Measurement, Monitoring and Environmental Assessment, Work package 4.1, State and trends

Water emission measurements

Contents

1 Abstract

Water emission measurements were surveyed in Europe, North America, South America and China. Most of the information was available on the internet but the Case studies in Finland and Uruguay are based on expert communication. The internet sources should be considered with caution. In this work the main focus is on automatic monitoring. As supportive information we have reflected regulations, permit processes, and organizational structures in different countries. The future progress is discussed, too.

2 Introduction

In this document we shortly present the water emission legislation in selected countries and regions. Firstly, a short introduction to global water consumption is given. Term water footprint was taken into use in 2002. It is a water consumption based indicator, which by definition is the amount of water needed to produce goods and services for people (Hoekstra & Hung 2002) i.e. the amount of water needed to sustain a population (Hoekstra & Chapagain 2007). The water footprint is composed of two parts: the domestic water consumption and water used outside the country's borders. A closely related term is virtual water. It is defined as the amount of water required for producing a service or goods (Allan 1993, 1994). Virtual water has two "directions" in a country: it can be either imported or exported (Hoekstra & Chapagain 2007).

Global water footprint is 7450 Gm^3/year and India has the largest absolute water footprint (987 Gm^3/year) (Hoekstra & Chapagain 2007). However, if water consumption is calculated per capita the largest footprint is found in the USA (2480 m^3/capita/year) (Fig. 1). The most important factors that define the size of the footprint for a single country are the amount of consumption, consumption habits, climate and agriculture (Table 1) (Hoekstra & Chapagain 2007). The connection between economic growth and water consumption would need to be decoupled in order to be able to diminish the water footprint (Hoekstra & Chapagain 2007). Moreover, consumption habits should be directed towards less water consuming options (Hoekstra & Chapagain 2007) and global water use efficiency needs to be enhanced (Chapagain et al. 2005). This can be done for example by choosing cultivation areas based on climate and weather conditions.

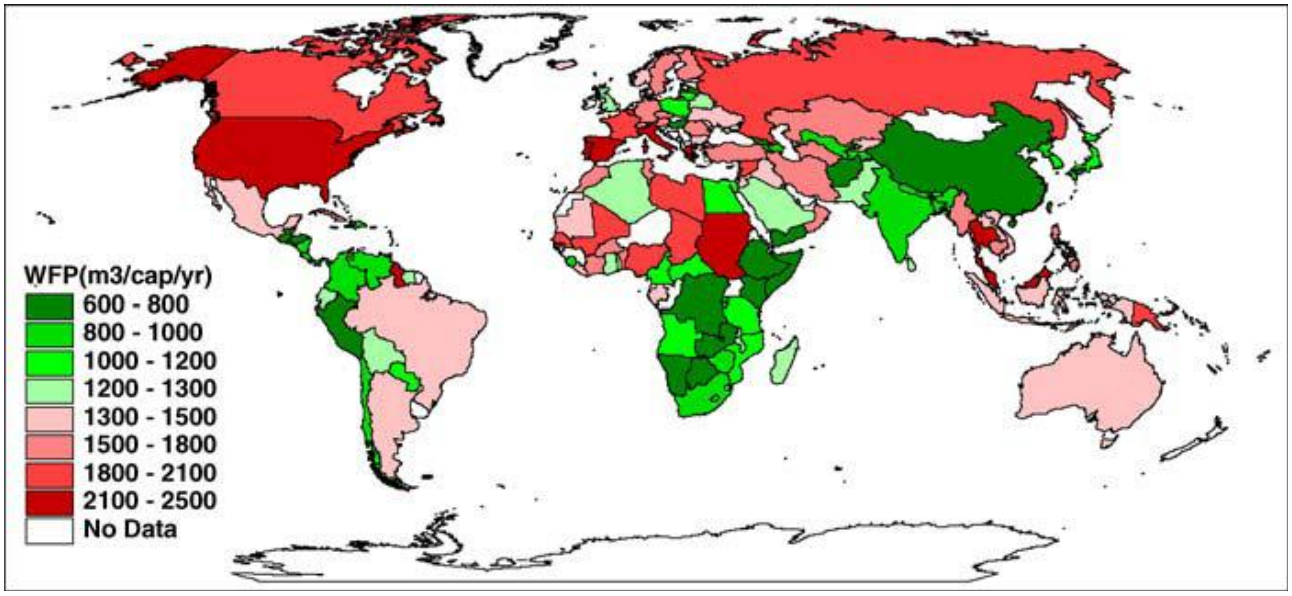


Figure 1. "Average national water footprint per capita (m^3/capita/yr). Green means that the nation's water footprint is equal to or smaller than global average. Countries with red have a water footprint beyond the global average" (Hoekstra & Chapagain 2007).

Waste water emissions do not necessarily show the same trends as water footprint. Part of the water used in irrigation evaporates to the air. Different branches of business do load the waters in different ways and amounts. The waste water purification influences the loads. Usually in developed countries the purification processes are efficient. On the other hand especially in undeveloped countries the municipal waste waters are led to the ground. The impacts of the waste water depend then on the vegetation and quality of the soil and bedrock. It is difficult to compare the loadings because of many loading factors and because their share changes according to the branch.

Table 1." Composition of the water footprint for some selected countries. Period: 1997-2001" (Hoekstra & Chapagain 2007).

		Use of domestic water resources					Use of foreign water resources			Water footprint		Water footprint by consumption category				
			Crop evapotranspiration*		Industrial water withdrawal		For national consumption					Domestic water	Agricultural goods		Industrial goods	
Country	Population	Domestic water withdrawal (Gm^3/yr)	For national consumption (Gm^3/yr)	For export (Gm^3/yr)	For national consumption (Gm^3/yr)	For export (Gm^3/yr)	Agricultural goods (Gm^3/yr)	Industrial goods (Gm^3/yr)	For re-export of imported products (Gm^3/yr)	Total (Gm^3/yr)	Per capita (m^3/cap/yr)	Internal water footprint (m^3/cap/yr)	Internal water footprint (m^3/cap/yr)	External water footprint (m^3/cap/yr)	Internal water footprint (m^3/cap/yr)	External water footprint (m^3/cap/yr)
Australia	19071705	6.51	14.03	68.67	1.229	0.12	0.78	4.02	4.21	26.56	1393	341	736	41	64	211
Bangladesh	129942975	2.12	109.98	1.38	0.344	0.08	3.71	0.34	0.13	116.49	896	16	846	29	3	3
Brazil	169109675	11.76	195.29	61.01	8.666	1.63	14.76	3.11	5.20	233.59	1381	70	1155	87	51	18
Canada	30649675	8.55	30.22	52.34	11.211	20.36	7.74	5.07	22.62	62.80	2049	279	986	252	366	166
China	1257521250	33.32	711.10	21.55	81.531	45.73	49.99	7.45	5.69	883.39	702	26	565	40	65	6
Egypt	63375735	4.16	45.78	1.55	6.423	0.66	12.49	0.64	0.49	69.50	1097	66	722	197	101	10
France	58775400	6.16	47.84	34.63	15.094	12.80	30.40	10.69	31.07	110.19	1875	105	814	517	257	182
Germany	82169250	5.45	35.64	18.84	18.771	13.15	49.59	17.50	38.48	126.95	1545	66	434	604	228	213
India	1007369125	38.62	913.70	35.29	19.065	6.04	13.75	2.24	1.24	987.38	980	38	907	14	19	2
Indonesia	204920450	5.67	236.22	22.62	0.404	0.06	26.09	1.58	2.74	269.96	1317	28	1153	127	2	8
Italy	57718000	7.97	47.82	12.35	10.133	5.60	59.97	8.69	20.29	134.59	2332	138	829	1039	176	151
Japan	126741225	17.20	20.97	0.40	13.702	2.10	77.84	16.38	4.01	146.09	1153	136	165	614	108	129
Jordan	4813708	0.21	1.45	0.07	0.035	0.00	4.37	0.21	0.22	6.27	1303	44	301	908	7	43
Mexico	97291745	13.55	81.48	12.26	2.998	1.13	35.09	7.05	7.94	140.16	1441	139	837	361	31	72
Netherlands	15865250	0.44	0.50	2.51	2.562	2.20	9.30	6.61	52.84	19.40	1223	28	31	586	161	417
Pakistan	136475525	2.88	152.75	7.57	1.706	1.28	8.55	0.33	0.67	166.22	1218	21	1119	63	12	2
Russia	145878750	14.34	201.26	8.96	13.251	34.83	41.33	0.80	3.94	270.98	1858	98	1380	283	91	5
South Africa	42387403	2.43	27.32	6.05	1.123	0.40	7.18	1.42	2.10	39.47	931	57	644	169	26	33
Thailand	60487800	1.83	120.17	38.49	1.239	0.55	8.73	2.49	3.90	134.46	2223	30	1987	144	20	41
United Kingdom	58669403	2.21	12.79	3.38	6.673	1.46	34.73	16.67	12.83	73.07	1245	38	218	592	114	284
USA	280343325	60.80	334.24	138.96	170.777	44.72	74.91	55.29	45.62	696.01	2483	217	1192	267	609	197
Global total/avg.	5994251631	344	5434	957	476	240	957	240	427	7452	1243	57	907	160	79	40

*Includes both blue and green water use in agriculture

3 EU and Finland

3.1 EU regulation of water pollution

EU directives and regulations for water pollution control in force 2011:

Directive WFD (2000/60/EC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:FI:PDF
Directive GWD (2006/118/EC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:372:0019:0031:FI:PDF
Directive UWWTD (1991/271/EEC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1991:135:0040:045:FI:HTML
Directive NiD (1991/676/EEC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0676:FI:HTML
Directive EQS (2008/105/EC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:348:0084:0097:FI:PDF
Directive IED (2010/75/EC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:FI:PDF
Regulation E-PRTR (166/2006): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:033:0001:0017:FI:PDF
Regulation EMAS (1221/2009): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:342:0001:0045:FI:PDF

In the European Union the Water Framework Directive (WFD, 2000/60/EC) sets up the framework for the management and monitoring of surface (lakes, rivers, transitional and coastal) and ground water bodies. Under the WFD there are specific daughter directives for the protection of ground waters (2006/118/EC), environmental quality standards (2008/105/EC) related to priority substances, treatment of urban waste waters (1991/271/EEC) and curbing of nitrates leaching from agriculture (1991/676/EEC). Moreover, Industrial Emissions Directive (IED, 2010/75/EC) together with the E-PRTR regulation lay down requirements for pollution prevention and control as well as emission monitoring and reporting at major industrial installations including big animal production units. Companies and organizations may voluntarily join the European Eco-management and audit scheme, EMAS (1221/2009), and report e.g. on significant environmental aspects and achievement of environmental goals.

In Finland the river basin management plans (RBMP) and the corresponding programmes of measures (PoM) required by the WFD were adopted by the Government in December 2009. Furthermore, in February 2011 the Government approved the national river basin management implementation programme up to 2015. The basic objective is to achieve good status of water bodies by 2015 and prevent the deterioration of water bodies in high status. The ecological and chemical status of all major surface and ground water bodies in Finland was classified and mapped in 2009. The measures required include a high variety of basic and supplementary measures for all activities affecting the status of surface and ground water bodies, e.g. new regulations and permits, economic instruments, voluntary action and information. The pressures and status of water bodies are monitored by means of surveillance, operational and investigative monitoring programmes. Specific monitoring programmes are set up for the EU and national priority substances in order to supervise the compliance with the environmental quality standards. The centres for economic development, transport and the environment are the main competent authorities in charge of facilitating the implementation process under the WFD in Finland.

The IED (entered into force 6th Jan 2011) repealed and replaced several directives regulating industrial activities (IPPC, LCP, WID, I-VOC, TiO2). In Finland the corresponding amendments to the existing national regulations, mainly Environmental Protection Act and Decree, need to be made by the beginning of 2013. Consequently, the role of emission and consumption levels determined in the Best Available Techniques (BAT) Conclusions, so called BAT associated emission levels (BAT AEL), is strengthened in the process of determining the environmental permit conditions. Moreover, the monitoring and reporting of emissions is more accurately regulated than before.

3.2 Permit procedure and inspections

Information on the internet:

Directive, access to env info (2003/4/EC): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:041:0026:0032:FI:PDF
European IPPC Bureau: http://eippcb.jrc.es/
E-PRTR FI: http://www.ymparisto.fi/default.asp?node=21843&lan=fi
E-PRTR EU: http://prtr.ec.europa.eu/pgAbout.aspx
BAT FI: www.ymparisto.fi/bat
Regional State Administrative Agencies, Environment and water permits, FI: http://www.avi.fi/fi/ymparistoluvat/Sivut/default.aspx
Legislation on water protection in FI: http://www.ymparisto.fi/default.asp?node=1176&lan=fi

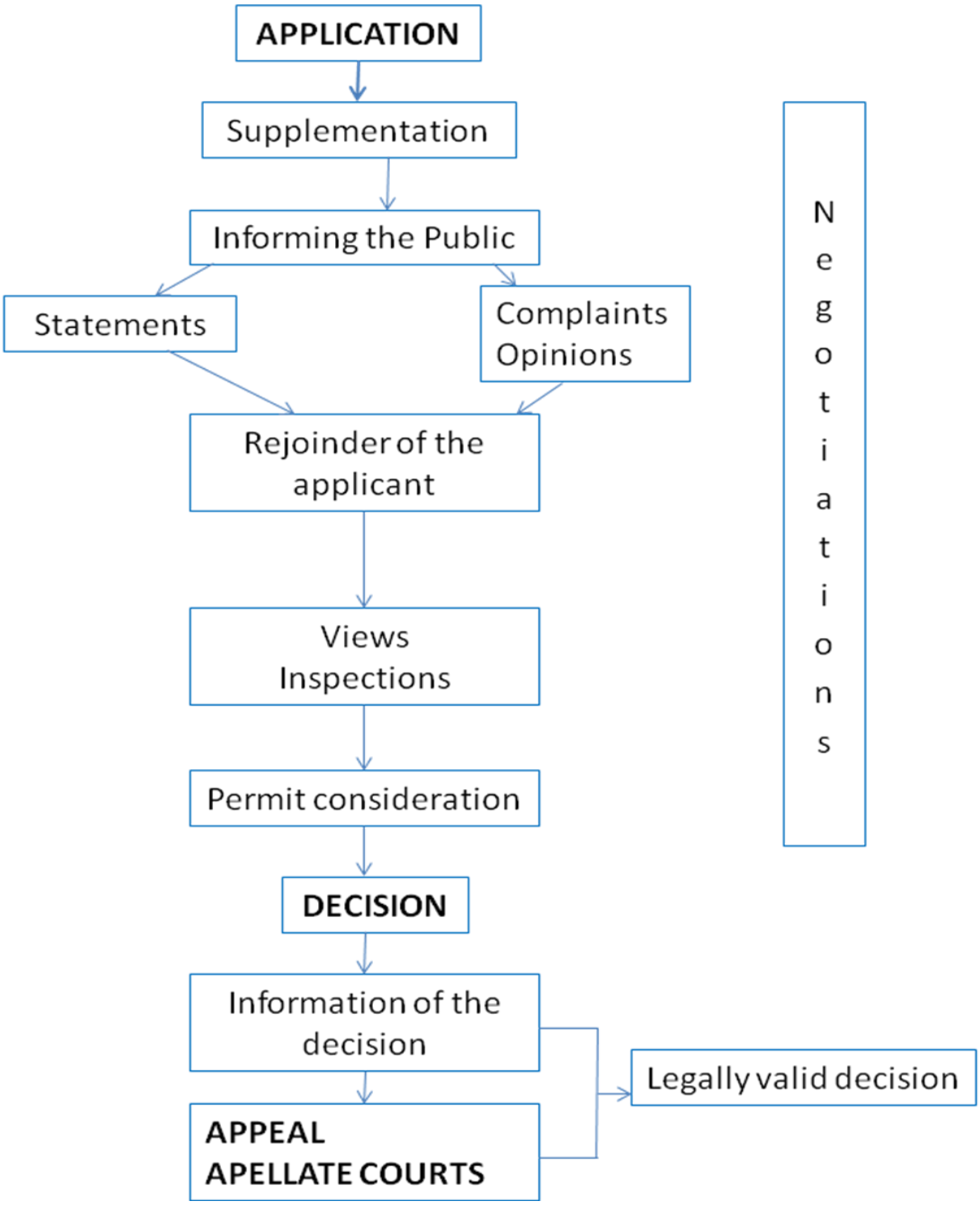


Figure 2. The permit procedure in Finland.

The Industrial Emissions Directive (IED) lays down provisions, among others, on the minimum scope of environmental permits, applications for permits, setting up of permit conditions and emission limit values, combined application of BAT and environmental quality standards, monitoring requirements, reconsideration and updating of permit conditions, measures for site closure, environmental inspections as well as access to information and public participation in the permit procedure.

The permit should include all the measures necessary to achieve a high level of protection of the environment as a whole and to ensure that the installation is operated in accordance with the general principles governing the basic obligations of the operator. The permit should also include emission limit values for polluting substances, or equivalent parameters or technical measures, appropriate requirements to protect the soil and groundwater and monitoring requirements. Permit conditions are to be set on the basis of best available techniques. In order to determine best available techniques and to limit imbalances in the Union as regards the level of emissions from industrial activities, reference documents for best available techniques (BAT reference documents, BREF) are drawn up and updated through an exchange of information with stakeholders. The key elements of BAT reference documents, i.e. BAT conclusions, are adopted through committee procedure.

BAT conclusions are the reference for setting permit conditions. They can be supplemented by other sources. In order to take into account specific circumstances where the application of emission levels associated with the best available techniques would lead to disproportionately high costs compared to the environmental benefits, permit authorities may set emission limit values deviating from those levels. Such deviations should be based on an assessment taking into account well-defined criteria. The binding emission limit values set out in the IED should not, however, be exceeded.

Changes to an installation may give rise to higher levels of pollution. Operators should notify the competent authority of any planned change which might affect the environment. Substantial changes to installations which may have significant negative effects on human health or the environment should not be made without a review of the permit.

In order to take account of developments in best available techniques or other changes to an installation, permit conditions are reconsidered regularly and, where necessary, updated, in particular where new or updated BAT conclusions are adopted. In specific cases where permit reconsideration and updating identifies that a longer period than four years after the publication of a decision on BAT conclusions might be needed to introduce new best available techniques, permit authorities may set a longer time period in permit conditions where this is justified on the basis of the criteria laid down in the IED. Operators must regularly report to the competent authority on compliance with permit conditions. The emission monitoring should enable the direct comparison of the emissions to the BAT associated emission levels.

The IED sets out specific requirements for a system of environmental inspections of installations addressing the examination of the full range of relevant environmental effects. All installations need to be covered by an environmental inspection plan. Based on the inspection plans, the competent authority regularly draws up programmes for routine environmental inspections, including the frequency of site visits for different types of installations.

The period between two site visits must be based on a systematic appraisal of the environmental risks of the installations and must not exceed one year for installations posing the highest risks and three years for installations posing the lowest risks. If an inspection has identified an important case

of non-compliance with the permit conditions, an additional site visit need to be carried out within six months of that inspection.

Non-routine environmental inspections are carried out to investigate serious environmental complaints, serious environmental accidents, incidents and occurrences of non-compliance and, where appropriate, before the granting, reconsideration or update of a permit. Following each site visit, the competent authority prepares a report describing the relevant findings regarding compliance of the installation with the permit conditions and conclusions on whether any further action is necessary. The report is made publicly available.

The European Pollutant Release and Transfer Register Regulation (E-PRTR, 166/2006) requires the IED installations report emissions to air and water as well as waste annually if the specific threshold values are exceeded. The reported pollutants fall into seven different categories: greenhouse gases, other gases, heavy metals, pesticides, chlorinated organic substances, other organic substances and inorganic substances. The reported data is publicly available on the E-PRTR register through the internet.

In Finland the Regional State Administrative Agencies or, in case of small scale activities, the municipal environmental administration process and issue the environmental permits. The authorities, stakeholders and local people affected by the undertaking are consulted during the process. At minimum the permit process may take four months but usually the process lasts one year or even more. The parties affected have a right to appeal against the permit decision to Vaasa Administrative Court or, eventually, to the Supreme Administrative Court. Naturally the appeals prolong the permit procedure, usually one to two more years.

The permits include provisions on operational, emission and impact monitoring. The detailed impact monitoring programme may be approved as a separate document by the competent authority, i.e. centre for economic development, transport and the environment. For the monitoring of urban wastewater emissions and, in general, release of national and EU priority substances to water bodies Government Decrees 888/2006 and 868/2010 set up detailed provisions.

The monitoring programme of industrial installations is drawn up case-by-case depending on the amount of emissions, loading substances, harmfulness of the substances and vulnerability of the receiving environment. The impact monitoring usually consists of water quality measurements (basic physico-chemical variables, nutrients, metals, toxic substances), quite often also biological indicators like algae, macrophytes, invertebrates and fish and sometimes sediment analysis. The impact monitoring programme may be carried out jointly by several polluters. Centre for economic development, transport and the environment is responsible for carrying out inspections and quality control of the whole monitoring data production chain. Monitoring results are made publicly available.

3.2.1 Enforcement in Finland

In Finland as well as in other Nordic countries, permit misconducts have been handled traditionally case-specifically by the supervisory authority. The authority reacts according to the extent of the crime and according to the intentions of the operator. Measures are taken to avoid environmental damage. The criminal code stipulates penalties and other punishments of environmental offences. The supervisory authority will inform the police of illegal activity it has noticed and thereafter the police will examine the case. A private person as well as a corporation can be punished. The need for fines imposed on a corporation arise just from the environmental offences. The corporation is

punished on the basis of illegal activity. The fines are imposed only in the court. This hinders possibilities for corruption. The same practice is applied to EU regulations, too.

The financial benefit gained by the environmental offence can be significant but also difficult to estimate. Confiscation is a possible criminal sanction. It can be set only in the court. As forfeiture you can lose financial benefit and the means of commission of an offence. This motivates to act according to the law.

Environmental offence may lead to business prohibition, as well.

3.2.2 Future

The most significant emissions will be monitored in order to get information about the implementation of the legislation. In the EU Directives surveillance will not be stricter but measuring frequency and reliability will be emphasized more in the future.

The IE-directive and EQS-directive have entered into force, and the national degrees based on the directives are in force as mentioned before in chapter 2.1. In Finland the environmental quality standards of the directive for priority substances and certain other pollutants are being completed in the near future. The EQS-directive stresses the importance of monitoring more than before and reliable data is needed.

The harmful substances are monitored manually because of small concentrations and missing equipment. Even for monitoring metal concentrations automatic measuring equipment is just under development.

The monitoring of emissions from installations will be included generally in the monitoring BAT. Sectoral BREF documents contain detailed instructions for monitoring. In sectoral BAT reports there will be sector-specific monitoring BAT conclusions. They describe how emission data is produced, the methods used and the best available practice in monitoring. Sectoral BAT reports are under preparation. BAT guidance (for guidance of the content of BAT reports) is expected to be adopted this year. Only two industries have just prepared pilot BATconclusions. According to the orders of the final BAT guidance the pilot BAT conclusions mightbe amended. The forest industry BREF is under preparation, too. It is the basis for the forest industry BAT conclusions.

Directives do not provide answers to how exceptional situations should be managed. Guidelines are being developed for these situations. Orders based on concentrations are problematic in exceptional situations. Orders based on loadings include as a baseline the emissions generated during disturbances. Both the load and the concentration viewpoints will be incorporated in BAT of Water emissions. The horizontal BREF is likely to be a general monitoring guidance giving general principles.

From the licensing and enforcement perspective the monitoring is going to be more laborious. Reporting to the Commission is going to be stricter than before. If you make exceptions in the permit decisions which deviate from the BAT conclusions, you have to provide explanations to the Commission.

3.3 Use of automatic monitoring equipments in regular water surveillance in Finland

In Finnish water monitoring programmes, automatic monitoring is mainly used for wastewater flow, pH and conductivity measurements, depending on the entity. A time-automated sampler is

commonly used to get pooled samples of certain parameters. Automatic monitoring is used in the internal surveillance for waste water flow, pH, temperature, conductivity, suspended solids, COD_{Cr} and oxygen concentration and nutrients (NH_4-N, PO_4-P). COD_{Cr} and suspended solids are not regular parameters to be monitored automatically. All of these parameters are measured from the wastewaters, some also from other sites of the process. There are some alterations between the facilities. For some facilities, like waste incineration plants, automatic measurements of acidity, temperature and discharge in the outlet of the facility are obliged in the waste incineration regulation.

The measurement method is selected based on previous experiences about the methods and costs. At some extent the conformity of traditional methods is inhibiting the urge to learn new methods.

The operator needs to consider if the automated technology is the best choice. The sensor has to fit for the monitoring purposes; the sensor has to be accurate enough and reliable. The sensor technology for a particular parameter might be too expensive or the instrument is difficult to use and requires intensive maintenance.

After selecting the most suitable sensor, proper installation is needed. The sensor has to be mounted into a representative place. For example when the sensor is connected into an alarm system it should not give false alarms due to incorrect placement. The sensor must be calibrated locally. After the calibration period the readings must be followed with surveillance samples that are compared to the sensor results. The sensor must be maintained. The maintenance should happen before there appear any anomalies in the data. It is good to have an automatic alarm system regarding exceptional results. Then sudden errors in the functioning of the sensor can be responded quickly.

The sensor measurements give lots of data with little effort compared to the traditional technique. However, in many cases it is not more affordable than the "old" technique because the sensors need rather constant monitoring and maintenance work.

3.4 Paper and pulp mill example in Finland

Information of permits on the internet:
http://www.avi.fi/fi/ymparistoluvat/Ymparistonsuojelulainmukaisetasiat/Sivut/default.aspx

The environmental permits are published in the internet. Monitoring programmes are also available from the relevant authority but they could not be found on the internet. Usually there are no electronic documents available. The monitoring programmes have been renewed many times and consequently there are many documents to deal with.

The environmental permit of the Kaukas pulp and paper mill in Lappeenranta was reviewed at the end of 2005. The latest monitoring programme was approved in 2008. The operational monitoring includes the factors which influence on the quantity and quality of waste waters. The processes of the biological purification plant are followed by automatic meters of Q, pH, temperature, conductivity, COD_{Cr} and O_2. Suspended solids and Na are measured manually daily and loss of ignition once per week. Total P, total N and AOX are measured weekly. The sampling sites are planned in such a way that they produce relevant information from the manufacturing process.

Impact monitoring of the UPM-Kymmene Oyj Kaukas mill is carried out together with other operators obliged to monitor the same recipient: the southern part of Lake Saimaa. Besides UPM-Kymmene there are three other paper and pulp mills and a small municipal waste water treatment plant in the area.

There are altogether 34 impact monitoring sites of which 19 belong to the impact monitoring of UPM-Kymmene.

Physical chemical sampling is carried out during different seasons altogether four times per year. An extra sample is taken in winter from three different sites near the factory. The samples are taken from different depths to find out the vertical profile of substances. Measurements are temperature, O_2, turbidity, conductivity, pH, color, COD_{Mn}, Tot.N, Tot.P, Na and odour.

Every 3 years intensive **biological monitoring** is carried out. It includes algae samples together with *chlorophyll a* and nutrient measurements from 12 different sites six times per growing season. Besides that there are three extra sites for *chlorophyll a* sampling. Periphyton plate incubation is carried out at the same sites for three periods in summer. Benthic animals are analyzed from the same sampling sites from deep water and thermocline bottoms. Zooplankton sampling has beenstopped. In the years between the intensive monitoring algae samples are taken from four sites five times per growing season. C*hlorophyll a* is analyzed altogether from 18 sites.

Monitoring of fish fauna is carried out, too.

The continuous monitoring of **harmful substances** was stopped after the wastewater purification plant was built in 1993/1994 and the toxic effects of waste waters were found to be small. In these cases the harmful substances are usually analyzed during every permission period.

At present it is hard to say how the monitoring will change. At least the operators must conform to permit requirements. This actually leads to the same requirements as today.

3.5 Voluntary systems

Information on the internet:

Emas: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:342:0001:0045:FI:PDF
ISO 14001: http://www.sfs.fi/iso14000/ymparistojarjestelma/
ISO14001: http://www.ymparisto.fi/default.asp?contentid=333675&lan=FI
CSR: http://ec.europa.eu/enterprise/policies/sustainable-business/corporate-social-responsibility/index_en.htm
CSR: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0136:FIN:en:PDF

The environmental management systems belong to BAT. Even though those are not mandatory requirements those are evaluated in the permit and inspection processes. There are differences between countries how voluntary systems are connected to mandatory ones. In Finland there is not a strong connection between the two.

3.5.1 EMAS

In the EMAS system operators will set their own environmental goals. "An EMAS committed facility" is committed to obey the environmental legislation, constant improving of their level of environmental protection and public reporting regarding their environmental issues to a neutral auditing (in Finland it is MIKES). The auditing entity will authenticate the functioning of the system and verify the information presented in the report.

The renewed EMAS legislation has enabled the joining of members outside the EU to the European register. From members outside the EU it is required that they comply with their national legislation, not the EU directives. For example UPM will probably make the registration for their Asian facilities. On the other hand Stora Enso has withdrawn from the EMAS system.

3.5.2 ISO14001

In the ISO 14000 standard series there are for example environmental audits, life span assessments and different standards regarding eco-labels. The renewed ISO 14000 standard was accepted in November 2004. An environmental management system constructed according to the ISO 14001 standard is also a part of EMAS system that is based on EU act.

In the environmental management system the organization

- commits to improve their environmental protection level constantly
- recognizes the environmental effects of its products, actions and services
- finds out about the legal liabilities and takes care of fulfilling those
- sets environmental goals and follows their actualization
- provides resources
- keeps up the personnel's' expertise
- guides processes and functions
- is prepared for the environmental risks and accidents
- observes and monitors the environmental effects
- to prevent environmental accidents and prevent their recurring
- keep up good environmental practices
- asses own actions and results and improve those

3.5.3 CSR (Corporate Social responsibility)

Corporate Social responsibility is "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis." The Commission intends to continue to promote CSR as a voluntary concept, with an emphasis on dialogue between stakeholders. In some EU Member states there is a high level of enterprise awareness supported by effective public policies to promote CSR. In the new European countries EU supports the awareness and development of corporate social responsibility by numerous projects.

4 Global level

4.1 North America

Text is based on information from:

EPA: http://water.epa.gov/type/watersheds/monitoring/monintr.cfm, http://www.epa.gov/lawsregs/laws/cwa.html, http://www.epa.gov/owow/watershed/wacademy/acad2000/cwa/cwa41.htm, http://cfpub.epa.gov/npdes/, http://www.epa-echo.gov/echo/index.html

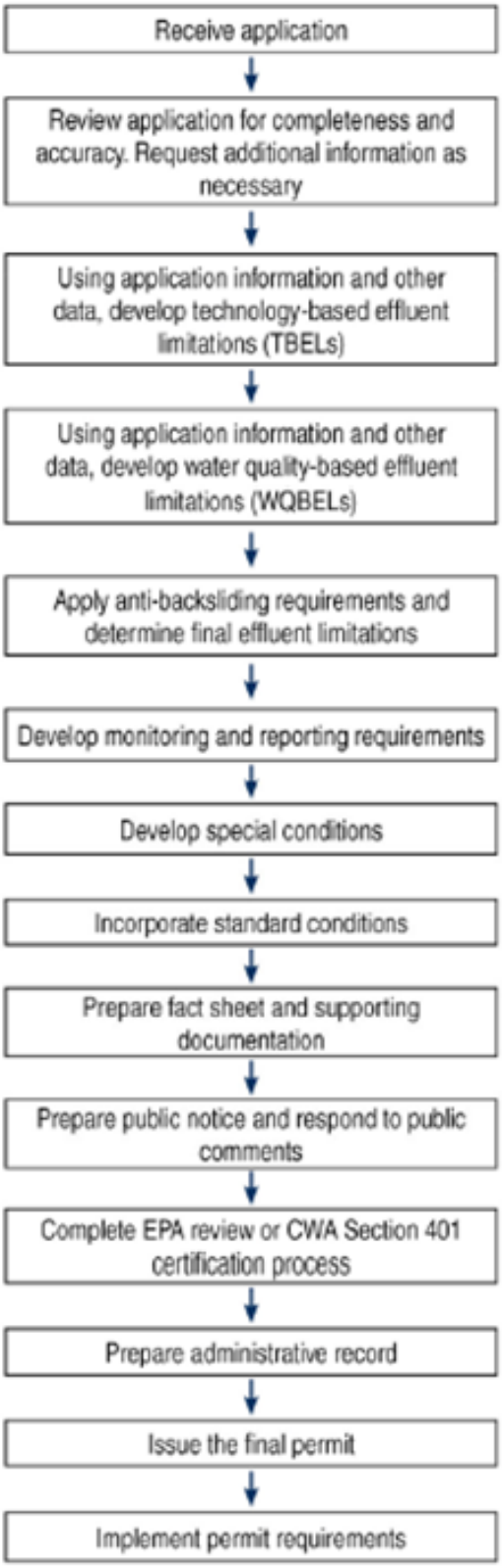
The Clean Water Act creates the basis of the water legislation in USA. It defines the pollutant discharge limits to US waters and provides the quality standards for surface waters. Under this act, EPA has set wastewater standards for industry. According to the Act facilities that discharge pollutants into waters need to have a permit to do so. National Pollutant Discharge Elimination System (NPDES) is a permit program which has been defined as follows in EPA's NDPES pages (http://cfpub.epa.gov/npdes/): "As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States."

The following text is based mostly on the U.S. Environmental Protection Agency NPDES Permit Writers' manual (U.S. Environmental Protection Agency 2010) and the Internet links mentioned below the headline. NPDES permit sets out specific requirements for discharging of industrial

process waters. The facility needs to have either general or individual NPDES permit if it discharges directly into water body. If it discharges into a sewer system the permit is included in the NPDES pretreatment program. Which ever the situation effluent guidelines cover many types of industries. The permit writer needs also take into account the possible non-process waste waters when planning monitoring conditions for a facility. The non-process waste water might dilute the concentration of pollutants in the process water.

As mentioned earlier, the NPDES permits can be divided into two types: individual and general permits. Both include same components but are used in different circumstances and the permit issuance processes are different. The individual permit is tailored specifically for a certain facility and operator applies for the permit. The general permit is created for certain industrial categories and initially it is the permit writer that has identified the need for a permit regarding the industrial branch. Permits are composed of a cover page, effluent limitations, monitoring and reporting requirements, special conditions and standard conditions. Figure 3a shows the individual permit application procedure and figure 3b presents the same for a general permit.

a



b

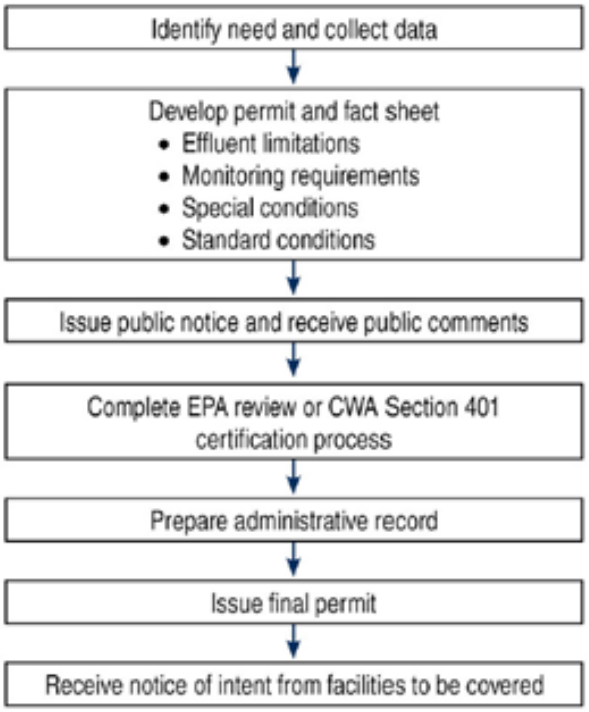


Fig. 3. Individual permit process (a) and general permit process (b) (original figures from U.S EPA NPDES Permit Writer's Manual).

In the general permit process the facilities that want to apply for the general permit will submit a notice of intent (NOI) to the permitting authority. After that the permitting authority will decide whether the facility belongs to the general permit or does it need to apply for an individual permit.

The application has to be complete and accurate. If the content of the permit application does not meet the requirements, the permit writer may ask to fill in the gaps (Fig.4).

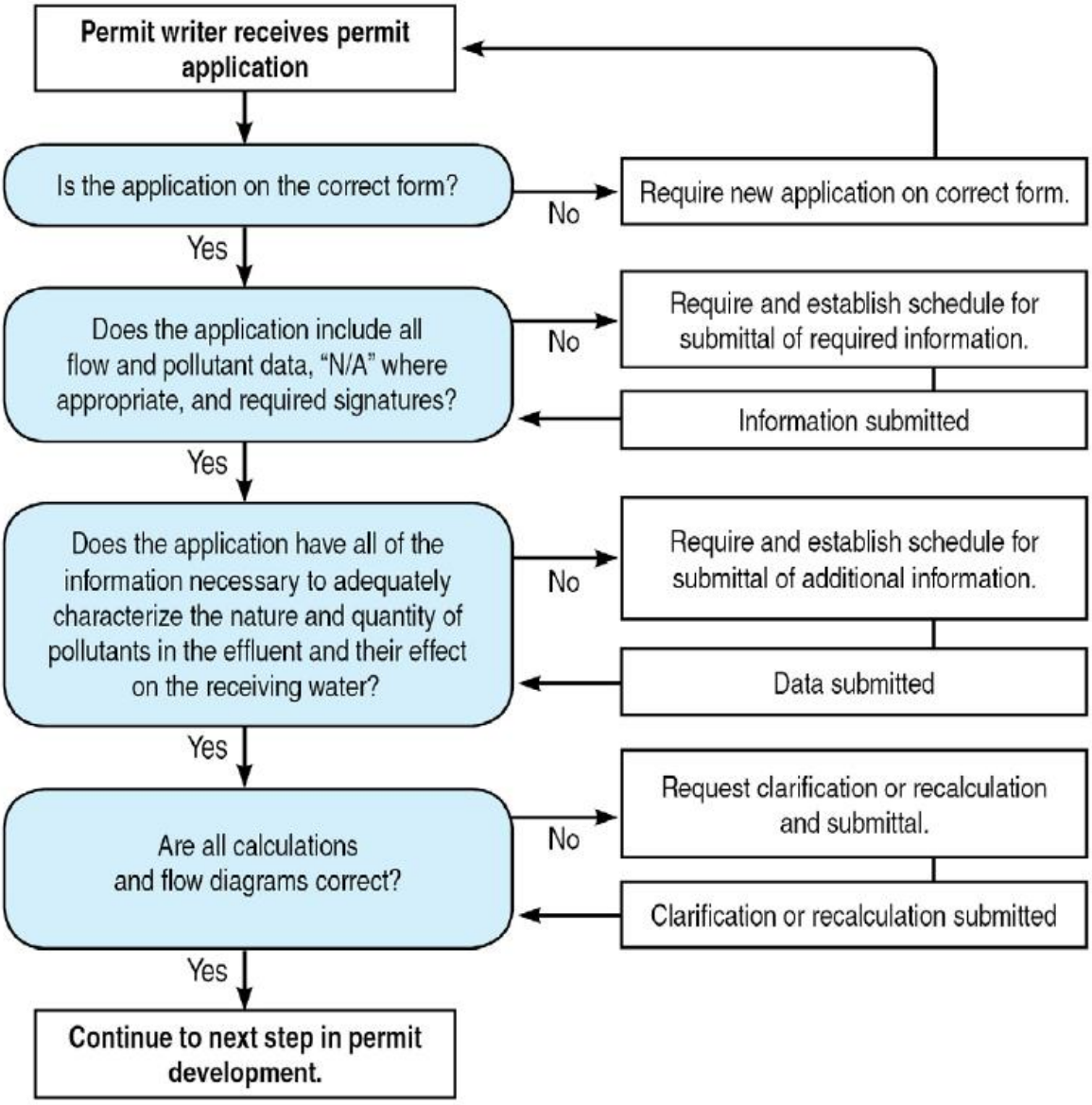


Fig. 4 The regular permitting procedure of the permit writer (original figure from U.S EPA NPDES Permit Writer's Manual).

Technology-based effluent limitations
The permit writer has to determine the effluent limitations for an operator based on the technology-based effluent limitations and water quality-based effluent limitations. The technology-based effluent limitations (TBELs) are made based on the technological performance capability for the certain pollutant. The TBELs are developed independently from the water quality-based limitations. The permit writer must set out the TBELs according to the legislation. In some occasions the state TBELs limitations can be stricter than the federal regulations require. The permit writer must be aware of the latest technology standards and requirements for the discharges. However, the operator may choose the technology they use to reach the set limits. The only requirement is that the limitations set in the permit with its example methods and technology are met.

Water quality-based effluent limitations
The permit writer also needs to take into account the requirements regarding the receiving water body. The state water quality standards set the water quality definitions. If the TBELs are not sufficient according to the water quality assessment the water quality-based limitations (WQBELs) need to be taken into use. First the permit writer needs to determine the need for WQBELs. This kind of "standards-to-permits" process includes four steps: determining the applicable water quality standards, characterizing the effluent and the receiving water, determining the need for WQBELs and the calculating of WQBELs.

The permit writer also needs to find out about the other possible requirements or backsets regarding the permit. Finally, the permit writer defines the final effluent limitations. Occasionally the permit can compose of several limitations factors (a mix of both TBELs and WQBELs). In the permit the permit writer must clearly point out what are the limitations based on.

There are also other laws applicable to the NPDES permits.

The permit authority can be either EPA or the state. Here the general administrative procedures of the both alternatives are presented (Figures 5 & 6).

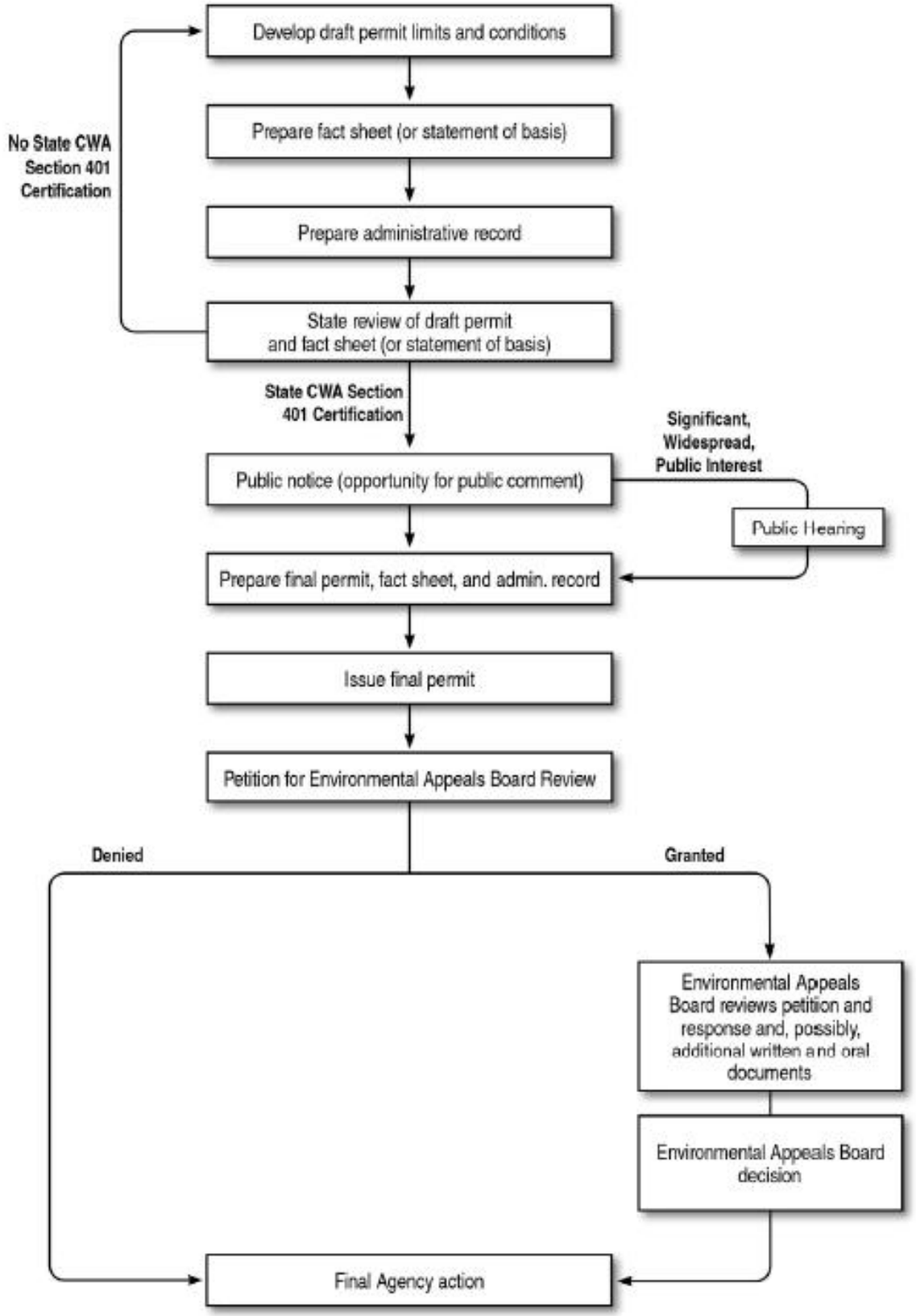


Fig. 5. EPA-issued NPDES permit process (original figure from U.S EPA NPDES Permit Writer's Manual).

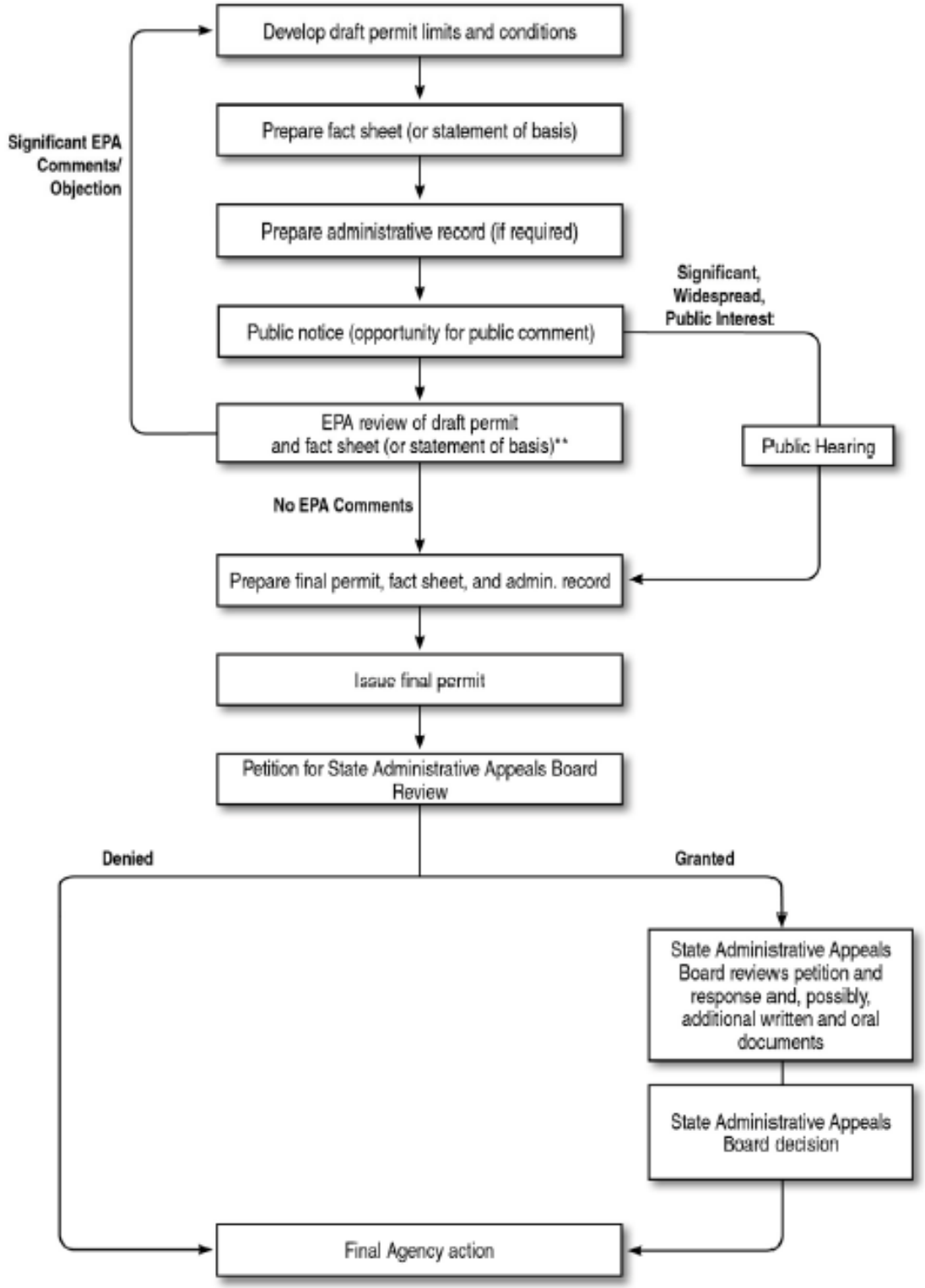


Fig. 6. State-issued NPDES permit process (original figure from U.S EPA NPDES Permit Writer's Manual).

4.1.1.1 Monitoring

The monitoring and reporting conditions are defined by the permit writer. The permittee demonstrates the compliance with the limits and if the permittee fails to do so, it gives the basis for an enforcement action. The operator has to conduct routine or episodic self-monitoring regarding the discharges and internal operations defined in the permit. The results have to be reported to the permitting authority and the report has to include also all the other essential information related to the results. In the NPDES permit the monitoring and reporting conditions usually include specific requirements for monitoring location, monitoring frequencies, sample collection methods, analytical methods and reporting and recordkeeping requirements. At least annually all the facilities need to report about the discharges and sludge use or disposal. In the permit there has to be a statement that the records must be retained at least for three years (in sewage sludge the time is 5 years) and also a definition where the records should be kept. Instream monitoring is not frequently required but it might also be useful to monitor the above and below outfall conditions.

4.1.1.2 Violations and enforcements

Besides situations like discharging without an NPDES permit or exceeding the pollutant discharge levels addressed in the permit, NPDES permittee need to do the monitoring and reporting as those have been assigned in the permit or the permittee will be accused of violating the permit. However, sometimes there is given a "compliance schedule" which means that the permittee has a given amount of time to modify their operations and renew their equipments if necessary according to the permit. Depending on the duration of the "compliance schedule" there can be interim milestones that must be achieved. If permittees realize that they fail to comply with one or more of the permit conditions, permittee needs to inform the NDPES authority.

Primarily it is the responsibility of states, territories and tribes to enforce the permits. If they fail to do so, EPA will take their role. Following enforcement actions were listed in EPA's site: "injunctions, fines for typical violations (exceed permit limits, failure to report), imprisonment for criminal violations (repeated, willful violations) and supplemental environmental projects (SEP)". Citizens can also make an appeal about a violation to EPA and the state, territory or tribe.

4.1.1.3 Public availability

When the permit is ready, issuing authority has to upload the permit limitations and special conditions into ICIS-NPDES (Integrated Compliance Information System for the NPDES program). This will ensure the surveillance. EPA's OECA (Office of Enforcement and Compliance Agency) is managing EPA's compliance and enforcement programs. The permit writer or a specific enforcement surveillance authority will supervise the enforcement.

ECHO (Enforcement and Compliance History Online) is EPA's public database collates data from EPA and non-EPA databases. It updates monthly and includes for example the information of ICIS-NPDES database. (http://www.epa-echo.gov/echo/index.html)

4.2 South America – a Paper and Pulp Mill Example in Uruguay

Text is based on information from:

BOTNIA S.A., Orion Pulp Mill, Uruguay – Independent Performance Monitoring Section Executive Summary, 2007, EcoMetrix inc.
BOTNIA S.A., Orion Pulp Mill, Uruguay – Independent Performance Monitoring Section 1.0: INTRODUCTION, 2008 EcoMetrix inc.
EIA Summary 2004/14001/1/01177, Carlos Faroppa & Kaisu Annala

Finnish pulp and paper industry has increasingly been expanding and shifting their work to foreign countries. Uruguay has been one of the new places where a Finnish pulp mill has been established. A thorough environmental impact assessment has been conducted and in the document it was

pointed out what type of emissions the mill is likely to cause and in what kind of situations. Different processes are described well and calculations about the emissions are presented in the summary. The target levels of the mill meet both IPPC and US EPA NSPS standards. Processes are aiming at effective water consumption. The physical effects are also assessed and simulations have been helping with the assessment. The effects of the mill to the biological state of the river have been evaluated. Hydrogeology and groundwater effects have also been included in the assessment summary.

According to the EIA summary, monitoring of the mill will be conducted on three levels. First one is the internal process control for the end-of-pipe system and pulp mill and it is conducted by the operator. Second one is the internal monitoring of the efficiency of the end-of-pipe systems and it is conducted by the supervisors of the mill. Third one is the monitoring of the environment and it is conducted by an independent entity. According to the Independent performance monitoring, Executive summary by EcoMetrix: "The monitoring programmes include the monitoring of the mill effluent, mill air emissions, water quality, sediment quality, biological indicators (plankton, invertebrates, fish), meteorological parameters, air quality, air inversions, groundwater, soil quality and terrestrial indicators (flora and fauna)".

4.2.1.1 Emission monitoring

Monitoring is conducted daily and weekly in the mill. Daily monitoring includes analysis of COD, SS, pH and conductivity. Conductivity and pH are also monitored continuously. Weekly monitored parameters include total phosphorus, total nitrogen and sodium. During the first six months of operation following parameters were analysed: temperature, pH, conductivity, colour, COD, BOD, suspended solids, ammonia, nitrate, total phosphorus and nitrogen, arsenic, cadmium, chrome, copper, iron, mercury, sodium, nickel, lead, sulphur, zinc, AOX, chlorophenols, phenols, chlorate, resin acids total, detergents (LAS), esteroles total, fats, cyanide, fecal coliforms, 2,3,7,8-TCDD and 2,3,7,8-TCDF (as TEQ).

Table 2. Emission monitoring programme (BOTNIA S.A., Orion Pulp Mill, Uruguay – Independent Performance Monitoring Section 1.0: INTRODUCTION, 2008)

Media	Location	Parameter	Frequency
Effluent quality	• Outlet from the effluent treatment plant	• pH • COD • BOD_5 • SS • AOX • N • P • Conductivity • >40 additional parameters	• Daily • Daily • Daily • Daily • Weekly • Weekly • Weekly • Daily • Parameter specific
Air quality	• Stack recovery boiler • Lime furnace • Gas boiler GOL • Gas boiler GOS	• SO_2, TRS, NO_x, Dust, CO • SO_2, TRS, NO_x, Dust • SO_2, TRS • SO_2, TRS, NO_x	• Continuous • Continuous • Continuous • Continuous

4.2.1.2 Monitoring of the environmental effects

The Uruguay River monitoring plan is also presented in the EIA summary. Once or a few times a year physical parameters, oxygen, nutrients, hydro biological parameters, fish population, bioaccumulation and some specific parameters are analyzed. The river data are publicly available.

4.3 China

Al the text about the Control of Water Pollution law is based on text found from the Asia Water Project webpage:
http://www.chinacp.org.cn/eng/cporg/cporg_sepa.html
http://www.asiawaterproject.org/regulatory-trends/water-regulations/

In 2008 the law on Prevention and Control of Water Pollution was promulgated. According to the law the supervision and administration of controlling and preventing water emissions is the responsibility of many different departments and institutions. Water quality monitoring of provincial boundary waters is conducted by the state determined local institutions. The maritime administrative body is responsible for the prevention and control of the water pollution from vessels. In addition, all entities and individuals are obliged to protect the waters.

State standards are formulated by the administrative department of environmental protection under the State Council. It is possible to work out local standards, which can be stricter than the state standards. The controlling and reducing of important water pollutants in a certain region is the responsibility of regional people's government. The State Council formulates the specific measures and implementation steps for people's governments in assigning the reduction and control of the total discharge of important water pollutants for the polluting entities.

In each region it is possible to decide the pollutants that are taken under observation. If the set limits are exceeded, the environmental impact assessment documents of new construction projects, which would increase the total discharge of important water pollutants, can be suspended. The regions, which have failed in controlling the water pollution, shall be published.

The entities that discharge pollutants into the waters need to have a permit to do so. The operator must let the supervising entity to know the concentrations, amounts and categories of the substances that will be discharged into waters under normal operating conditions. The operator also has to provide the relevant technical information about the preventing and controlling of water pollution.

Automatic monitoring is mandatory for major operators. The administrative department of environmental protection of the local people's government determines the operators that need to conduct automatic monitoring. There is a "pollutant discharge fee" that operators are required to pay. The fee is based on the category and quantity of the pollutant substance(s). The income from the fees must be used in the prevention and control of pollution. The state has the responsibility to organize water quality and pollution discharge monitoring system. The State Council is responsible for setting out the monitoring norms and reporting about the results. The authorized entities have the right to conduct random tests in the facilities of the operators.

It is prohibited to discharge certain substances into the waters or cause other damage to the water environment. Those substances and activities are listed in the law. More detailed information about the regulations can be found from the Asia Water Project webpage.

According to the legislation the distribution of industry needs to be planned and it is required from the enterprises that they make technical innovations and are more water efficient. Also reducing water pollution discharge is mentioned. The harmful techniques that are causing water pollution are published and need to be eliminated within a certain time limit. Also equipments which pollute waters are listed and it is prohibited to produce, sell, import or use them. It is prohibited to build some small-scale production projects. Enterprises need to adopt new clean technologies that are

more effective and cause less pollution and strengthen the administration to reduce the pollution discharges to waters. There are discharge standards for many different types of industries and those standards are available on webpage: http://english.mep.gov.cn/standards_reports/standards/water_environment/Discharge_standard/.

However, corruption is still a problem in China. State-owned factories are ignored by the local authorities even though those would be the major cause of pollution in a certain region (Lahtinen 2010). People probably are concerned about the environment but public participation regarding environmental issues is limited. In a recently published doctoral dissertation it was written that "Today, China's environmental policy lacks a critical monitoring system and correction mechanism and while local authorities enjoy a larger degree of freedom, there is a growing diversity amongst the Chinese provinces and towns in how they address local and regional environmental challenges" (Lahtinen 2010).

5 Comparison between the practices in different countries

In Uruguay the monitoring programme consists of a remarkable biological monitoring compartment. Harmful substances are measured regularly. In Finland the main concern has been in chemical monitoring. The harmful substances have been measured but when the concentrations have been under limits the monitoring has not been carried out every year but every permit period.

It is difficult to say where the limit values are most stringent. The approaches differ in different countries. In the USA the basis for permit control is the quality of the receiving waters. The limitations of loading have been set in such a way that the water quality remains good. In Europe the Best Available Technique, BAT, is the main basis for permit conditions. The limit values can be set as concentrations or loads. The concentrations are usually preferred in countries where rivers are the main recipients and as loads where waste waters are discharged into lakes.

IE-directive harmonizes the permit conditions. The operators have to comply with the best available technique described in the BAT-reports in all the member countries. In some special cases it is possible to deviate from the best available technique described in BAT-reports. Then the reason for this must be written in the environmental permit.

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