organic compounds (VOCs), which include among others halogenated hydrocarbons (e.g. chlorinated hydrocarbons, AOX) and aromatic hydrocarbons (e.g. BTEX compounds). Simply stating that it is forbidden to convey all VOC compounds to a sewer is problematic because the number of substances that can be classified as VOC compounds is so vast and the properties of these substances differ significantly. Furthermore, some VOC compounds are ubiquitous and trace amounts can even be found in drinking water.

When considering the limit values for hazardous and harmful substances, the following principles can be applied:

- Maximum allowable concentration, MAC-EQS (AA-EQS if MAC-EQS not given) concentrations given in WFD (2000/60/EC) or in national legislation can be used as limit values for industrial wastewaters according to receiving water body of WWTP
- Emission levels (BAT AEL) for direct and indirect water emissions can be used as limit values. BREF documents and BAT conclusions should also be consulted
- Literature references can be found about concentration of substances inhibiting nitrification. Svenskt Vatten (2019) has published a comprehensive list of substances inhibiting nitrification (translated in English in FIWA 2018, Appendix 14). The concentrations causing inhibition of nitrification can be used as limit values for industrial wastewater
- The table in Annex 1 can be used when considering which substances are essential for the industry

So called “A, B, C assessment” is used in Denmark when evaluating industrial wastewater of operators. In category A, wastewater contains substances which are undesirable in the environment. In category B there are substances that should not be present in such large quantities in the wastewater that it exceeds environmental quality requirements / criteria. Category C is for substances that do not give rise to limit values.

It is recommended to give loading limits to the substances for which the WWTP is designed (BOD, COD, phosphorus, nitrogen). Loading limits are especially relevant if there is a risk of exceeding the capacity of the WWTP but these limits should also be given based on evaluating what share of the WWTP’s design loading can be allotted to a single operator. German wastewater association (DWA) has issued guidelines that the industrial wastewater load from a single operator should not exceed 10% of the input to the WWTP. The share needs to be defined so as to leave room for future growth in loading to the WWTP. The whole remaining capacity of the WWTP cannot be given to one operator because then no room for any new industrial operators or for the growth of existing ones would be left.

It may not be necessary to set limit values for BOD, COD, phosphorus and nitrogen concentrations unless the concentrations are high enough to cause harm to a sewer system such as odour or corrosion problems. For suspended solids, a limit value for concentration is necessary to prevent the accumulation of solids in the sewer and to prevent harm to the pumping stations. High concentrations of organic substances or sulphur may also cause an odour in long transfer sewers.

When granting permission for wastewater discharge into a municipal sewer from a new industrial facility, limits for permitted wastewater flow must be set on the basis of the hydraulic capacity of the WWTP and sewer network. The units of the limit value should be considered e.g. litres per second and cubic meter per hour because those units are relevant particularly for the capacity of pumping stations and the sewer.

2.6 Politics

SUMMARY OF RECOMMENDATIONS
Economic and industrial policies should not be made at the cost of WWTPs and the environment.
A transition to more independent regional water utility companies or centralised wastewater treatment is seen as a solution for preventing local economic and industrial policy from affecting the management of industrial wastewaters.

Water utilities and WWTPs should be able to operate without political pressure. However, economic and industrial policy tend to be entangled especially when it comes to industrial wastewaters and limiting loading from industrial plants as they bring tax revenue and employment to the region or municipality. In some cases, industrial operators have been given lower water and wastewater fees and permission to convey wastewaters to a sewer without pretreatment or with insufficient pretreatment, thereby increasing regional preference. Economic and industrial policies should not be made at the cost of WWTPs and the environment.

More independent water utilities can be seen as a solution. The further away the water utility is from local decision-making and politics, the lower the risk is to get wastewater management and economic and industrial policy mixed. One solution would be a transition from municipal water utilities to more independent regional water utility companies or to centralise wastewater treatment to bigger units to which wastewaters are conveyed from several municipalities.

Water utilities owned by local governments have also been found to grant lower-than-usual water and wastewater fees for industrial facilities in order to attract the companies to invest in the municipalities. However, it is important to keep in mind that state aid to a single company is prohibited in Article 107 of the Treaty of the Functioning of the European Union (TFEU): “State aid is defined as an advantage in any form whatsoever conferred on a selective basis to undertakings by national public authorities” (European Commission 2019). If a company pays lower water or wastewater fees than the normal tariff, resulting in significant savings compared to other companies, it might be seen as prohibited state aid because the company is providing public services on preferential terms leading to distorting the competition. Companies and consumers may lodge a complaint against alleged unlawful state aid.

In Estonia, the local competition authority confirms the prices for water services in order to avoid the situation described above. An interesting measure is used in Germany for ensuring that the polluter pays principle is fulfilled. Consumers can institute a class action lawsuit if there is a suspicion that households pay for the treatment of industrial wastewaters through their wastewater fees.

3 Guidelines for the co-treatment & pretreatment of industrial wastewaters

3.1 General

Industrial wastewater discharged into a sewer network can have both positive and negative effects on the WWTP. The benefits can be enhanced and damage mitigated by applying proper pretreatment before the wastewater is conveyed to the sewer and by preparing for exceptional situations at both ends of the pipe. This chapter gives guidelines for best practice of co-treatment of industrial wastewater at municipal WWTPs. The chapter gives an overview of established and advanced methods for on-site pretreatment of industrial wastewaters. In addition, guidelines for controlling hazardous substances in industrial wastewaters as well as industrial sludge are given in Chapters 3.5-3.6.

3.2 Best practice for co-treatment

SUMMARY OF RECOMMENDATIONS (Chapters 3.2–3.4)
Co-treatment can be both a cost-efficient and efficient way to treat industrial wastewaters, when industrial wastewaters are monitored and there is good cooperation between the WWTP and the operator. (Chapter 3.2)
Successful and optimised co-treatment requires that a WWTP has sufficient capacity, personnel is aware of the specific operation measures needed and the operator immediately informs the WWTP of all exceptional discharges. (Chapter 3.2)
Accidental leaks and load peaks must be prevented by risk management planning of operators. WWTPs must prepare for possible problems caused by industrial wastewaters and plan and rehearse needed actions beforehand, such as isolating and by-passing parts of the treatment process. (Chapter 3.3)
Operators can improve the quality of their wastewater by preventive measures like optimising production processes, minimising the use of chemicals and substituting chemicals with less hazardous chemicals. (Chapter 3.3)
On-site pretreatment of industrial wastewater is necessary if the operator is unable to meet limit values and restrictions. (Chapter 3.4)
If industrial wastewater contains hazardous substances that cannot sufficiently be removed on-site, wastewaters should be collected and delivered to a hazardous waste treatment plant. (Chapter 3.4)

Co-treatment can have many advantages, depending on the wastewater composition, WWTP capacity and the industrial loads. The main advantage is greater cost-efficiency and increased competence of personnel in centralised wastewater treatment. Other advantages of co-treatment include greater efficiency of wastewater treatment processes in larger units, which enables better treatment results especially for nitrogen.

Sometimes industrial wastewaters can be a resource to the WWTP. Easily biodegradable organic matter (BOD) in industrial wastewaters from e.g. food processing industry can support biological phosphorus and nitrogen removal, reducing the need for external carbon sources, if the BOD load is at a tolerable level and consistent. However, this might require equalisation. Additionally, warmer waters from industry can benefit the biological treatment process if the operator is located close to the WWTP.

Co-treatment is best practised when all the necessary information about the quality and amount of industrial wastewater is available to both parties. The key to preventing disturbances to WWTP operation is good cooperation between operator and WWTP, which is further discussed in Chapter 5.2. In practice, good cooperation means that the operator informs the WWTP on any changes to the industrial wastewater amount and quality and any accidental leaks or load peaks. Co-treatment requires sufficient monitoring of the quality of industrial wastewater. Depending on the operator, monitoring should be focused on the

concentrations of organic matter and nutrients or the concentrations of hazardous substances (see Chapter 2.5.2).

3.3 Risk management and preventive measures

Accidental leaks and load peaks should be prevented by the operators through their preparedness and risk management planning and doubling of critical equipment. WWTPs should also be prepared for abnormal industrial wastewater discharges. WWTP personnel must be aware of what types of exceptional discharges can occur, what their potential effects on the treatment process are and exactly what actions must be taken when such discharges happen. These procedures need to be planned beforehand and practiced. It is recommended to publish guidelines for actions on these exceptional and emergency situations in each BSR country in their national language(s).

Biological treatment processes can recover relatively quickly even from a total deactivation of biomass in one or two treatment trains, provided there is healthy biomass available in other, non-affected trains. If the whole microbial community dies, recovery may take months. This is why it is vitally important to be able to isolate parts of the WWTP (e.g. by avoiding mixing of all return sludge flows with each other) and to be able to temporarily bypass unit processes in several points in the WWTP. In cases where a significant part of biomass has been severely affected e.g. by a toxic discharge, recovery can be accelerated by importing healthy seed sludge from another WWTP. Possible sources for seed sludge and the procedures for importing it must be known beforehand. Industrial wastewaters and necessary actions for reducing the risk caused by industrial wastewaters must be included in the risk management plans (e.g. Sanitation Safety Plan, SSP) of WWTPs.

Quality of industrial wastewater can be improved by preventive measures, besides or instead of pretreatment. Preventive measures are actions such as optimising processes, minimising the use of chemicals and substituting chemicals with less hazardous chemicals. These measures require close review, and knowledge about the processes and water cycles of the industrial facility as well as a proper chemical inventory on the chemicals used. In addition to improved wastewater quality, financial benefits can also be achieved when the amount of valuable materials ending up in wastewater is reduced by process optimisation and adding internal water cycles.

3.4 Pretreatment of industrial wastewater

3.4.1 Common problems and necessity of pretreatment

Industrial wastewaters may have multiple effects in a sewer network and at a WWTP. In sewers, fats and solids can cause blockages, while sulphides, organic matter and hazardous substances can cause odour problems, corrosion and occupational safety risks (due to formation of hydrogen sulphur). The most common problems experienced at WWTPs are:

- Accumulation of grease and/or surfactants in process tanks and sludge treatment
- Deactivation or disturbance of biological treatment (e.g. inhibition, solids washout), overloading of the aeration system
- Premature wear of pumps and other equipment (e.g. corrosion, abrasion)
- Hydraulic overloading

If industrial wastewaters contain hazardous substances such as heavy metals, they might have a toxic effect on the biological processes and cause nitrification inhibition at the WWTP. Industrial wastewaters can also cause pollution of the receiving water body or reduce the quality of sewage sludge and therefore impede the reuse possibilities of the sludge (see Chapter 3.5).

On-site pretreatment of industrial wastewater is necessary if the operator is unable to meet limit values and restrictions which have been set to the quality or amount of industrial wastewater in the environmental permit or industrial wastewater contract. The need for pretreatment therefore depends on the limit values, but typically pretreatment is necessary if industrial wastewater has characteristics listed in Table 3-1. The table lists pretreatment methods for each type of industrial wastewater. The methods are further discussed in Chapters 3.4.2–3.4.6.

The pretreatment processes are typically situated at the operator's property. However, if there is a direct sewer line from the industrial facility to the WWTP and the quality of the untreated industrial wastewater does not prevent discharge to the sewer e.g. due to corrosiveness, it may be more convenient to have the pretreatment units at the WWTP. For example, operation, maintenance and logistics (chemicals, excess sludge, etc.) may be arranged more conveniently at the WWTP than at the industrial site. In this case, the operator shall compensate all costs caused by pretreatment to the WWTP.

Where possible, equalisation of flow and load should be placed as the first step in order to optimise the dimensioning and operation of other pretreatment units.

Table 3-1 Typical characteristics of industrial wastewater causing problems at WWTPs and sewers necessitating the need for on-site pretreatment. Examples of typical sources by industry and methods for pretreatment are also listed. See more in Annex 1 and in the Finnish Industrial Wastewater Guide (FIWA 2018).

Characteristics of industrial wastewater	Examples of typical industrial sources	Pretreatment methods
High organic loading (BOD, COD)	Food industry e.g. breweries, slaughterhouses, meat processing, dairies, sugar processing, pulp and paper industries, other process industries, waste management	Biological treatment (e.g. activated sludge process, MBBR), flash aeration, chemical precipitation
High phosphorus and/or nitrogen loading	Slaughterhouses, dairies, fertiliser industries, landfills, biogas plants	Chemical precipitation (lime, metal salts), stripping, nitrification-denitrification or deammonification
High solids loading or concentration	Food industry, concrete plants	Mechanical treatment (e.g. sedimentation, flotation, grit removal)
Low or high pH	Dairies, chemical industries, concrete plants	Neutralisation
High temperature	Power plants, slaughterhouses	Equalisation, cooling towers
Harmful or hazardous substances (e.g. heavy metals, solvents, AOX, cyanide etc.)	Metal industry, chemical industry, printing industry, power plants, textile and leather industry, waste management	Chemical treatment (e.g. precipitation), activated carbon, oxidation
Oils	Petrochemical industry, machinery workshops, metal industry, car repair shops	Oil separators
Fats and grease	Food industry, bakeries	Grease traps
Corrosive substances (e.g. sulphides, chloride)	Concrete plants	Chemical precipitation, oxidation, ion exchange
High variation in loading or flow rate	Food industry, seasonal production in any sector	Equalisation

Pretreatment can also help the operator to reduce the increased wastewater fee that is defined according to organic, nutrient and solids concentration (or loading) (see Chapter 4.4.4).

In some cases, it is advisable for the operator to take the industrial wastewater to be treated elsewhere. For instance, if the wastewater contains harmful substances that cannot sufficiently be removed on-site, the water should be collected and delivered to a suitable waste treatment plant. This can be more cost-efficient for small, concentrated wastewater streams than building on-site pretreatment facilities. Often, taking one small wastewater stream to be treated elsewhere can significantly improve the quality of the rest of the industrial wastewater. Hazardous waste must always be collected separately from other waste and wastewaters and delivered to a hazardous waste treatment plant.

3.4.2 Neutralisation

Neutralisation is an important pretreatment method for balancing the pH value, which has a significant effect on the biological treatment process. Low pH (<6) also has a corroding effect on concrete sewers. Recommended pH value is e.g. 6–11 in Finland and 6.5–9.5 in Poland. Chemicals used to raise pH most commonly include sodium hydroxide, sodium carbonate and calcium hydroxide. Alkaline wastewaters can either be neutralised with acidic waste streams or for example with sulfuric acid. Neutralisation should be designed with the online monitoring of pH so that no wastewater is conveyed to the sewer if the pH deviates from the limit values.

3.4.3 Equalisation

Equalisation means that peaks in flow rate and loading are balanced in storage basins. Equalisation therefore reduces problematic load peaks and gives more security in controlling accidental leaks. Equalisation can also be used to balance the flow rate and loading between weekdays if industrial wastewaters are only produced during the working week. The drawback is that equalisation can require large basin sizes and therefore has large space requirements. Equalisation basins also might need to be covered for odour control. Mechanical treatment (screening for removal of solids and grit removal) before equalisation could be needed to prevent sedimentation in the equalisation basin. This also creates the need for treatment, storage and disposal of screenings and grit, for which similar technologies as are used at WWTPs can be applied.

3.4.4 Mechanical treatment

Mechanical treatment processes separate solids or fat and grease from the water phase.

Fat and grease removal

Pretreatment is generally needed when industrial wastewater contains oils or fat and grease. Wastewaters containing oils needs to be separated in oil separators. Oil separators are used e.g. in car washes, car repair garages and waste management. Both animal origin and plant origin fats block sewers and have high BOD concentrations. Wastewaters containing fats need to be separated in grease traps. Both oil separators and grease traps need regular maintenance and overflow alarms.

Grit removal

Industrial wastewater containing sand or inorganic particles (e.g. coffee grounds, eggshells) needs to be pretreated to protect pumps and other equipment at sewer pumping stations and WWTPs. Screening and aerated grit chambers similar to those used at WWTPs are effective in separating heavier particles.

Sedimentation

Solids content in industrial wastewater can be reduced by allowing particles to settle by gravity in sedimentation basins. Two or more sequential sedimentation basins may be necessary to achieve necessary solids reduction. Solids removal can be enhanced by adding coagulant for chemical precipitation. It is important to scrape the bases of sedimentation basins regularly to maintain the volume of the basin. Settled sludge needs to be properly managed e.g. by a waste treatment plant.

Flotation

Even the lighter particles, which would normally settle down slowly or not at all (e.g. fibres from pulp and paper processing or grease from food processing), can be separated by flotation. In this process, liquid-solid separation is induced by dissolving pressurised gas into the treatment unit. The gas is released as micro-bubbles that rise to the surface, capturing

the solids on the way. The sludge bed formed on the surface of the tank is withdrawn by scrapers or overflow and must be subsequently processed. Chemical coagulant and/or flocculant are usually required to accumulate particles into separable flocs (see Chapter 3.4.5).

Lamella separation

In lamella separation, settleable solids are separated from the liquid phase by a series of inclined plates. The advantage of lamella separation over traditional clarifiers is a reduced space requirement due to the increased effective settling area of the plates. Lamellas can also operate with high flow rates. Fine screening, grit and grease removal prior to this process might be needed.

Filtration

Removing suspended solids and BOD by filtration through a granular bed or mechanical membrane is one option to reduce the industrial wastewater load. Sand filters and disc filters are common alternatives for solids removal. Activated carbon filtration is applied for adsorbing dissolved, non-ionic compounds. Activated carbon filtration is suitable for removing hazardous substances or e.g. pharmaceuticals from industrial wastewaters. Membrane filtration, even down to reverse osmosis level, can be used e.g. for wastewaters with relatively low volume and high concentrations of soluble impurities such as landfill leachate. In all cases, the reject from filtration, containing the separated impurities, must be either treated in an environmentally sustainable way or transported to a suitable waste treatment plant especially if the reject contains hazardous substances.

3.4.5 Chemical treatment

Chemical treatment can be applied for neutralisation to improve solids removal or e.g. to precipitate heavy metals. Chemical precipitation by coagulation and flocculation can be used also for removing phosphorus. Inorganic coagulants (typically ferric sulphate or polyaluminium chloride) and/or a polymer are needed. The separated solids may need to be disposed of as hazardous waste, depending on the quality of the industrial wastewater.

3.4.6 Biological treatment

In addition to physical and chemical processes described above, biological processes may also be needed as pretreatment. Biological treatment is generally applied to reduce BOD loading to the WWTP, but it can also be designed to remove nitrogen. Biological pretreatment is suitable for industrial wastewaters with high concentrations of BOD and nitrogen. Biological treatment typically means a classic activated sludge process and nitrogen removal can be applied by nitrification and denitrification. Some newer biological treatment process alternatives are discussed below.

MBBR

Moving bed biofilm reactor (MBBR) is a fixed-film biological process where biofilm is attached to freely floating carrier media. The process is implemented in steel or concrete tanks equipped with coarse or fine bubble aeration and sometimes mechanical mixing. A subsequent solid separation phase for separating excess sludge detached from the biofilm and other residual solids can be applied. MBBR can handle fluctuating organic and volumetric loads very well. MBBR is also fairly robust towards toxic substances and has a smaller footprint than the traditional activated-sludge process, which makes it a suitable alternative for the pretreatment of industrial wastewaters.

Anaerobic processes

Industrial wastewaters with high BOD concentration can also be pretreated with anaerobic processes. These can take the form of traditional UASB (upflow anaerobic sludge blanket) reactors or more advanced circulating bed reactors. A common trait of these processes is the proliferation of granular anaerobic biomass, reduction of easily and medium degradable organics, and formation of biogas, which can be used for energy production. Anaerobic processes tend to have a lower energy demand and smaller sludge production compared to aerated processes.

3.5 Control of hazardous substances in industrial wastewaters

Industrial wastewaters can be a route for hazardous substances to the WWTP and further to the environment. Some hazardous substances can accumulate in wastewater sludge or pass through WWTPs to surface waters. Many substances such as solvents can also impact the occupational safety and health of the employees of the water utility or the WWTP. The presence of hazardous substances in industrial wastewaters often results from the use of chemicals or certain raw materials in the processes of the industrial operators. It is therefore important to monitor the operator's use of chemicals and include hazardous substances in monitoring programmes (see Chapter 2.5.2). Annex 1 lists sources of hazardous substances by industry sectors. This list is recommended to be used as the basis for monitoring programmes.

Industrial wastewaters can cause contamination of wastewater sludge and therefore hinder or prevent sludge reuse. To recycle nutrients and organic matter in sludge, it is important to prevent the pollution of sludge. On a general level, the substances in industrial wastewaters creating most problems for sludge reuse are heavy metals. Management of industrial wastewaters is important for preventing the accumulation of heavy metals in sludge. Maximum allowed values for heavy metals are usually set in national legislation for fertiliser products. Heavy metals can be removed from industrial wastewaters by chemical precipitation, adsorption or ion exchange.

Hazardous substances in wastewater can originate also from household activities. For instance, pharmaceuticals originate primarily from domestic wastewaters. Other organic micropollutants are also present in domestic wastewaters, such as flame retardants and phthalates.

Industrial wastewaters can also contain organic micropollutants. Sources of some micropollutants are listed in Annex 1. The monitoring of organic micropollutants in industrial wastewaters is challenging because the substances include a wide spectrum of degradation and transformation products. They are usually present in wastewaters in low concentrations and could not until recently be detected with available analysis methods. Therefore, regulations considering the maximum allowed concentrations of these substances in wastewater or sludge products are not yet well developed. Their presence in the commonly experienced concentration range does not affect the performance of WWTP processes. For sludge reuse, the role of organic micropollutants was not found to be significant in the inquiry of the Swedish Government (Holmgren et al. 2020). Therefore the greatest risk comes from organic micropollutants entering the aquatic environment through the WWTP.

3.6 Control of industrial sludges

SUMMARY OF RECOMMENDATIONS
Before unloading industrial sludge loads, the importer needs to authenticate and give data to the water utility such as the origin and the quantity of the sludge and whether the load contains industrial sludge or only domestic sludge.
It is recommended that industrial sludge is only allowed into the WWTP if its quality has been analysed and the WWTP gives permission for unloading.

Not only industrial wastewaters conveyed to WWTPs but also industrial wastewaters and sludge transported by tank trucks to WWTPs or other collection points from industrial facilities are an issue in many BSR countries. Industrial sludge may cause loading peaks at WWTPs and contain hazardous and harmful substances that can cause disturbances and decline in the quality of the WWTP's sewage sludge and can end up in the aquatic environment. There is often lack of data about the quality of sludge brought to the WWTPs.

The importer that brings the industrial sludge to the WWTP is always responsible for the load and should have sufficient data about it. Before unloading, the importer needs to authenticate and provide data to the water utility about the origin and quantity of the sludge and whether the load contains industrial sludge or only domestic sludge. It is recommended that industrial sludge is only to be received if the quality has been analysed and the water utility gives permission for unloading. Permission can also be given if a contract about sludge

transportation has been made with the producer of the industrial sludge. However, water utilities should frequently inspect sludge loads and take random samples from the sludge. This is regularly conducted by HSY (Helsinki Region Environmental Services Authority) in Helsinki, Finland. HSY only allows loads containing grease waste from restaurants to be transported directly to the WWTP. HSY also requires vehicle specific identifiers for all importers.

4 Guidelines for industrial wastewater contracts

4.1 General

The purpose of industrial wastewater contracts is for a water utility and an industrial operator to agree upon the terms of discharging industrial wastewater into the sewer and onwards to the WWTP. As discussed in Chapter 2.3, the aim of controlling industrial wastewaters is to follow the polluter pays principle in order to ensure that operators are responsible for the sufficient pretreatment of industrial wastewaters and to get reliable data about the quality of industrial wastewaters. The polluter pays principle means that the industrial operator is responsible for the costs resulting from the industrial wastewater, including the costs of pretreatment and quality monitoring and the expenses caused by disturbances and increased investment and operation costs at the WWTP. Sufficient terms for following the polluter pays principle should be given in industrial wastewater contracts.

Another important target for industrial wastewater contracts is for the operator to get more information about the possible harmful effects of its industrial wastewaters in the contract negotiations and by monitoring the quality of the wastewater. At the same time, the water utility gets information on what risks the industrial wastewaters might have to the sewer network, pumping stations or the WWTP. In addition, the target is to begin and maintain cooperation between the water utility and the operator. An important part of the process of making an industrial wastewater contract is therefore to get the relevant personnel from the water utility and the operator to meet regularly in person.

It is important to strive for equal contractual terms for all industrial facilities, especially within the same industrial sector. The same principles should apply for all operators and the same contractual basis should be used. However, the terms of the contract need to be evaluated case specifically, considering the specific features of the industrial facility.

Furthermore, the main purpose of controlling industrial wastewaters must not be in achieving financial benefit for the water utility, environmental authorities or municipalities. The purpose of setting increased wastewater fees, penalty clauses and other fees is to ensure the operation of sewer and WWTP and to reduce the environmental load. Unfortunately, in some BSR countries, it can be seen that the current principles of setting limit values and monitoring programmes aim at collecting maximal fees, whereby more efficient on-site pretreatment is considered to be a negative trend.

This chapter gives guidelines for preparing industrial wastewater contracts and recommendations for the contents of the contract and the contractual terms.

4.2 Process steps of preparing industrial wastewater contracts

SUMMARY OF RECOMMENDATIONS
Water utilities should systematically map out the sources of industrial wastewaters. It is an important part of the risk assessment of the water utility and supports justification for preparing industrial wastewater contracts.
The following data and measures can be used when mapping out sources: environmental permits, previous wastewater analyses, water consumptions, taking sewer samples and samples of sediments and sewer biofilm, tacit knowledge of local environmental authorities and water utility personnel.
Water utilities should prioritise operators based on their loading and potential risk. Industrial wastewater contracts are concluded according to prioritising order.
Before starting negotiations, it is recommended to draft a contractual basis which will be used with all operators and to decide which terms will be the same for all operators and which can be negotiated.
The following steps are recommended during the negotiation process: 1. Collecting data 2. Visiting the operator 3. Drafting of terms 4. Negotiations 5. Signing.

If the quality of the industrial wastewater has not been previously analysed, it should be sampled and analysed before the contract negotiations.
When drafting contractual terms, chemical lists and properties of chemicals used should be examined and BAT reference documents and BAT conclusions considered. Other water utilities or external experts can also be consulted.
Starting the negotiation process with a visit to the operator is highly recommended for facilitating negotiations and improving later cooperation.

4.2.1 Mapping out sources of industrial wastewater

The need for drawing up industrial wastewater contracts should be assessed for all potential sources of industrial wastewaters. Mapping out potential sources of industrial wastewaters is an important part of risk assessment of water utilities and WWTPs. When the sources and characteristics of their wastewater are known and disturbances have been detected in the sewer or at the WWTP, potential sources of accidental leaks are limited and those operators can be contacted. In Finland, environmental permits of WWTPs usually include an obligation to be aware of sources of industrial wastewaters and to ensure sufficient pretreatment of industrial wastewaters.

Mapping out potential sources of industrial loading from the sewer area may be difficult, especially if the sewer area is large. It is easier, however, to identify new industrial facilities and assess the need for an industrial wastewater contract when new operators make connection agreements.

Environmental permits and previous industrial wastewater analyses are an important source of information for water utilities. Potential producers of industrial wastewater can be listed by going over environmental permits of industrial facilities located in the sewer area. Cooperation and the exchange of information with local or regional environmental authorities is valuable in gathering information about local operators that might need industrial wastewater contracts. Environmental authorities may also know about operators that do not have environmental permits. Cooperation with environmental authorities is further discussed in Chapter 5.3. Also the tacit knowledge of water utilities and authorities on potentially significant sources of industrial loading should be utilised.

Operators that do not have environmental permits can be difficult to map out. One way is to go over water consumption in the area to find big consumers of water. Taking wastewater samples from different locations in the sewer system nearby potential sources of industrial wastewater, is one way to locate significant sources of industrial wastewater. Likewise, sampling of sediments (by sediment traps) and sewer biofilm (by traps consisting of a rubber sponge in a plastic tube) can be used to locate harmful effluents.

Once a list of potential sources of industrial wastewater has been prepared and the amount of loading and potential risks estimated, the operators should be prioritised by the following principles:

- Operators with the biggest wastewater loading (BOD, COD, P, N, solids)
- Operators whose industrial wastewater possibly contains harmful or hazardous substances
- Operators whose industrial wastewater may otherwise cause a risk to the operation of the water utility, the WWTP or to the environment

Industrial wastewater contracts should be concluded according to the prioritised order. During contract negotiations, companies often enquire about why they are especially required to negotiate an industrial wastewater contract. An important argument is that the company has been prioritised after systematic research of sources of industrial wastewaters.

4.2.2 Stages of making an industrial wastewater contract

Before starting the contract negotiations, it is advisable to draft a contractual basis to be used for all industrial wastewater contracts. In the contractual basis, the principles for all industrial wastewater contracts are set. A legally sound and well prepared contractual basis makes contract negotiations easier. The aim is to develop a contractual framework that can be used with all operators with minimal changes. It is recommended that operator-specific terms of

the contract (e.g. monitoring programme and limit values) are listed in the annexes of the contract, so that later changes can be made to the annexes instead of having to renegotiate the whole contract. The recommended contents of the contract are discussed in Chapter 4.4.

Drafting an industrial wastewater contract often starts the cooperation between an industrial operator and the water utility. The recommended first step of the process is to contact the operator and explain why their industrial wastewater is being assessed and why an industrial wastewater contract is necessary. Often, operators ask why they have been selected over other companies to make a contract. In such circumstances, it should be explained that contracts are also made with other major operators.

The second step is to gather and ask for necessary information and data. At least the following information is needed:

- Chemicals and hazardous substances used by the operator
- Water consumption and amount of industrial wastewater produced
- Connection agreement
- Environmental permit
- Analysis results for industrial wastewater quality
- Plant layout

When requesting information about the chemicals and hazardous substances used by the operator, the form published in FIWA (2018, Appendix 13) can be utilised.

Figure 4-1 shows the recommended stages of contract negotiations for an industrial wastewater contract. The negotiation process should be started with a visit to the industrial facility. The main objective of the visit is for the relevant personnel to get to know each other. Experience has shown that this facilitates subsequent contract negotiations and improves the later cooperation between the operator and the water utility. Another objective of the visit is to get to know in which processes wastewater is produced and which substances the wastewater may contain. The visit also allows the water utility to explain the principles of the industrial wastewater contract and both parties to express their views for starting the contract negotiations. Another advantage of the visit is that the water utility can share information on the potential impacts of industrial wastewater on WWTP processes, sewer network and the environment (hazardous substances).

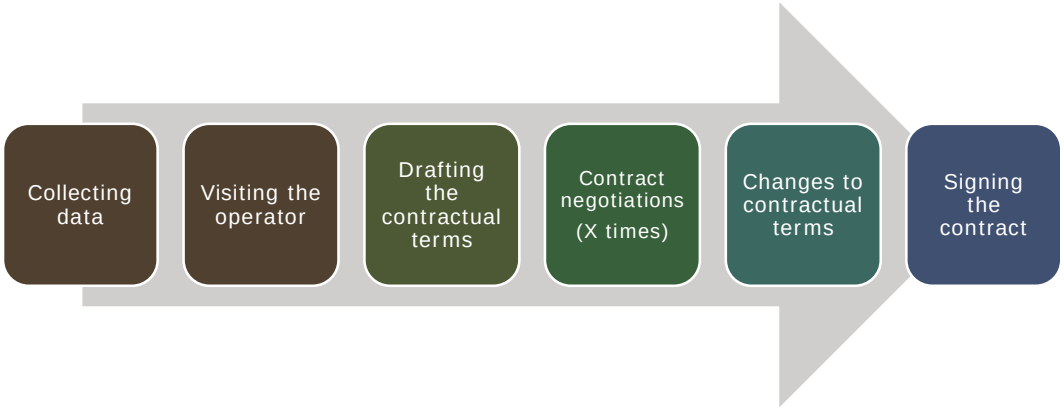

Figure 4-1 Contract negotiations for an industrial wastewater contract.

In some cases, after the visit and obtaining the necessary information, it is possible to conclude that an industrial wastewater contract is not necessary.

After the visit, the terms of the contract are drafted. The terms need to be considered case specifically, taking into account the views of both parties. At this point, chemical lists and properties of chemicals used should be examined in detail. Also BAT reference documents and BAT conclusions are recommended to be used while considering the terms (e.g. monitoring programme and limit values). Other water utilities or external experts can be consulted when drafting the contractual terms. The recommended contents of an industrial wastewater agreement is discussed in Chapter 4.4. If the quality of the industrial wastewater has not been previously analysed, it should be sampled and analysed before the contract negotiations.

The purpose of contract negotiations is to go over the contents of the industrial wastewater contract, which the water utility delivers before the meeting. Before starting the negotiations, the water utility should have clear principles about which terms may be negotiated and every term of the contract should be properly justified. Several contract negotiations may be needed for solving complex cases. When both contracting parties are satisfied with the terms, the contract and its annexes are signed. If annexes are updated separately from the main contract, annexes must be confirmed with new signatures.

4.3 Updating existing contracts

SUMMARY OF RECOMMENDATIONS
Contracting parties need to negotiate changing existing contracts. An argument for updating a contract could be e.g. changes in legislation or in the operations of either of the parties or significant changes in other conditions compared to the original moment of signing.
New contracts need to include specific terms for changing the contractual terms. It is recommended to set new contracts for a limited time period.

In some cases, an old industrial wastewater contract is outdated but binds the water utility to continue receiving industrial wastewaters that cause harm to the sewer or the WWTP. If the old contract does not include terms about changing the contract, it can be difficult to terminate the contract.

If there is a need for updating an existing contract, contracting parties may negotiate it. The party that wants to update the contact should have convincing arguments such as changes in legislation or in the operations of either of the parties, or significant changes in other conditions compared to the original moment of signing. Updating the contract can also be a requirement in the environmental permit of the operator.

In principle, contracts are legally binding and the general rule is that contracts and conditions agreed on in those contracts bind the parties. The parties do not have the unilateral right to change the contract unless it has been agreed on. The threshold for unilateral modification is high. Conditions for unilaterally changing the contract or a specific condition in it can be, for example invalidity (e.g. a mistake), excess of a condition or an insuperable hindrance (force majeure). Ultimately these situations are resolved in court.

To prevent situations where an old contract binds the water utility to receive industrial wastewaters from an operator but the contract cannot be updated, the contract should be valid only for a limited period of time and/or include specific terms for changing the contractual terms. Recommendations for such terms are given in Chapter 4.4.7.

4.4 Contents of an industrial wastewater contract

4.4.1 Contracting parties

SUMMARY OF RECOMMENDATIONS
On the industry side, the contracting party can either be the operator or the property owner. The contracting party shall be selected case-by-case.
On the water utility side, the contracting party is the water utility that owns the sewer to which industrial wastewaters are conveyed. If the WWTP is owned by a separate water utility, the representatives of the WWTP have to be included in drafting the contractual terms and in the negotiation process.

The initiative for drawing up an industrial wastewater contract comes typically from the water utility or from the WWTP. As a general rule, industrial wastewater contracts need to made with operators or properties that produce industrial wastewaters and cause significant BOD, COD, nitrogen, phosphorus or suspended solids loading, or that have caused or are likely to cause harm to the water utility or WWTP (e.g. based on industrial activities or the sector of industry).

For the industry, the contracting party can be either the operator or the property owner. The contracting party shall be selected case-by-case. If the property has different types of activities and several tenants that produce industrial wastewaters, the contracting party should be the property owner. In this case, the property owner is responsible for the operations of the tenants corresponding to the terms of the industrial wastewater contract. If there is only one main tenant that produces industrial wastewaters, the contracting party should be the tenant. The property owner needs to be notified of the starting of contract negotiations and the final contract needs to be sent to the property owner for information.

The other contracting party is the water utility that owns the sewer to which industrial wastewaters are conducted. If the WWTP is owned by a separate water utility, cooperation between the sewer owning water utility and the WWTP is important during the negotiation process. Several contractual terms are related to the WWTP. Thus, the representatives of the WWTP have to be consulted when drafting the contractual terms and during negotiations. For ensuring that the operation of the WWTP is considered sufficiently, the WWTP can be a third negotiating and signing party of the contract.

4.4.2 Terms for monitoring programmes

SUMMARY OF RECOMMENDATIONS
Sampling procedures and the extent of analyses are agreed upon in the monitoring programmes. The contents of a monitoring programmes have to be considered case specifically according to the amount and quality of the wastewater and the pollutants and hazardous substances potentially ending up in the wastewater. See Chapter 2.5.2 for the guidelines on defining the contents of a monitoring programme.
Industrial wastewater contracts should include the clause that the water utility has the right to change the monitoring programme with justified reasons.
The water utility needs to have the right to inspect the operator's pretreatment, sampling and discharge arrangements and take additional samples without prior notice. The right for visits and procedures for visiting the premises of the operator should be agreed upon in the contract.

One of the main parts of the industrial wastewater contract is to agree on a monitoring programme. The target of the monitoring programme is to identify typical wastewater quality of the operator during normal operations and loading/pollution peaks and to detect violations of the contractual terms.

The contents of a monitoring programme have to be considered case specifically according to the amount and quality of the wastewater and the pollutants and hazardous substances potentially ending up in the wastewater. See Chapter 2.5.2 for the guidelines on defining the contents of a monitoring programme.

Requirements should always depend on the wastewater quality and quantity, not the size of an operator. Subsidising small operators through easier contractual terms or channelling the funds of the water utility should be avoided, because it is important that the water utility does not distort competition between companies. Furthermore, it is hard to define which operators can be defined as "small operators" that are allowed to get subsidies or easier terms.

Certain terms should be stated in industrial wastewater contracts as follows:

- The operator is responsible for the costs of monitoring and is obligated to arrange the space and the equipment needed to get representative samples of the industrial wastewaters.
- The water utility has the right to change the monitoring programme. It is advisable to include the monitoring programme in an annex so that it can be changed without changing the contract. The water utility must have justified reasons for changing the terms.
- Monitoring samples are taken and analysed by an external certified and independent party (i.e. a laboratory)

- The water utility has the right to take additional samples at its own expense, to carry out spot checks in order to ensure the representativeness of samples taken according to the monitoring programme.
- The water utility has the right to inspect the operator's pretreatment, sampling and discharge arrangements for industrial wastewater. The right for visits and procedures for visiting the premises of the operator should be agreed in the contract. Often the operators need to be notified in advance but the notification should come no earlier than the day before. In some cases, operators may demand a confidentiality or non-disclosure agreement (CA, NDA) to be signed before entering the premises.

4.4.3 Terms for limit values

SUMMARY OF RECOMMENDATIONS
Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators in the same industry. See Chapter 2.5.3 for the guidelines on defining the limit values for the quality and quantity of industrial wastewater.
It should be stated in industrial wastewater contracts that the diluting of industrial wastewaters is prohibited for the purpose of avoiding the exceeding of concentration limits.
Limit values for nitrification inhibition are recommended to be set in industrial wastewater contracts.

Guidelines on defining limit values are given in Chapter 2.5.3. Limit values must be defined in the industrial wastewater contract if the operator does not have an environmental permit or if the conditions of the environmental permit are not sufficient for protecting the operation of the WWTP and the sewer. Certain aspects are introduced in this chapter that should be taken into account when the limit values are defined in industrial wastewater contracts.

Equal limit values and restrictions on the quality or the amount of industrial wastewater should be given to operators in the same industry and in the same sewer area. However, features of each operator should also be considered when setting limit values and restrictions. Before contract negotiations, it should be decided which limit values are the same for all operators and which have room for negotiation.

Sufficient time should be given to the operator to design and construct the pretreatment, equalisation or other sufficient measures if the operator is unable to meet the given limit values, unless the substance in question poses immediate danger to the water utility and the WWTP. A deadline should therefore be given by which the limit values need to be met. Before this deadline, no penalty will be given to the operator.

Limit values for the concentrations of BOD, COD, nitrogen, phosphorus and suspended solids, (in mg/l) are included in the formulas of increased wastewater fees (see Chapter 4.4.4). The load of organic matter and nutrients (in kg/d) is usually more relevant for WWTPs than concentrations. Therefore, loading limits for these parameters are recommended in addition to concentration limits.

It should be stated in industrial wastewater contracts that the diluting of industrial wastewaters is prohibited for the purpose of avoiding the exceeding of concentration limits. Especially, if diluting is suspected, it is recommended to use loading limits (kg/d or g/d) in addition to concentration limits (mg/l).

In addition to concentration and loading limits of certain substances, a limit value for nitrification inhibition is recommended for all industrial wastewater contracts to estimate the impact of the industrial wastewater on the nitrogen oxidising bacteria of the WWTP. The limit value should be set even if testing nitrification inhibition is not included in the monitoring programme. This way, nitrification inhibition can be analysed if needed and the test results can be compared to the limit value. The contract may specify that when the limit value is exceeded, the operator must (within a certain time) determine which substances in the industrial wastewater may cause nitrification inhibition and reduce emissions of these relevant substances so that nitrification inhibition stays below the limit values.

The limit values for nitrification inhibition published by the Swedish Water & Wastewater Association (Svenskt Vatten) and the Danish Environmental Protection Agency are listed below in Table 4-1. The nitrification inhibition of industrial wastewater or a chemical can be determined by laboratory tests according to ISO 9509:2006. It is recommended to use activated sludge from the receiving WWTP if possible.

Table 4-1 Limit values for nitrification inhibition used in Sweden (Svenskt Vatten, 2019) and in Denmark (Danish Environmental Protection Agency, 2006).

Concentration of industrial wastewater in the sample	Nitrification inhibition may not exceed following limit values
20% industrial wastewater (Sweden)	20%
40% industrial wastewater (Sweden)	50%
200 ml/l industrial wastewater (Denmark)	20% (guiding limit)
	50%

4.4.4 Wastewater fees for industrial wastewater

SUMMARY OF RECOMMENDATIONS
Increased industrial wastewater fees are usually used for covering increased treatment costs caused by industrial wastewaters. National calculation formulas are highly recommended to be determined in all BSR countries.
Increased wastewater fees are typically charged based on the quality of the industrial wastewater compared to the quality of domestic wastewater. It is recommended to determine the fee for the parameters the WWTP is designed for (BOD, COD, nitrogen, phosphorus, solids).
Industrial wastewater fees can be formulated to include capital costs of WWTP. This is recommended especially if a single operator accounts for a major proportion of the WWTP's design load.

The polluter pays principle should be implemented in industrial wastewater contracts or through legislation. Thus, households would not pay for increased treatment costs caused by industrial wastewaters through their wastewater fees. Increased industrial wastewater fees ensure fair and justified division of increased investment and operation costs of the WWTP.

By the increased wastewater fee, an operator is motivated to improve pretreatment of its industrial wastewaters and to reduce pollution loading to the WWTP. In Germany and Denmark, national effluent/environmental taxes are used as economic incentive to avoid or reduce harmful discharges into the sewer.

Increased wastewater fees can be charged based on the quality of the industrial wastewater, for the substances and parameters for which the treatment plant is designed and which the plant is capable of receiving (BOD, COD, nitrogen, phosphorus, solids). The quality of industrial wastewater is compared to the quality of domestic wastewater to define the amount of the fee. The increased part of the wastewater fee should be directed to the party responsible for WWTP operation and investments for covering the costs of the treatment of industrial wastewater.

Increased wastewater fees are calculated based on calculation formulas, which can be nationally applied. National calculation formulas are applied e.g. in Latvia, Finland and Sweden. An example on how the fee can be calculated can be found in the Finnish Industrial Wastewater Guide (FIWA 2018, p. 33), which is available online in English.

If the industrial loads are beneficial to the WWTP, such as readily biodegradable carbon to a WWTP needing external carbon for nitrogen removal, compensation can be given on the wastewater fee for cost savings.

If a single operator accounts for a major proportion of the WWTP's design load, the contractual terms must be considered case specifically. It is recommended to obligate the operator to contribute to investment costs for increasing the plant's capacity. This can be done either by direct investment or by adding a capital cost element to the tariff calculation formula e.g. on the basis of the share of the maximum allowed load from the operator vs. total dimensioning load of the WWTP. It is possible, to a certain degree, to distinguish between expansion and rehabilitation costs and assign different capital and operational cost weights to various load factors (e.g. BOD load, total N load) in the tariff formula. It is important to avoid a situation where the water utility is de facto investing on behalf of the operator without getting any investment expenses covered by the operator.

4.4.5 Notification obligation and cooperation

SUMMARY OF RECOMMENDATIONS
The operator must immediately inform the water utility on exceptional emissions and any other unusual situations affecting the quality or amount of wastewater. Notification obligation should be stated in the contract.
The operator and the water utility are recommended to have regular contacts, especially when either party is planning changes in their operations. Yearly meetings are recommended.
It is recommended to include an annex in the contract that lists contact information of both contracting parties.

The operator must immediately inform the water utility on exceptional and emergency situations and on process disturbances and any other unusual situations affecting the quality or amount of wastewater (pollutant emissions into the sewer network). The water utility may then act by e.g. isolating the activated sludge process before the emission reaches the WWTP. Notification obligation should be stated in the contract.

Operators should report about planned changes to the operations in advance, so that the contract parties can assess any effects the change may have on wastewater quality prior the change in cooperation. Respectively, the water utility would inform the operator on disruptions and changes that have an effect on the operator's activities as early as possible. It is recommended to include an annex in the contract that lists contact information, which needs to be kept up-to-date according to procedures described in the contract.

It is recommended to include a chapter in the industrial wastewater contract on cooperation, for instance setting up yearly meetings between the contracting parties. Recommendations for cooperation procedures between a water utility and an operator are given in Chapter 5.2.

4.4.6 Violations of contractual terms, illicit releases and liability

SUMMARY OF RECOMMENDATIONS
Contract term violations can be detected by wastewater samples taken according to monitoring programme or by additional samples carried out by the water utility or the environmental authorities.
The consequences for violating contractual terms need to be defined in the contract. A penalty clause is strongly recommended for all contracts.
The fine needs to be substantial so that it steers the activities of the operator. The fine should not however be so high that it threatens the operator with bankruptcy and is thus unreasonable. Minimum and maximum sums can be set for the fine if necessary.
The penalty clause should be the same in all contracts so that operators are treated equally. When considering the size of an operator the fine can be tied to the amount of wastewater, to the wastewater fee or to business revenue.
The contract should obligate the operator to be liable for any harm or damage caused by the industrial wastewaters, including any additional maintenance costs.

To ease cooperation between contracting parties, it can be agreed that the water utility will not demand sanctions according to the penalty clause if the operator fulfils the terms of notification obligation and the accidental release is not recurrent.

Typically, contract violation comes from exceeding the limit values or from repeatedly causing undesirable effects to the sewer or the WWTP. These violations can be identified by the wastewater samples taken according to the monitoring programme or by additional samples carried out by the water utility or environmental authorities.

Illicit releases can be traced at pumping stations e.g. for emission of solids, oils or fats. The source of a release can also be traced by taking samples from the sewers e.g. from pumping stations, which helps the water utility to delimit the sources to a certain sewer area. In Germany, emissions of toxic substances have been traced by analysing the sewer biofilm, which helps localise the source of the illicit release in the network.

The consequences for violating contractual terms need to be defined in the industrial wastewater contract. A penalty clause is strongly recommended for all industrial wastewater contracts. The fine needs to be substantial so that it steers the activities of the operator. The fine should not however be so high that it threatens the operator with bankruptcy and is thus unreasonable. Minimum and maximum sums can be set for the fine if necessary.

To ensure equal treatment to all operators, the penalty clause should be the same in all contracts. Therefore, it is advisable to tie the fine to the amount of wastewater, to the wastewater fee or to the size of the operator (e.g. business revenue). The fine could be defined e.g. according to one of these principles:

- A percentage of the previous year's wastewater fee (e.g. 50%)
- A percentage of the operator's revenue (e.g. 2%)
- A progressive fine (e.g. the fine increases each time the same violation is repeated)

Warsaw Municipal Water and Sewage Management Company has applied a sophisticated system of contractual penalties where penalty rates differ according to the substance and the degree of exceeding the permissible concentration (Table 4-2) (Maśliński et al. 2019).

In addition to the penalty clause, the contract should obligate the operator to be liable for any harm or damage caused by the industrial wastewaters, including any additional maintenance costs. This, however, places the burden of proof on the water utility.

In order to not discourage operators from notifying about accidental releases, it can be stated in the contract that the water utility will not demand sanctions according to the penalty clause if the operator fulfils the terms of notification obligation and the accidental release is not recurrent. The operator is still responsible for covering the costs of any damage caused or increased maintenance and operating costs.

However, paying sanctions must not be an option for taking care of industrial wastewaters and preventing illicit releases, especially when it comes to hazardous substances. Termination of the contract is discussed in the next chapter. A timeline for fixing the cause of an illicit release must be given when sanctions or a claim for damage are demanded.

Table 4-2 System of contractual penalties for exceeding permissable concentrations used by the Warsaw Municipal Water and Sewage Management Company. The penalty rates are given per unit of pollutant load of industrial wastewater introduced into the sewer network per day. (Maśliński et al. 2019)

Indicator	1st degree of exceedance	Penalty rate [PLN]	2nd degree of exceedance	Penalty rate [PLN]	3rd degree of exceedance	Penalty rate [PLN]
Temperature [°C]	less than 5°C	0.20	5°C or more	1.20		
Reaction [pH]	less than 0.5	1.20	0.5-1.5	3.60	> 1.5	7.20
BOD5 [mgO2/l]	700.0001 - 1000	2.40	1000.0001 -1500	4.80	> 1500	12.00
COD [mgO2/l]	1000.0001 - 2000	1.60	2000.0001 -4000	3.20	> 4000	8.00
Total nitrogen [mgN/l]	220.0001 - 250	2.40	250.0001 - 280	4.80	> 280	12.00
Ammoniacal nitrogen [mgN/l]	200.0001 - 220	2.40	220.0001 - 250	4.80	> 250	12.00
Total phosphorus [mgP/l]	15.0001 - 20	2.40	20.0001 - 25	4.80	> 25	12.00
Total suspended solids [mg/l]	500.0001 - 600	1.50	600.0001 - 800	3.00	> 800	7.50
Petroleum ether extractables [mg/l]	100.0001-150	6.00	150.0001 - 200	12.00	> 200	30.00
Non-ionic surfactants [mg/l]	20.0001 - 30	8.00	30.0001 - 35	16.00	> 35	40.00
Anionic surfactants[mg/l]	15.0001 - 20	8.00	20.0001 - 25	16.00	> 25	40.00
Chlorides [mg/l]	1000.0001 -1200	0.80	1200.0001 -1600	1.60	> 1600	4.00
Sulphates [mg/l]	500.0001 - 600	0.80	600.0001 - 700	1.60	> 700	4.00
Lead [mgPb/l]	1.0001 - 1.5	66.00	1.5001 - 2.0	132.00	> 2.0	330.00
Copper [mgCu/l]	1.0001 - 2.0	66.00	2.0001 - 3.0	132.00	> 3.0	330.00
Zinc [mgZn/l]	5.0001 - 8.0	66.00	8.0001 - 10.0	132.00	> 10.0	330.00
Cadmium [mgCd/l]	0.4001 - 0.6	66.00	0.6001 - 0.8	132.00	> 0.8	330.00
Total chromium [mgCr/l]	1.0001 -2.0	12.80	2.0001 - 3.0	25.60	> 3.0	64.00
Chromium+6 [mgCr/l]	0.2001 - 0.3	66.00	0.3001 - 0.5	132.00	> 0.5	330.00
Nickel [mgNi/l]	1.0001 - 2.5	54.00	2.5001 - 3.5	108.00	> 3.5	270.00
Iron [mgFe/l]	10.0001 - 20.0	1.60	20.0001 - 50.0	3.20	> 50.0	8.00
Free cyanides [mg/l]	0.5001 - 1.0	400.00	1.0001 - 2.0	800.00	> 2.0	1600.00
Complex cyanides [mg/l]	5.0001 - 10.0	40.00	10.0001 - 20.0	80.00	> 20.0	200.00
Petroleum hydrocarbons [mg/l]	15.0001- 20.0	6.00	20.0001 - 40.0	12.00	> 40.0	30.00
Mercury [mg/l]	0.1001 - 0.5	66.0	0.5001 - 0.8	132.00	> 0.8	330.00

4.4.7 Termination of the contract and changes to contractual terms

SUMMARY OF RECOMMENDATIONS
It is recommended to set new contracts for a limited duration (e.g. 2–5 years). If a contract is set to be valid until further notice, it needs to include specific terms for changing the contractual terms and for terminating the contract.
The contract needs to state clearly the terms for terminating the contract. In addition, a water utility must have the right to cut off the discharge of industrial wastewater to the municipal sewer to avoid immediate danger to the network or treatment plant.

If the activity is new, or the quality and quantity of industrial wastewaters are unclear, the contract should be set for a fixed period of time (e.g. 2–5 years), after which the terms of the contract would be revised. Contracts valid for limited duration are recommended. However, it is recognised that the prospect of changing contract conditions in the foreseeable future may lower the interest of companies in investing in that location.

If the contract is set to be valid until further notice, specific terms need to be defined in the contract for changing the contractual terms. These terms need to include:

- Changes in legislation
- Changes in the environmental permit conditions for the WWTP

- Changes in requirements from the authorities
- Non-compliance with contractual terms and endangering the operation of the WWTP or the sewer network
- Cchanges in the activities of the operator and wastewater quality
- New findings about causing harm or danger to the water utility or to the WWTP

The contract needs to state clearly the terms for terminating the contract. First, the contract should state that the operator is allowed to convey industrial wastewaters to the sewer network and to the WWTP within the scope of the contract. Without a valid contract, the operator is not allowed to convey industrial wastewaters to the sewer network of the water utility. Secondly, the contract should list the conditions for terminating the contract:

- If the industrial wastewater causes imminent danger or serious harm (immediate termination)
- If the contractual terms are violated repeatedly, and a written notice has been given to the operator with reasonable time to rectify the situation
- The operator has a right to terminate the contract after a period of notice, which has to be specified case specifically based on the significance of the operator to the WWTP (e.g. one month for small operators)
- The water utility must be able to terminate the contract after a sufficiently long period of notice (e.g. 12 months), so that the water utility is not bound to indefinite contracts

Terminating the contact means that industrial wastewater can no longer be conveyed to the sewer, which in practice may mean blocking the sewer if considered necessary. However, there is a risk that the operator can make a claim for damages caused by e.g. lost profit, and sue the water utility. Additional conditions for cutting off industrial wastewater discharge into the sewer is recommended to be included in the contract for the worst cases where the operation of the water utility or WWTP or working safety is immediately endangered. Thus, a clear contractual clause and related procedures (e.g. notice) also need to be stated in the contract. In addition, evidence of the violation of contractual terms must be clear.

4.4.8 Publicity vs. confidentiality of the contracts

SUMMARY OF RECOMMENDATIONS
Annexes or sections of a contract containing the operator's business secrets may be marked as confidential but it is not recommended to set the whole contract as confidential.
Keeping contracts public has many advantages for both the water utility and the operator, such as comparing contractual terms and sharing good practice.

Confidential sections of the contract need to be specified. Annexes or sections of the contract containing business secrets may be marked as confidential. The reasons for marking a section of the contract as confidential should be mentioned in the contract. It is also important to understand the difference between confidentiality and secrecy obligation. It is preferred to use secrecy obligation.

Not classifying industrial wastewater contracts as confidential may have several advantages for both parties. Publicity gives water utilities the chance to compare contracts and share good practice. Thus, harmonising industrial wastewater contractual terms helps water utilities to justify the terms to operators, and operators to compare contractual terms between other operators in the same industry. This calls for water utilities to treat operators equally. Public contracts also guide the water utility to make contracts with all similar companies within the sewer area, as opposed to focusing on just a single operator.

Industrial wastewater contracts can also contain a section that allows both the water utility and the operator to publish the names of the contracting parties and also to mention good accordance to the terms of the contract in their annual reporting. This option and its benefits are further discussed in Chapter 5.2.

Contracts classified as confidential may need to be sent to other parties, such as the property owner, environmental authorities, other water utilities (operators of a WWTP or sewer network) or an external expert, such as a consultant helping the water utility. In these cases, the parties to whom the contract can be sent need to be agreed in the contract. If confidential contracts are sent to environmental authorities, the contracts may come under publicity law, depending on national legislation. This would mean the contracts become public documents.

The right of access to documents also depends on the ownership form of the water utility. For municipal water utilities, the right of access to documents is more open than for water utility companies.

5 Guidelines for cooperation

5.1 General

Lack of cooperation between water utilities, industrial operators and environmental authorities is a general problem related to industrial wastewater management in the Baltic Sea Region (Figure 5-1). Sharing and providing information about industrial wastewaters not only to industrial operators but also to the public is important in raising awareness of the possible challenges caused by industrial wastewaters. Between the water utility and the operator, cooperation is crucial for sharing information from both sides.

Figure 5-1 For best results of industrial wastewater management, cooperation is needed between industry (operator), environmental authorities and WWTPs (and water utilities/sewer owners) (BEST project).

5.2 Cooperation between the water utility and operator

5.2.1 Advantages of cooperation

SUMMARY OF RECOMMENDATIONS
Cooperation is needed between the water utility and the operator to share information. Good cooperation means that the operator gives early warnings of exceptional discharges and the water utility can share information about the effects of industrial wastewater on the sewers and the WWTP. Contract negotiation is the key moment for laying foundations for continuous further cooperation. The negotiation process should start with a visit to operator's facilities.
Industrial wastewater contracts should include a chapter on cooperation and an obligation to set up yearly meetings between the contracting parties. In these meetings, possible process changes and the monitoring results from the previous year would be discussed and any necessary changes to the annexes of the contract could be made.
The yearly meetings could be combined with the inspection by environmental authorities. Inviting operators for a guided tour on the WWTP is recommended.

Public image is increasingly important to many companies and today many operators emphasise environmental sustainability in their communications and marketing. Many operators also strive to be responsible and want to manage their wastewaters well. In cooperation with the water utility, the operator gets more information on industrial wastewater management and how any possible problems can be solved.

For the water utility, the main advantage of cooperation is in building trust with the operator. Trust increases the amount of information shared between the operator and the water utility. The goal of cooperation is for the water utility to be able to get early warnings of exceptional discharges and to give instructions to the operator. In good cooperation, the operator would share information on planned activities such as operational shutdowns, start-ups, maintenance activities and new investments.

Industrial customers are often an important customer segment of water utilities. Thus, water utilities should make the effort to improve customer relationships and services especially with the industrial clients.

The industrial wastewater contract should include a chapter on cooperation. It is recommended for the contracting parties to have yearly face-to-face meetings and maintain the cooperation built during the contract negotiations. This practice should be defined in the industrial wastewater contract and a timing (a month) should be selected for the yearly meeting. In the meeting, the monitoring results from the previous year would be discussed and any necessary changes to the annexes of the contract could be made. It is recommended that not only the management level but also the workers join the meeting so that the personnel communicating e.g. on emission disturbances can meet. For saving limited resources of especially small companies, the yearly meeting could be combined with the inspection of environmental authorities. Operators could be invited for a guided tour of the WWTP while explaining the possible effects of industrial wastewaters on WWTP processes.

5.2.2 Forms of cooperation between the water utility and operator

SUMMARY OF RECOMMENDATIONS
Different kinds of cooperation for the co-treatment of industrial wastewaters can be applied depending on the extent of the operator's loading to the WWTP and local conditions. The most suitable form of cooperation should always be considered case specifically. A mutually beneficial solution can usually be found.
Different kinds of cooperation can also be found for the pretreatment of industrial wastewater. In some cases, the best solution for pretreatment of industrial wastewater might be to have industrial wastewaters pretreated on the site of the municipal WWTP or personnel of the WWTP operate the industrial wastewater facility.

Co-treatment of industrial wastewaters can be arranged in various ways through cooperation between a water utility and an operator. Four principal options for administrative arrangement of co-treatment can be identified:

1) WWTP owned by a water utility (one or more municipalities)
2) WWTP owned jointly by a water utility (municipality/municipalities) and operator(s) through e.g. a jointly owned stock company
3) WWTP owned by a third party (not a water utility or operator)
4) WWTP owned by an operator

These four options include sub-options where e.g. the WWTP is owned by a municipality but operated by a third party, such as a limited liability company, through concession or other contractual arrangement. The municipal ownership can also take many forms, e.g. a public utility company or a public limited liability corporation. In any case, direct investments for capacity increase or major renovations are usually made by the party who owns the assets and billed from the non-owner customers.

Option 1 (with its various sub-options) is the most common one in the BSR. In this case, capital and operational costs are usually included in the wastewater fee billed from the operator (see Chapter 4.4.4). The capital cost part of the tariff can be determined e.g. on the basis of the share of the maximum allowed load from the operator vs. total dimensioning load

of the WWTP. Direct investment from the operator's side is also possible, but not often applied.

Examples of Option 2 are found around BSR. In jointly owned WWTP companies, the owners can contribute to the investments in proportion to ownership or recorded loading or through tariffs in the same way as in Option 1.

Option 3 is very rare in the BSR, however, it is applied in e.g. Tallinn. Option 4 is also uncommon but a few examples exist. These are usually such cases where the domestic wastewater flow and load is significantly lower than the industrial one, e.g. in the case of a small or medium-sized town and a large forest industry facility with its own WWTP. Despite benefits of such arrangements, such as the creation of an optimal organics to nutrient (BOD/N) ratio in the wastewater to be treated, industries are usually reluctant to allow domestic wastewater into their treatment plants. This is mostly because of issues with e.g. environmental responsibilities and effects on sludge treatment.

Different kinds of cooperation models on the pretreatment of industrial wastewater are used in BSR. In some cases, like in Riihimäki (Finland) and in Rheda-Wiedenbrück (Germany), the operator's industrial wastewater is pretreated on the site of the municipal WWTP. Another option is that the industrial pretreatment facility would be operated by the staff from the municipal WWTP like in Falkenberg (Sweden), in Bremen (Germany) and in several places in Poland. These kinds of cooperation models are good examples of finding solutions that would benefit both sides.

5.2.3 Information sharing

SUMMARY OF RECOMMENDATIONS
It is recommended for the water utility to publish an annual or periodic report on industrial wastewater to share information and improve transparency. Information about industrial wastewaters and best practice should be shared on water utilities' web pages.
Good compliance with contractual terms could be highlighted in the annual report with the names of the operators, if permissions have been granted.
Water utilities should publish guidelines about best practice addressed to certain industries.

It is advisable for the water utility to publish an annual or periodic report on industrial wastewater either as part of annual reporting or as a separate report. The report may include information on e.g. trends in industrial loads, any damage to the WWTP or the sewer network, development projects related to industrial wastewater, network sampling results and industrial wastewater monitoring results. The report will improve transparency of the water utility towards its customers. This type of reporting has been done, for example, in the Helsinki Metropolitan Area by HSY (Helsinki Region Environmental Services Authority).

If agreed with an operator in the industrial wastewater contract (see Chapter 4.4.8) or otherwise agreed (NB written permission required), the report could include the names of the operators and/or mention the operators whose wastewater quality has been in accordance with their contractual terms during the year. The report could also highlight good examples of projects that have reduced industrial wastewater discharges. This would encourage companies to manage their obligations related to industrial wastewaters well and also to allow companies to refer to the report in their own communications. In this way, industrial wastewater contracts would work almost like a certificate or a quality assurance system.

However, reporting should refrain from naming companies that have not complied with their contractual terms because this would have a detrimental effect on cooperation. Listing companies in a negative light also has the risk of legal action on the basis of damages and loss of earnings caused by negative publicity. Should the water utility decide to highlight the name of the company in a negative tone, the permission for publishing the name of the company in the reporting of the water utility must be recorded in the industrial wastewater contract.

A water utility is not able to prepare industrial wastewater contracts with every company and industrial operator, especially with the smallest ones. Those companies may still have an effect on the sewer and the WWTP. Thus, a water utility should attempt to improve the situation by sharing information and giving guidance to different sectors. For example, the water utility company of Käppala, Sweden has published several different guidelines e.g. for chemical storing, paint shops and car washes. In the Helsinki Metropolitan area, HSY makes regular visits to petrol stations to inspect the operation of separators and to give guidance on how to maintain separators correctly. HSY also sends letters to the restaurants which are suspected of causing fat blockages in the sewer.

Furthermore, increasing awareness of industrial wastewaters would be important for both water utilities and industry. Information for industrial clients can be shared on the water utilities' web pages. Parent organisations of industrial operators may also invite a representative of a water utility to their seminars for sharing information about the effects of industrial wastewaters.

5.3 Cooperation between the water utility and environmental authorities

SUMMARY OF RECOMMENDATIONS
Water utilities and environmental authorities can benefit from sharing information and consulting each other, especially when negotiating industrial wastewater contracts and permits, and thus cooperation should be developed.
The terms of environmental permits and industrial wastewater contracts should be harmonised. It is recommended to send the contracts to environmental authorities.
Water utilities and WWTPs should have their opinions requested in the permitting process for the operators that produce industrial wastewaters. Water utilities should consult authorities when drafting a contract proposal.
Regular (at least yearly) meetings between the water utility and the environmental authorities are strongly recommended.
A shared database for monitoring industrial wastewaters is recommended.

Cooperation and trust between environmental authorities and water utilities should also be constantly improved. Environmental authorities may not have sufficient technical knowledge and awareness of issues related to the co-treatment of municipal and industrial wastewater. On the other hand, authorities may have better knowledge about environmentally hazardous substances than water utilities. Increasing cooperation between water utilities and environmental authorities on a national (e.g. through national water utilities associations), regional and local level is an important solution for regulating industrial wastewaters in environmental permits.

The relationship between water utility and environmental authorities should be about consulting each other and sharing information. Water utilities benefit from consulting environmental authorities e.g. when drafting the limit values and monitoring programmes in industrial wastewater contracts. Consulting of environmental authorities is therefore recommended during the contract negotiations. However, environmental authorities cannot interfere with the contents of the contract but only give guidance because an industrial wastewater contract is based on private law. Thus, authorities should not participate in contract negotiations.

However, it is recommended to invite environmental and chemical authorities to take part in the visit at the beginning of the negotiation process for an industrial wastewater contract. Thus, the operation of an industrial facility is considered from different perspectives, information is exchanged and time is saved when inspection visits of different authorities could be combined in one visit. In addition, harmonising the terms of the environmental permit and the industrial wastewater contract could be discussed during the negotiation process. Harmonisation of the terms is important for clarifying demands because discrepancies between the permit and contract might be challenging and confusing to the operator.

The demands of water utilities and WWTPs should be considered during the environmental permitting process. Environmental authorities may not always be able to consider what impact industrial operators could have on the sewer and to the WWTP. Water utilities and WWTPs should therefore have their opinion requested regarding the permit applications of operators that produce industrial wastewater at the beginning of the permitting process. Water utilities should also get information about new permit applications or ongoing permitting processes from the authorities.

It is recommended to send the industrial wastewater contracts to environmental authorities for the purpose of increasing their awareness about industrial wastewaters. This is helpful in giving the authorities references on limit values and restrictions for different types of industrial operators, so that requirements between environmental permits and industrial wastewater contracts can be harmonised.

Cooperation with environmental authorities is helpful when the water utility is mapping out sources (see Chapter 4.2.1) of industrial wastewater because authorities often have information and tacit knowledge also about industrial facilities which do not have an environmental permit. Authorities can be helpful in the prioritisation of operators that also need industrial wastewater contracts.

Regular (at least yearly) meetings between the water utility and the environmental authorities are strongly recommended. Meeting both local and regional environmental authorities is necessary for exchanging information on new industry in the sewer area, to review monitoring data on industrial wastewaters and for observations on the operations of industrial facilities and possible changes in their operation.

Similarly to environmental authorities, water utilities monitor the results of industrial wastewater samples. A shared database to which laboratories could directly download monitoring results would be a practical and helpful tool for enhancing control of monitoring data and thus recommended. The database would also be helpful to the operator if they had access to their own data. The given limit values could be entered into the database and wastewater quality trends could also be easily followed through the database. This kind of database is in use e.g. in Jyväskylä, Finland and in Käppala, Sweden.

5.4 Cooperation between water utilities

SUMMARY OF RECOMMENDATIONS
Water utilities should build cooperation practice so that information and experience of industrial wastewaters can be shared. A yearly seminar concentrating on industrial wastewaters is recommended.
It is recommended for all BSR countries to develop national guidelines in their national language(s) for controlling industrial wastewaters. Common guidelines help to harmonise the terms and restrictions set for industrial wastewaters on a national level.
Cooperation is especially needed between WWTPs and other water utilities in the same sewer area. Regular meetings are strongly recommended.

Information sharing between water utilities on industrial wastewater management is highly recommended. Cooperation practices between water utilities should be built so that people working with industrial wastewater would have more contacts to consult on the matter and ask for and give advice.

A recommended practice for improving cooperation between water utilities and WWTPs is to hold a yearly seminar concentrating on industrial wastewaters. Hosted by the national water utilities association, the seminar would focus on the challenges and solutions related to industrial wastewater. Water utilities could share what kind of problems they have encountered with industrial wastewaters and lessons learned and to give advice to others at the seminar.

It is recommended for all BSR countries to develop national guidelines in their national language for controlling industrial wastewaters. Experience from e.g. Germany, Sweden,

Finland and Denmark shows that common guidelines help to harmonise the terms and restrictions set for the discharge of industrial wastewaters into the sewer.

A national register of industrial polluters would also help water utilities to share information between each other and is thus recommended. In Germany, the register is maintained by WWTPs and the register includes data from each operator e.g. branch of industry, water consumption, material used, storage of ecologically harmful substances and pretreatment method.

Good cooperation is highlighted in areas with centralised WWTPs, where the sewer network is owned by separate water utilities or municipalities. In these situations, the WWTP and the owner of the network might have separate interests about the management of the industrial wastewaters. For example, a municipality may give an industrial facility the permission to discharge industrial wastewater into the sewer without any limit values, but the WWTP sees the quantity and/or quality of industrial wastewater as a risk for the operation of WWTP and demands limit values to be given. To avoid these kinds of conflicts, the following procedures are recommended:

1) Policies on the management of industrial wastewaters are agreed upon together, such as the content of industrial wastewater contracts and selecting the operators that require contracts
2) Regular meetings (at least yearly) between WWTP and the owner(s) of sewer network(s)
3) The WWTP is involved in the negotiating processes of industrial wastewater contracts.

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Annexes

Annex 1: Examples of substances to be investigated in industrial wastewater

This table is modified from Annex 16 of the Finnish Industrial Wastewater Guide (FIWA 2018).

Sector/industry	BOD	COD	N	P	SS	T	pH	Con-duc-tivity	SO_4	Metals	VOC	Oils	Fats	Hazardous substances	Other
Food industry															High BOD, solids, phosphorus and nitrogen concentration, and changes in the pH value are typical
Dairies	x	x	x	x	x		x						x		Online pH and T measurements if necessary
Slaughterhouses	x	x	x	x	x	x	x	x					x		Online pH and T measurements if necessary
Breweries	x	x	x	x	x		x								
Distilleries (spirits)	x	x	x	x	x		x	x							
Potato and vegetable processing plants	x	x	x	x	x		x								
Bakeries	x	x	x	x	x		x						x		Online pH and T measurements if necessary
Fish processing plants	x	x	x	x	x		x						x		Online pH and T measurements if necessary
Chemical industry														DEHP, HBCD, alkylphenols and their ethoxylates if necessary	
Paint and coating industry	x	x	x	x	x		x			x	x			Alkylphenols and their ethoxylates, DEHP, DBP and BBP	
Rubber industry	x	x	x	x	x		x			x	x	x		DEHP, DBP, MBeT, octylphenols and ethylenethiourea if necessary	
Explosives	x	x	x	x	x		x			x					
Pharmaceutical products	x	x	x	x	x		x	x			x			AOX and drug ingredient concentrations if necessary	
Enzyme production	x	x	x	x	x		x								
Sulphuric acid production							x	x	x	x					
Printing inks	x	x	x	x	x		x	x		x	x			Can be a source for phthalates	

Sector/industry	BOD	COD	N	P	SS	T	pH	Con-duc-tivity	SO_4	Metals	VOC	Oils	Fats	Hazardous substances	Other
Metal industry														Can be the release source especially for TBT, mercury, cadmium and nickel	Nitrification inhibition tests if necessary
Surface finishing plants					x		x			x	x	x		CN and zinc if necessary*	
Steel pickling plants					x		x	x		x					
Phosphating process plants	x	x	x	x	x		x	x		x	x	x			
Anodising plants	x	x	x	x	x		x	x	x	x					
Shipyards										x	x	x		TBT and TPHT if necessary	
Printing industry														Can be a source especially for DBP, cadmium, lead and zinc	
Offset	x	x	x	x			x	x		x					
Silk screen printing	x	x	x	x			x	x		x					
Forest industry															High BOD and COD concentrations are typical
Paper and pulp industry	x	x	x	x	x		x	x		x				AOX if necessary	
Textile and leather industry															
Textile (textile printing)	x	x	x	x	x		x	x		x	x			Organic substances and DEHP if necessary	
Leather (tanneries)	x	x	x	x	x		x	x	x	x				Cr and hexavalent chromium from metals. Organic hazardous substances if necessary	
Laundries	x	x	x	x	x		x	x						Alkylphenols and their ethoxylates, DEHP	
Manufacturing of mineral products															
Glassworks and fibreglass plants	x	x	x	x	x		x	x		x					
Concrete plants	x	x	x	x	x		x	x	x			x		Metals if necessary (coloured pavers)	
Traffic															
Airports	x	x	x	x	x		x	x		x				Alkylphenols and their ethoxylates, HBCD, PFOS	
Energy production					x		x			x		x		PAH compounds	

Sector/industry	BOD	COD	N	P	SS	T	pH	Con-duc-tivity	SO_4	Metals	VOC	Oils	Fats	Hazardous substances	Other
Waste management														TBT, PFOS, PBDE, phthalates (DEHP), alkylphenols and their ethoxylates if necessary	
Waste treatment plants/landfill	x	x	x	x	x		x	x		x	x			AOX and chloride concentrations if necessary	
Composting/Leachate	x	x	x	x	x		x	x		x				AOX and chloride concentrations if necessary	
Biogas plants	x	x	x	x	x		x	x		x	x			AOX and chloride concentrations, and alkalinity if necessary	
Services															
Hospitals	x	x	x	x	x		x	x		x	x			AOX and drug ingredient concentrations if necessary	
Car service stations	x	x	x	x	x		x	x		x	x	x		Alkylphenols and their ethoxylates if necessary	

Abbreviations:

AOX	Halogenated organic compounds
Alkylphenols and their ethoxylates	Nonylphenols and their ethoxylates, Octylphenols and their ethoxylates
CN	Cyanide
SS	Suspended solids
T	Temperature
TBT	Tributyltin
Oils	Mineral oils C_{10}-C_{40}
*	Galvanising plant

Annex 2: Key recommendations for Estonia

Challenges	Key recommendations	Responsible parties
Indirect industrial wastewaters are not considered in environmental permit conditions	Indirect release of substances into water is included in IED (2010/75/EU) and limit values and monitoring requirements must be given in permits. Permitting practices should be changed so that indirect industrial wastewaters are clearly considered.	Environmental Board
Although the permitting process is public, WWTPs are not always aware of industrial permits under consideration	Water utilities and WWTPs should be heard during the course of the permitting process, with enough time given for comments. This requires changes in permitting practices.	Environmental Board
Water utilities need more information for setting limit values (especially for harmful and hazardous substances) and monitoring programmes for industrial wastewater contracts	National industrial wastewater guidelines in Estonian would be an important tool for sharing information and to harmonise the terms (incl. limit values and monitoring) of contracts and permits.	Estonian Water Works Association
	Limit values for hazardous substances are discussed in Chapter 2.5.3 and Annex 1.	Ministry of the Environment, Water utilities, Industry
	Monitoring programmes are discussed in Chapters 2.5 and 4.4.2.	Supervising authorities, Water utilities, Industry
Violations of contracts	Notification obligation on accidental leaks, process disturbances and abnormal discharges should be stated in contracts. An operator will not be fined if the water utility has been notified about an accidental leak. Online monitoring of pH or conductivity and automatic alarms. Requirement for equalisation of industrial wastewater before it reaches the sewer. Improved risk management and contingency planning of both the industrial operators and the water utilities.	Water utilities, Industry

Annex 3: Key recommendations for Finland

Challenges	Key recommendations	Responsible parties
The roles of environmental permits and industrial wastewater contracts are unclear in managing industrial wastewaters	The role of industrial wastewater contracts in environmental permit practice/legislation should be clarified. A detailed analysis should be made discussing the following topics: – If the role of contracts is increased, do the environmental authorities have a right to supervise the contracts? – Can the authorities force water utilities to update old contracts? – What is the role of authorities during the negotiating process? – How to strengthen the role of contracts in national legislation. – Should water utilities be obligated to make contracts? – How to ensure sufficient resources and knowledge of water utilities.	FIWA and Ministry of the Environment
Small water utilities can struggle with local politics interfering with the management of industrial wastewaters	Transition from municipal water utilities to more independent and bigger regional water utility companies. An addition to national legislation that industrial wastewater contracts must be updated and the criteria for the need to update a contract. New contracts should be valid only for limited duration. Advising services given for the negotiation process.	Water utilities, Ministry of the Environment
Operators do not inform water utilities about exceptional emissions, leading to unpredictable industrial wastewater loading to the WWTP	Notification obligation on accidental leaks, process disturbances and abnormal discharges should be stated in contracts. An operator will not be fined if the water utility has been notified about an accidental leak. Online monitoring of pH or conductivity and automatic alarms. Requirement for equalisation of industrial wastewater before it reaches the sewer. Improved risk management and contingency planning of both the operators and the water utilities.	Water utilities
Old industrial wastewater contracts can be very difficult to update or change	Environmental authorities can obligate a contract to be updated when revising the terms of a permit. “Updating campaigns”: Updating contracts with all operators. The water utility must have sufficient arguments for updating contracts. New contracts should only be made for limited duration.	Environmental authorities, Water utilities
Operators have lack of awareness about the impacts of industrial wastewater on the water utility and the WWTP and have a lack of knowledge about the best methods for the pretreatment of industrial wastewaters	Yearly meetings between contract parties should be stated in contracts. Contract negotiations can be held at the WWTP, including a tour of the plant. Publishing guidelines for better management of wastewaters for a certain industry e.g. food industry, surface finishing plants, waste management. “Help desk” or “travelling advisor” for giving guidance and sharing information about better management of industrial wastewaters.	Water utilities, FIWA

Annex 4: Key recommendations for Latvia

Challenges	Key recommendations	Responsible parties
Indirect industrial wastewaters are not considered in environmental permit conditions	The indirect release of substances into water is included in IED (2010/75/EU) and limit values and monitoring requirements must be given in permits. Permitting practices should be changed so that indirect industrial wastewaters are clearly considered.	Ministry of the Environment
Lack of resources of supervising authorities for sufficient monitoring and control of industrial wastewaters	Operators must cover the expenses of monitoring i.e. the polluter pays principle and the operators' responsibility for being aware of their environmental effects should be enforced. Environmental authorities should have sufficient resources for controlling industrial wastewaters.	Ministry of the Environment
Limit values for industrial wastewater are commonly set to domestic water quality	Develop a compensation formula set in legislation to correspond better with increased operating and investment expenses at WWTPs caused by industrial wastewaters containing organic matter and nutrients (see Chapter 4.4.4 and https://www.vvy.fi/site/assets/files/1110/finnish_industrial_wastewater_guide.pdf).	Environmental authorities or Cabinet of Ministers and water utilities associations
Exceeding these limit values is severely punished, which leads to operators not notifying water utilities about exceptional emissions	If the operator reports an exceptional emission immediately and such an emission has not happened before, the water utility should decide whether the operator needs to pay a fine or if it is enough to cover the damage (see Chapters 4.4.5 and 4.4.6).	Water utilities
National guidelines needed for regulating industrial wastewaters, setting increased wastewater fees and establishing cooperation	National industrial wastewater guidelines in Latvian would be an important tool for sharing information and harmonising limit values for different types of industrial wastewater. The guidelines should include a formula for the increased wastewater fee and provide information, examples and best practice for cooperation.	Water utilities association or environmental authorities
Hazardous substances are not sufficiently monitored from industrial wastewater	Hazardous substances should be included in monitoring programmes according to industry sectors and types of activities (see Chapter 2.5.2 and Annex 1). More information and procedures for monitoring hazardous substances should be included in the national guidelines.	Environmental authorities, water utilities
There are trust concerns between operators and water utilities, especially about representative sampling and analysing	Use an independent certified/accredited third party (laboratory) for sampling and analysing (this must be stated in contracts). Both parties may observe sampling. Request a statement from a sampler of the third party on representative sampling from the selected sampling point. Improve cooperation by organising yearly meetings, by inviting operators for a tour of the WWTP and by starting negotiation processes with a visit to the industrial facility (see Chapter 5.2).	Contacting parties

Authorities and water utilities are not able to take samples of industrial wastewaters without giving prior notice	If possible, the sampling point should be located outside of the operator's premises. It should be stated in contracts that the water utilities have the right for inspections and additional sampling.	Contracting parties
Water utilities are not always allowed to enter the operator's premises to take samples	Changes in national legislation are necessary so that inspections and sampling are possible for water utilities and authorities.	Cabinet of Ministers
Lack of education and knowledge of industrial wastewater treatment, discharge and potential impacts on the environment within the municipal and industrial WWTP operators and owners	Training of WWTP personnel on industrial wastewater treatment and handling technologies.	Educational organisations (universities, vocational schools and colleges)

Annex 5: Key recommendations for Lithuania

Challenges	Key recommendations	Responsible parties
Indirect industrial wastewaters are not considered in environmental permit conditions	The indirect release of substances into water is included in IED (2010/75/EU) and limit values and monitoring requirements must be given in permits. Permitting practices should be changed so that indirect industrial wastewaters are clearly considered.	Ministry of the Environment
There are trust concerns between operators and water utilities, especially about representative sampling and analysing	Use an independent certified/accredited third party (laboratory) for sampling and analysing (this must be stated in contracts). Both parties may observe sampling. It should be stated in contracts that the water utilities have the right for inspections and additional sampling. Changes in national legislation are necessary so that inspections and sampling are possible for water utilities and authorities.	Contracting parties
Operators have a lack of knowledge about the impacts of industrial wastewater on the water utility and the WWTP Operators and WWTPs do not have enough knowledge about best methods for the pretreatment of industrial wastewaters	The establishment of temporary specialised national competence groups is recommended, bringing together top scientists and practitioners to address the problems of local industrial wastewater treatment. A legislative framework needs to be developed to establish rules and roles of the competence groups. The target of the group is to find optimal technical and technological solutions to problems related to industrial wastewater discharges. The activities of such groups should not focus on political or industrial interests but on public interest and environmental concerns. Competence clusters could transfer good practice to other companies, creating a real opportunity for small businesses to properly solve problems or unify their needs. Competency groups could be involved in establishing and substantiating indicators for the degree of the pretreatment required by the operators of the establishments.	Ministry of the Environment
Operators have a lack of knowledge about the operating wastewater pretreatment processes, resulting in the incorrect operation and accidents	The personnel operating pretreatment equipment must be qualified and have necessary competencies (environmental technology or similar certificates), which should be a requirement in the job description. This requires changes in national legislation. Universities should prepare the necessary number of specialists in this field and organise semi-annual training seminars. Another option is that the personnel of the WWTP operate the pretreatment as a service of the water utility. Such a solution is used e.g. in Beck's brewery in Bremen, Germany.	Ministry of the Environment (implementing), municipal authorities (control), universities
There is lack of cooperation and information sharing between operators, local environmental authorities and municipal WWTP representatives	Local authorities and WWTP representatives should be invited to participate in the consideration of company plans for the selection and reconstruction of local industrial wastewater treatment plants. Yearly meetings between operators, authorities and water utilities (and WWTPs). Invitation to the operators and authorities for a guided tour of the WWTP.	Operators, authorities, water utilities

Annex 6: Key recommendations for Poland

Challenges	Key recommendations	Responsible parties
Lack of resources of supervising authorities for sufficient monitoring and control of industrial wastewaters	Industrial operators must cover the expenses of monitoring. This is in line with the polluter pays principle and the responsibility of being aware of the effects of the operations on the environment. These principles should be established in national legislation and stated in industrial wastewater contracts.	Polish Water, water utilities, law makers
Lack of coherence of legal acts and their dispersion. “Gaps” in legislation	Regulation of industrial wastewater should be comprehensive and coherent, and the number of legal acts describing industrial wastewater management should be limited. Examples of observed development needs: - The definition of industrial wastewater should be clarified in such a way as to also include wastewater from all kinds of businesses which produce equally troublesome wastewater as industry. - There is a lack of a uniform methodology for calculating extra fees for oversized discharge of industrial wastewater. - Sewage agglomerations calculate the sanitation access coefficient based on the algorithm established for reports on the implementation of the National municipal wastewater treatment program (KPOŚK). Paradoxically, the algorithm design may cause a worsening of agglomeration assessment due to better pretreatment of industrial wastewater and vice versa - worse pretreatment of industrial wastewater may result in improved agglomeration assessment.	Law makers
Lack of supervision and control of industrial wastewaters	Sufficient frequency of sampling should be required from monitoring programmes. Supervising authorities and/or water utilities should take additional samples and carry out inspections if any violations are suspected. Water utilities or Polish Water should also supervise the fulfilment of contractual terms, and have the right to give fines if limit values are exceeded. If violations are repeated, conveying of wastewaters to the sewer should be forbidden. A technical tool that helps supervising is a database where laboratories input all analysis results of industrial wastewater samples and where the limit values for parameters are saved.	Polish Water, water utilities
Water utilities need more information for setting limit values and monitoring programmes for hazardous substances	Hazardous substances should be included in monitoring programmes according to industry sectors, types of activities and size of the industrial operators (large industrial operators that discharge wastewater into small treatment plants vs. dispersed, small industries) (see Chapter 2.5.2 and Annex 1). Limit values for hazardous substances are discussed in Chapter 2.5.3. National industrial wastewater guidelines in Polish would be an important tool for sharing information and harmonising the terms of contracts and permits.	Polish Water, water utilities

There are trust concerns between operators and water utilities especially about representative sampling	Use independent certified/accredited third party for sampling and analysing (must be stated in the contract). Sampling dates and time should not be known in advance. Both parties may observe sampling. In the contract, it should be stated about the right for inspections and (additional) sampling. The water utility should order additional samplings and carry out inspections.	Contracting parties
Operators do not inform water utilities about exceptional emissions and industrial wastewater loading to WWTPs is unpredictable	The development of regulatory or financial steering mechanisms for building retention tanks situated on either the operator's side or at the WWTP. Notification obligation on accidental leaks, process disturbances and abnormal discharges should be stated in contracts. An operator will not be fined if the water utility has been notified about an accidental leak. Online monitoring of pH or conductivity and automatic alarms. Improved risk management and contingency planning of both the operators and the water utilities.	Law makers, Contracting parties
Transport of industrial wastewater by vacuum trucks; mixing industrial and domestic sewage; leaks in septic tanks	The credibility of industrial wastewater transport should be improved. It can be achieved by better monitoring of the transport process and by creating mechanisms to motivate operators and transport companies to maximum honesty.	Polish Water, water utilities Law makers
Lack of technical and legal knowledge of industrial wastewaters among small WWTPs and industrial operators	Currently, experts are concentrated in large urban centres and large treatment plants. Their knowledge and experience should be transferred to smaller treatment plants and industrial operators. Implement a nationwide training programme for small WWTPs and various types of industry and services that produce troublesome wastewater.	Water utilities' association, Polish Water, Industrial associations, National Fund for Environmental Protection and Water Management (NFOŚiGW)
Lack of effective procedures in the event of a major contamination of unknown or known origin requiring large scale intervention	WWTPs in large cities must prepare for the emergence of large pollution loads. They need to estimate the risk, create a pollution warning system and wherever possible, build retention tanks to prevent harm to the WWTP.	Polish Water, water utilities

Annex 7: Key recommendations for Russia (Kaliningrad)

Challenges	Key recommendations	Responsible parties
The Best Available Technologies (BAT) approach should be launched for a wide range of companies. The recently introduced BAT approach would enable ecological modernisation, but insufficient legislative framework prevents its full usage	Ecological modernisation of the industries with the Best Available Technologies approach is an important tool for environmental regulation and industrial policy. It provides economic instruments such as tax and environmental payment reliefs for those companies which transform their processes and environmental techniques into modern technology. Thus, it gives an opportunity to start a transition from the current system, in which payment for environmental damage looks more economically effective for companies than ecological modernisation. To reduce industrial discharges to municipal networks, modernising both production processes and treatment technology is crucial. According to the current Russian legislation, the industrial companies are divided into 4 categories by environmental impact, where category 1 is characterized by significant pollution and category 4 by minimal impact. However, implementation of the BAT approach is obligatory only for industries in category 1, whereas enterprises in other categories do not have such obligations. The legislative framework enforcing BAT approach should thus be further developed to involve also enterprises of categories 2 and 3. In addition, economic support measures on the Federal level and the main advantages of the BAT implementation should be more highlighted to stakeholders.	Federal Ministries
Obtaining of environmental permits is hindered due to the deficiency of the implementing regulations and related instructions	Making the process of obtaining the environmental permits clearer would enable its wide and effective implementation. For this purpose, regulations and special instructions need to be developed. Moreover, the main steps and actors of the permit system should be clearly described to enable permit application by water utilities and industrial enterprises.	Federal Ministries
Lack of contracts or outdated industrial wastewater contracts	The discharge of industrial wastewaters from all companies into the municipal sewage system should be covered by industrial wastewater contracts. They should include detailed and updated requirements such as limit values for wastewater quality, monitoring programme and control measures, reporting, and fees. Before discharge, industrial enterprises should pretreat their wastewater to achieve parameters set in the contract.	Industrial operators and water utilities
Industrial operators do not have enough knowledge about best methods for pretreatment of their wastewaters	It is important to identify optimal technical and technological solutions for the pretreatment of wastewaters from different industries. Modern wastewater treatment methods for different industries as well as links to basic service literature and other sources of information should be available to the stakeholders.	Committee on Housing and Communal Services of the Kaliningrad region

There are insufficient opportunities for life-long learning for wastewater treatment specialists in the Kaliningrad region	Establishment of a regional training/ competence building programme on treatment of industrial wastewaters entering municipal WWTPs, which brings together the best experts of industrial wastewater treatment, water utilities and operators could support capacity building. The objective is to address the problems of industrial wastewater treatment, find optimal technical and technological solutions to problems related to industrial wastewater discharges and to share information about best practices and pre-treatment methods.	
Cooperation and information sharing between water utilities and operators	Contract negotiations should be started by visiting the operator's facilities. Yearly meetings between contract parties as well as notification obligation on accidental leaks, process disturbances, and abnormal discharges should be included in contracts. The focus should be more on dialogue and cooperation than mere sanctions and penalties by water utilities. Water utilities could share information about the issues caused by industrial wastewaters on their websites and publish guidelines/info sheets addressed to specific industries.	Industrial operators and water utilities