



BAT and Cleaner Technology in Environmental Permits

Part 2: Surface Treatment of Metals

PlanMiljø AS

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1. Introduction

1.1 Scope

The working committee Product/Waste (The P/A group) under the Nordic Council has asked PlanMiljø to be responsible for carrying out the project of preparing an easy to use tool for identifying what environmental terms, Best Available Technology (BAT) and Cleaner Technology (CT) that are used by the environmental authorities in the Nordic countries within the fishing industry and the metal processing industry.

This document reports on the results related to the metal processing industry and more specific on the surface treatment processes.

The involved countries are Denmark, Iceland, Norway and Sweden. Finland has decided not to participate as the scope was not considered relevant for them.

1.1.1 Target group

The specific target groups for the report are:

- Primarily employees in the public administrations that approve industrial activities with environmental impact in the surface treatment industry.
- Employees working with the environmental issues in Small and Medium sized Enterprises (SME) that operates within the surface treatment industry.

In environmental administrations, with just a few surface treatment industries within their jurisdiction, the employees do not necessarily have contemporary experience in working with environmental applications and environmental permits. Hence, they need information they can lean on when making the environmental permits and when communicating terms, BAT and CT with the industry. In this context, the quite complex BREF documents (Best Available Techniques reference) are not always of much help. (Although a short executive summary in all membership country languages are available for all BREF documents.)

Also, companies working with surface treatment processes can hopefully find inspiration in this document when considering BAT/CT. The reason that the focus is on SME in this project is that the larger companies in general have the competences to work with the more complex BREF documents.

1.1.2 Aim

The overall aim of the project is to ensure that the Nordic industry is producing according to technologies and methods that lead to the lowest possible impact on the environment. This overall aim should be achieved through formulation of conditions in environmental permits and licenses which are as uniform as possible¹ within the various industrial sectors.

The immediate aim is to elaborate an easy-to-use tool for Nordic environmental authorities providing them with guidance, and to get:

- an overview of practices used by Nordic colleagues
- an overview of the Nordic experience concerning terms, BAT and CT.

More specifically, what terms have been used when formulating conditions in the permit and licensing process. The tool can also be seen as a guide to industries applying for permits etc.

It is important to be aware of the fact that the environmental permit is just the end-result of the licensing process that is often carried out in close dialog between the environmental authorities and the industries. The terms and condition stated in an environmental permit can therefore not necessarily be taken out of the context in which it was defined.

The tool should therefore not be used to define the exact terms and conditions in an environmental permit without considering the specific context, nor as a substitute for dialog. It is meant as an inspiration for the environmental authorities and enterprises.

The tool can relatively easy be elaborated into an internet based datasheet.

1.1.3 Processes included

The iron, steel and metal processing industry covers a huge variety of different production technologies and products. As it is too comprehensive to focus on all processes in this project, it has been necessary to focus on certain processes.

The project has looked specifically into the following seven surface treatment processes:

- Blast cleaning
- Degreasing with organic solvents
- Water based degreasing
- Galvanising
- Powder painting
- Spray painting with liquid organic coatings
- Immerse finishing

¹ Variations will always occur considering localisation etc.

These seven processes have been selected since they have earlier been described as the most common methods and processes related to surface treatment of metals².

1.2 Main Environmental Impacts

The following is a list of the main environmental problems and their impact:

- The main problem from the blasting process is related to the dust. Especially dust with heavy metals can be problem. Likewise the waste water and waste can include heavy metals.
- The dominating problem from the degreasing with organics solvents is the emission of solvents into the air. The most toxic solvents are the halogenated substances. Besides the air pollution, a problem is the solvents ability to accumulate into, and leakage from, sewerage systems and thereby causing ground water pollution.
- The main problem related to water based degreasing is the content of oil in the waste water and to some degree heavy metals.
- The main problem from the galvanising is the release of aerosols that influence the working environment. Waste water will normally need pre-cleaning before discharges to the sewer system.
- The main problem from powder painting is the emission of dust, especially epoxy dust which is influencing the working environment.
- The main problem related to spray painting is related to the emission of vaporised organic solvents.
- The main problem with immerse finishing is also the emission of the applied solvents.
- Furthermore, the processes all create some form of hazardous waste that needs to be handled.

² Vejledning fra Miljøstyrelsen, nr. 2 1998, Tilsyn med de ydre miljøforhold ved overfladebehandling af metaller.

2. Existing BAT/Cleaner Technology Material

2.1 Existing material

All though the aim of this project is to explore and refer to the terms that specifically have been used in the Nordic environmental administrations, there is a lot of existing related material that could be of interest to the reader. In this chapter there will be looked more into such material.

Five different BREF's are dealing with the metal industry in some way and could as such be relevant for the reader:

- BREF on the Ferrous Metals Processing Industries, December 2001
- BREF on the Production of Iron and Steel, December 2001
- BREF on Non Ferrous Metals Industries, December 2001
- BREF on Surface Treatment of Metals and Plastics, 2006
- BREF on Surface Treatment using Organic Solvents, August 2007

If specifically looking into surface treatment "BREF on Surface Treatment of Metals and Plastics" is properly the most interesting. Secondly "BREF on Surface Treatment using Organic Solvents" can be of interesting if such activities are carried out.

In the course of reporting this project other relevant documents have been identified that could be relevant for the target group. The following documents can be recommended:

- "*DEA – an aid for identification of BAT in the inorganic surface treatment industry*" (TemaNord 2002:525). It describes in more details some of the theory and methods for specific BAT's.
- "Miljørigtig overfladebehandling af metaller og plast – Gennemgang og kommentering af EU's referencedokument med BAT-anbefalinger for den metaloverfladebehandlerende industri"(Arbejdsrapport fra Miljøstyrelsen Nr. 1 2007). It goes through the BREF's within the sector. Also there is a short and systematic overview of the BAT solutions presented in the BREF document.
- "Overfladebehandling med organiske opløsningsmidler – Gennemgang og kommentering af EU's referencedokument med BAT-anbefalinger for industrier, der foretager overfladebehandling med organiske opløsningsmidler" (Arbejdsrapport fra Miljøstyrelsen Nr. 2 2008). It goes through the BREF's within the sector. Also there is a short and

systematic overview of the BAT solutions presented in the BREF document.

- BAT tjeklister 2008 (Miljøstyrelsen på Hjemmesiden: <http://www.key2green.dk/page534.aspx>). Gives a good overview of the BREF's.

2.1.1 BAT BREF solutions

The BREF documents are normally quite complex and intended to be used by larger industries. However, there is a short executive summary for the BREF documents that is not very complex and give a good overview.

Below a number of possible BAT solutions are listed. The list is not complete, as the purpose mainly is to give an overview of the content and configuration of the BREF's. To get more specific knowledge, please refer to the relevant BREF document.

A list of examples on BAT that are common for all the sub-sectors is found under Section 2.1.2. Subsequently, BAT specific for each of the sub-sectors are described in Section 2.1.3.

2.1.2 General BAT

Examples below are copied from “BREF on Surface Treatment of Metals and Plastics” and “BREF Surface Treatment using Solvents”. The BAT's described are only examples from the total list and by no means exhaustive.

1. Management techniques

- Implement and adhere to an Environmental Management System
- It is BAT to implement a housekeeping and maintenance programme
- Plan actions and investments to achieve ongoing improvements.

2. Installation design, construction and operation

- Prevention of unplanned emissions through proper design, construction and operation
- Reduce fire and environmental risk in storage and handling of hazardous materials
- Minimise consumption and emission through training of staff, written up-to-date operational procedures, and operation of a planned maintenance system.

3. Utility inputs – energy and water

- Benchmark utilities.

4. Monitoring

- Monitor VOC emissions (Combine with a solvent management plan)
- Calculate solvent balances regularly.

5. *Water Management*

- Minimise water usage by monitoring all points of water.

6. *Reducing, reusing, and recycling rinsing water*

- Cascade rinsing
- Recover raw materials and/or water
- Use closed cooling systems and/or heat exchange systems
- Avoiding the need for rinsing between activities
- Reduce drag-in and minimize drag-out.

7. *General process solution maintenance*

- Increase the process bath life as well as maintain output quality.

8. *Energy management*

- Maintenance and adjustment of equipment to the correct settings
- Maximise the amount of solvent being captured with minimum air intake.

9. *Raw material management*

- Ensure that the raw materials used have the lowest possible environmental impact
- Minimise raw material consumption (various techniques described).

10. *Coating processes and equipment*

- Reference is given to BREF on Surface Treatment of Metals and Plastics.

11. *Drying/curing for all surface treatment*

- Chose a system that minimise solvent emissions and energy usage, and maximise raw materials efficiency.

12. *Cleaning*

- Conserve raw materials and reduce solvent emissions by minimising colour changes and cleaning
- When cleaning spray guns, minimise the release of solvent by collecting, storing and reclaiming for re-use the purge solvent used to clean coating spray guns and/or lines. 80 to 90% can be re-used.

13. *Using less hazardous substances (substitution)*

- Select non-solvent or low solvent techniques for cleaning
- Minimise adverse physiological effects by replacing those with the risk phrases R45, R46, R49, R60 and R61 in accordance with Article 5(6) of Council Directive 1999/13/EC

- Minimise adverse eco-toxic effects by replacing those with the risk phrases R58 and R50/53 where there is a risk of emission to the environment and alternatives exist
- Reduce stratospheric (high level) ozone depletion by replacing those with the risk phrases R59. In particular, all halogenated or partially halogenated solvents with the risk phrase R59 used in cleaning should be replaced or controlled
- Minimise the formation of tropospheric (low level) ozone by using VOC's or mixtures with a with lower ozone formation reactivity where other measures to reduce fugitive or unabated solvent emissions to meet emission levels associated with BAT are not possible or not technically applicable, such as having unfavourable cross-media effects.

14. Emission to air and waste gas treatment

- Several opportunities are described.

15. Waste water treatment

- Several opportunities are described.

16. Materials recovery and waste management

- Prevent material loss and recover and reuse and recycle materials
- Recover and reuse solvents.
- It is BAT to reduce drag-in and drag-out

17. Odour abatement

- Reduce odour e.g. by changing the type of process or the materials used, by using waste gas treatment or by installation of high stacks for waste gas emissions.

16. Noise

- Reduce noise by using appropriate control measures such as closure of bay doors, minimise deliveries and delivery times
- Reduce noise through installation of silencers, use of acoustic enclosures etc.

17. Groundwater and soil protection and site decommissioning

- Prevent emission to soil and ground water.

2.1.3 BAT/CT specific for Surface treatment

The following are BAT/CT, specific for cleaning, painting and/or coating of various objects, are extracted from the BREF documents. Many of the opportunities are already partly covered by the general BAT/CT listed in Section 2.1.2.

1. Joint BAT

- BAT 126. Select paint and dryer systems that minimise solvent emissions and energy usage, and maximise raw material efficiency (BAT 28).
Combine with air and gas treatment in accordance with BAT 37 to 42

2. Solvent emissions to air

- BAT 127. Use low solvent paints and/or BAT 126 in conjunction with the general BAT. Emission values of VOC associated with these techniques are 0.1 to 0.33 kg VOC/kg solid input (for most processes)
- BAT 128. Replace paints based on halogenated solvents by other coating systems.

3. Materials efficiency

- BAT 129. Reduce material consumption (including solvent use) by using high efficiency application techniques.

1–4 derive from “BREF on Surface Treatment using Organic Solvents”.
The BAT numbers refers to chapter 21.

4. Degreasing/cleaning with organic solvents

- Emission of solvents to the air can be reduced by increasing the cooling zone efficiency
- When removed from the (heated) baths the drag-out of metal can be reduced up till 75% by increasing the drip-off period, by air drying, or by spray rinsing the treated metal
- By installing a coal adsorption unit, 98–99% of the air emissions can be removed. The adsorbed solvents can be regenerated with steam
- Emission of solvents to the air can be reduced by increasing the cooling zone efficiency
- By using water based degreasing technologies the emission of solvents to air can be fully eliminated. Changing to water based degreasing implies a total replacement of the existing degreasing unit.

5. Water based degreasing

- The use of de-emulsifying degreasers extends the lifetime of a degreasing bath and increases the possibilities for reusing the water
- The oil/fat and micro contents in the rinsing bath can be minimised by using an oil skimmer and ultra- or micro filtration of the rinsing bath, by which the lifetime of the rinsing fluid is also extended. From the filtration unit oil/fat can be drained out in a concentrated form
- By establishing a biological separation at alkaline degreasing units, the contents of oil/fat in the rinsing water can be reduced
- By covering the surface (of the degreasing baths) with e.g. plastic balls, evaporation can be reduced by up till 90% and the loss of heat by up till 60%

- Some degreasing substances are effective at low temperatures, and by using these, a reduction of energy consumption can be achieved
- Consumption of water can be reduced by establishing the succeeding rinsing as return flush and by (partly) returning used rinsing water to the degreasing bath
- Inhibitors (anticorrosion agents) in the degreasing bath can be avoided in larger units for degreasing of iron/steel by a fast drying of the items with overheated steam or hot air. In smaller units without succeeding rinsing, sodium silicate can be used as inhibitor in the degreasing bath
- By using de-mineralised water, the use of complex compounds is not needed in the degreasing agent.

6. *Galvanising*

- By installing ultra filtration and double return flush, the consumption of water and the amount of wastewater can be reduced significantly, to a point at which wastewater is almost eliminated. This is especially of relevance for larger units
- By covering the surface of the bath (both for the immersing and the sluicing process) with e.g. plastic balls, evaporation can be reduced by up till 90% and the loss of heat by up till 60%
- Automatically registration and dosage of chemicals reduces the use of chemicals
- The consumption of water and energy can be reduced by connecting the control of the process to the conveying of the items.

7. *Spray painting with liquid organic coatings*

- The utilisation of paint can be increased significantly by making the items electrostatic, and the emissions are reduced proportional
- HVLP-guns (High Volume Low Pressure) operate at a lower pressure than traditional spray guns. By that both consumption and over-spray can be reduced
- The over-spray is lower when using hybrid spraying, than when using pneumatic or hydraulic spraying
- Depending on the technical demands for the surface quality alternative paints and processes can be applied, e.g. water-based paints, high-solid paints or powder painting. In some cases it is possible to use items that are pre-treated with e.g. powder paint.

8. *Immerse finishing*

- Whenever it is technically possible, immerse finishing should be substituted by powder finishing methods, or the use of water-based paints or high solids should be considered

- The slit through which the items are immersed into the bath, must be reduced to the smallest size possible
- Reflux of dripping-off paint can reduce the consumption of paint and the emissions of organic solvents into the air.

3. Data Sheet (Easy-to-use Tool)

3.1 General remarks

In the following tables specific terms made by authorities in the environmental permits are presented. Moreover BAT/CT described by the industries in their environmental application is mentioned if they are considered to be of interest to the target group.

Specific emission values and terms for the described processes have only been found on a very limited basis. In general, emission limits in the environmental permits refer to the legislation³. It has not been the purpose of this document to refer to common legal terms but to focus on more special terms and limit values. Hence, if in an environmental permit, it is indicated that the limit value must be within the legislation or other common standard, the value is not included in the table below. Instead we refer to the appropriate national authorities.

It is again important to state that the aim of this project is to give examples of what have been written and approved in environmental permits in the Nordic country, to serve as inspiration on how terms can actually be formulated in environmental permits. Only hands-on examples are included, and the description is kept as true to the original text as possible.

Since legislation can vary across time and national borders, the stated terms should not be used or copied without ensuring they correspond with the valid national legislation.

In the environmental permits, several terms, conditions and requirements are made. Since it is not relevant to include all terms, there has been a critical selection process. The following criteria have been used in the selection process:

- Terms that have interest for authorities working with SME have been prioritised
- Terms of a too soft formulated nature have normally been excluded (e.g. “*it is a good idea to...*”)
- Terms that referred to national legislation have not been included (as these can be found by referring to the relevant authorities)
- Terms referring to noise have not been included (as these are based on local conditions)

³ In Sweden, the terms seldom comes from specific limit values in the legislation.

- Processes related to the general heating of the premises have not been included as these are not very industry specific
- Similar terms have generally not been repeated when found in different permits.

All in all 37 environmental permits have been received; hereof six from Sweden, two from Norway and 29 from Denmark. The first table (Table 3.1) refers to general terms and processes, while the second table (Table 3.2) is referring to more process specific terms.

Table 3.1: Terms, Bat and CT for general processes used in environmental permits

Environment	BAT/cleaner technology/procedure	Effect/Result	Conditions/terms	Reference (country-year)
Water				
Reuse of water	Reuse of cleaned waste water after degreasing and pickle	Less water used (30%) and less waste water	Described as a cleaner technology used by the company in the environmental application that is approved by the authorities.	Environmental permit – Midtjydsdsk Fornikling og Forchromning (DK-2008)
Air				
VOC and chemicals	Substitution of VOC and chemicals	Less VOC and hazardous chemicals	VOC or chemical products which are hazardous should as soon as possible, if technological possible, be substituted with less hazardous products.	Environmental permit – Dymek (DK-2006)
Dust				
Waste				
Waste handling	Production of waste	Less waste	The company is obliged, as far as possible without undue costs or nuisance, to avoid generation of waste. Especially the content of hazardous substances in the waste shall be avoided as much as possible.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Environmental permit – Ørsta Stål (NO-2007)
Waste handling	Re-use of waste	Less waste and use of raw materials	Waste that is a product of the operations must strive re-used in the production or other companies' productions, or – for combustible waste – strive to be used for energy production.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Environmental permit – Ørsta Stål (NO-2007)
Waste handling	Sorting	Better re-use of waste	The waste must be sorted and hazardous waste shall not be mixed with other types of waste.	Environmental permit – Rogaland Pulverlakk AS (NO-2007)
Waste water				
Waste water system	Control of the waste water system	Avoid spill	The company shall at least every 10th year prove that the waste water system is tight.	Environmental permit – Midtjydsdsk Fornikling og Forchromning (DK-2008)

To be continued

Continued						
Waste water system	Terms for the system	Better control with waste water	There must be established a measuring cesspool for sampling and measuring of the total disposal of waste water before connection to the public waste water system. The installation shall be approved by the municipal administration.	Environmental permit – Carøe Industriflakering (DK-1984)		
Waste water amount and quality	Maximum quantity (and quality)	Waste water quality is acceptable for Waste water treatment plant	It is not allowed to discharge more than 15 m ³ to the public waste water system. The waste water may not contain chemicals which can deteriorate the system, related facilities or the persons operating them.	Environmental permit – Carøe Industriflakering (DK-1984)		
Storage						
Floor cover	Acid resistant floor	Less chance of external pollution	The company must have tight acid resistant floor cover where there are process batches.	Reassessment of the Environmental permit – Odense Galvano Industry (DK-2005)		
Storage of chemicals	Safe handling and storage Chemicals	Less chance of external pollution	No outdoor storage of chemicals and hazardous waste. Chemicals and hazardous waste must be stored in tight closed containers/tanks indoor on impermeable floors without drain. The municipality can demand that an impartial consultant makes the inspection; Maximum once a year.	Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)		
Collection capacity	The capacity for spill collection	Less chance of external pollution	There must be collection capacity corresponding to the volume of the largest stored container/tank.	Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)		
Collection capacity	The capacity for spill collection	Less chance of external pollution	There must be collection capacity corresponding to the volume of the largest stored container/tank and 50% of the stored volume.	Environmental permit – Bodycoat (SE-2006)		
Hazardous waste	Storage of hazardous waste	Avoid spill of hazardous waste to the environment	Hazardous waste must be stored in tight closed containers. The containers must be kept under a roof and be protected against the weather. The storage area must be with tight floor without drain. The area must be made so that spills can be kept within a delimited area without potential for discharge to soil, ground water, surface water or drainage system.	Environmental permit – Dymek (DK-2006)		
Sand trap	Installation of sand trap	Less sand from blasting in waste water	In the environmental permit it is stated that there must be established a sand trap within five month on the paved area in front of the blasting hall. The term is made due to the fact that there has been observed over-normal amount of sand in the waste water system.	Environmental permit – Stålcøating AS (DK-2003)		

To be continued

Continued					
Chemicals	Storage of hazardous chemicals	Less chance of fire and contamination	Storage of chemicals must be undertaken in a way so there is no risk of discharge/emission to water, air or soil and such as there is no danger of fire. This implies that acid and cyanides must be stored separately to avoid generation of Cn gasses. Flammable and oxidising chemicals must be stored separately to reduce fire risk. The storage shall be made so potential leakages do not contaminate the ground water and water.	Environmental permit – Ørsta Stål (NO-2007)	
Hazardous waste	Labelling and protection	Better control with hazardous waste	Hazardous waste that is stored and awaits further delivery must be labelled and the storage shall be protected against discharge and potential evaporation to the air. The storage shall be protected against entry of intruders. Hazardous waste must not be stored more than 12 months.	Environmental permit – Ørsta Stål (NO-2007)	
Resources					
Energy	Energy assessment	Less energy consumption	The company must perform an energy analysis with the intention to optimise the energy consumption in the company.	Environmental permit – Bodycoat (SE-2006)	
Energy	Reduction in the consumption of electricity for the electrolytic process for heating and heating of batches by changing to heating by natural gas	An expected reduction in electricity consumption of 25%	In the environmental application, this is described as a cleaner technology the company will use.	Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)	
Energy consumption	Energy accounting and reporting	Better control of energy consumption	Specific energy consumption must be accounted and reported on a yearly basis.	Environmental permit – Rogaland Pulverlakk AS (NO-2007)	
Energy control	There must be an energy control system	Efficient energy usage	The company must have a system for continuously assessing what can be initiated to obtain the highest possible energy efficiency in the production facilities.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Ørsta Stål (NO-2007)	
Energy	Improve energy efficiency	Less energy consumption	At significant process changes or expansion of the facilities, measures to improve the energy efficiency must be evaluated.	Environmental permit – Rogaland Pulverlakk AS (NO-2007)	
Chemicals					To be continued

Continued				
Hazardous chemicals	Check if hazardous chemicals can be substituted by other chemicals	Avoid hazardous chemicals that can be substituted	The company must under supervision of the authorities go through the use of chemicals with the intention to substitute to less hazardous chemicals.	Environmental permit – Bodycoat (SE-2006)
Chemicals	Knowledge of chemicals and alternatives	Less use of hazardous chemicals and better control	Chemicals that are used in a way where they can lead to risk of contamination must be tested for degradability, toxicity and bioaccumulation by accredited laboratories. The company must establish a system for substitution of chemicals and raw materials. There must be made continuously assessment of the effects related to health and environment caused by the used chemicals and raw materials. If better alternatives exist these must be used, within a reasonable economical frame.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Ørsta Stål (NO-2007)
General				
Environmental Management	Environmental Management	Introduction of environmental management will help the company and the environment	A recommendation made by the authorities under Cleaner Technology section.	Environmental permit – GPV Laser Teknik (DK-1999)
Environmental statement/account	Yearly environmental statement	Better environmental account	In every fiscal year an environmental statement must be made including information on environmental improving measures taken and planned and a description how reuse is optimised.	Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)
Drag -out	Reduction and reuse of drag-out	The company avoids and minimise waste of chemicals and raw material	Described as a BAT used by the company in the environmental assessment that is the basis for the re-consideration of the environmental permit.	Environmental assessment – Roskilde galvanisering (DK-2007)
Hazardous chemicals	Check if hazardous chemicals can be substituted by other chemicals	Avoid hazardous chemicals that can be substituted	The company must under supervision of the authorities go through the use of chemicals with the intention to substitute to less hazardous chemicals.	Environmental permit – Bodycoat (SE-2006)
<i>To be continued</i>				

Continued				
Trial period	The company is allowed to operate under a trial period where it has to assess several environmental parameters before the final environmental terms are defined	Better environmental terms can be made	The company is required to make several environmental assessments with in a short time span (1½ year).	Environmental permit – Bodycoat (SE-2006)
Discharge/emission	Reduce discharge and emission if possible	Less discharge and emission	In the environmental approval it is stated that all pollution from the activities, including emission to air and water, as well as noise, dust and waste, is unwanted. Even if the discharge is within the defined discharge limits, the company is obliged to reduce the discharges as much as possible without undue costs. The obligation is also valid for components where there are set no explicit limits in the approval.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) And Environmental permit – Ørsta Stål (NO-2007)
Discharge	Production reduction must lead to proportional discharge reduction	Less discharge	For production processes where the discharge is proportional to the amount of production, a reduction in the production as defined in the approval must result in a proportional reduction in the discharges.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Ørsta Stål (NO-2007)
Contamination risk	Measures at increased risk of contamination	Better control and knowledge of potential contamination	If in relation to irregular operations or other reason there is a risk of increased contamination, the company is obliged to introduce necessary measures to eliminate or reduce the increased contamination risk, including reducing or stopping the operation if necessary. The company must as soon as possible inform the authorities of any irregular condition that has contamination significance.	Environmental permit – Rogaland Pulverlakk AS (NO-2007)
Internal control	Internal control of processes	Better control of processes that can lead to discharge and contamination	The company is obliged to make internal control according to the current valid instructions. The internal control shall among other things ensure and prove that the company is in compliance with terms in the approval, the pollution legislation, the product legislation and other relevant laws. The internal control must be up-to-date. The company is obliged to have a summary at all times that shows all activities that can lead to contamination and account for the risk conditions.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Environmental permit – Ørsta Stål (NO-2007)
<i>To be continued</i>				

Continued						
Environmental risk assessment	Environmental risk assessment	Better knowledge of risk	The company must make an environmental risk assessment. The company must evaluate the results in accordance with acceptable environmental risks. Potential sources for pollution of water, soil and air must be mapped. The assessment shall prove and include all conditions from the company that can lead to acute pollution.	Environmental permit – Rogaland Pulverlakk AS (NO-2007) and Ørsta Stå (NO-2007)		
Excavating	Excavating soil and sediments	Avoid spreading of pollution	Excavating or other measures that can influence contaminated soil or sediments require approval according to the pollution legislation, possibly the municipality.	Environmental permit – Ørsta Stå (NO-2007)		
Reporting of emissions and discharge	Yearly reporting of emissions and discharge to the authorities	Knowledge of emission and discharge	The company must report on a yearly basis on standardised schemes that is send out by the authorities. The company shall in connection with the reporting of emission/discharge comment on the uncertainty of the data material.	Environmental permit – Ørsta Stå (NO-2007)		
Inspection	Inspections at all times	Control of activities	The company is obliged to let representatives from the environmental administration or those authorised by this to make inspections of the facilities at all times.	Environmental permit – Ørsta Stå (NO-2007)		

Table 3.2: Terms, Bat and CT for specific processes

Processes	BAT/cleaner technology/procedure	Effect/Result	Conditions/terms	Reference
Blast cleaning				
Air quality measurements	Measurement of the air quality	The risk of harmful air quality is reduced	The company must every second year carry out measurements that prove that they comply with the emission terms.	Environmental permit – Gladsaxe metalsliberi (DK – undated, probably 2001)
Operational records	Monthly records	Better knowledge of environmental performance	The company must make monthly records that are available for the municipality, of the operation. The reporting includes several environmental parameters.	Environmental permit – Gladsaxe metalsliberi (DK – undated, probably 2001)
Particle Filters	Use of Particle filter	Less particles in the outside air	Air with particles from the blasting process must pass an efficient particle filter before emitted to the outside.	Environmental permit – Odense Galvano Industri (DK-1997)

To be continued

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Pressure relations	Tight doors and gates	Avoid dust from blast cleaning in the outside air	Doors and gates to the open must be tight. The fraction between exhaust air and sucked in air must be so that there is a constant lower pressure in the blasting carbine under operation.	Environmental permit – Dymek (DK-2006)
Alarm on filter	Alarm system connected with the filter	Broken filters are revealed so emission can be avoided	The must be installed difference-pressure meters on every filter. The pressure meter must be connected to an alarm system that reacts with light or sound at problems with the filter. At the same time the control system must close down the blasting facility.	Environmental permit –Dymek (DK-2006)
Degreasing with organic solvents				
TCE	Only use TCE when technical solution	Less TCE and less hazardous waste	It is stated in the environmental application that TCE only is used when it is the sole technical solution. Some of the costumers within the electronic industry require very harsh terms regarding the cleanliness of the product. The geometry or size of the product can make it impossible to used water based degreasing.	Environmental permit – GPV Laser Teknik (DK-1999)
TCE	Use of gas detectors	Less TCE	The emission of TCE may not exceed 25 gram pr. hour. The company must establish 3 gas detectors at relevant locations.	Environmental permit – GPV Laser Teknik (DK-1999)
TCE	Tight floor	Avoid soil and ground water contamination	One room must have tight floor and waste water system above the floor to avoid soil contamination.	Environmental permit – GPV Laser Teknik (DK-1999)
Use of organic degreasing for special parts	Minimising usage of TCE	Less TCE	The company must work out an Action Plan for the next 8 years with regard to minimising the use of TCE. The Action Plan must include time schedule and methods for project related to testing alternative cleaning solvents (e.g. soap and water) and alternative working processes, including raw materials and cooling/lubricants. The projects shall be prepared in cooperation with the environmental authorities, The Danish Working Environment Service, suppliers and relevant consultants and must be paid by the company. The projects must report the latest results on a yearly basis including the yearly amount of metals that are still degreased with TCE as well as the yearly consumption of TCE.	Environmental permit – GPV Laser Teknik (DK-1999)

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Water based degreasing			
Galvanising			
Chrome (VI)	Substitution of chrome (VI) (with Chrome (III))	No use of chrome VI	The chromium plating with chrome (VI) must, at the latest seven month after this permit is given, be faced out from the production. Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)
Water reduction	Use of 2 and 3 step return flush as well as automatic control of water addition	Reduce the water consumption with 50% compared to the former level	Described as a cleaner technology used by the company in the environmental application that is the basis for the environmental permit. Environmental permit – Midtjydsk Fornikling og Forchromning (DK-2008)
Drag-in/drag-out	Optimise drainage method	A significant source for increased raw material use, water consumption and waste is drag-in/drag-out from one process to the other. Reduction partly by suitable drainage time, IT controlled transportation and by the way of suspension to maximise draining	Described as a cleaner technology used by the company in the environmental application that is the basis for the environmental permit. Environmental permit –Midtjydsk Fornikling og Forchromning (DK-2008)
Cyanide	Lower concentration of cyanide in process batches	Less use of cyanide using traditional process batches	Described by the company as a cleaner technology they use in the approved environmental application. Environmental permit – Roskilde Galvanisering (DK 1996)
Chromate	In a new line chrome (III) is used instead of chrome (VI)	Less environment impact, partly because chrome (III) has less impact and partly by water savings because of longer life time in the chrome (III) batches	Described by the company as a cleaner technology they use in the approved environmental application. Environmental permit – Roskilde Galvanisering (DK 1996)

To be continued

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Sludge drying	Introduction of sludge drying process	Makes it possible to extract 60% of the water from the sludge. This water is reused in the process	Described by the company as a cleaner technology they use in the approved environmental application.	Environmental permit – Roskilde galvanisering (DK-1996)	
Waste water	Cleaner Technology	One production line (Tromlenikkellinen) is based on cleaner technology wherefrom there is no process waste water.	Described by the company as a cleaner technology they use in the approved environmental application.	Environmental permit – Odense Galvano Industri (DK-)	
Zink bath	Cleaning measures for dust emission		The company must within 15 month establish cleaning measures for the dust emission from the zink bath. The emission must be < 5 mg/Nm ³ .	Environmental permit – Ørsta Stål (NO-2007)	
Powder painting					
New types of paints	Avoid excessive use of harmful paints	Less use of harmful paint	If the company starts to use new types of paints and the usage exceeds 100 kg/year it must be verified that the new types of paint do not harm the environment more than the ones approved in the environmental permit.	Injunction on changed terms – PMC technology (DK-2004)	
Nozzle capacity	Decrease capacity of nozzle	Less use of paint etc.	When applying primer or enamel paint it is not allowed to use a nozzle with a capacity of more than 0.15 l/min at 20 bar.	Injunction on changed terms – PMC technology (DK-2004)	
Spray painting with liquid organic coatings					
Water based paint	Change to water based paint	Less or no VOC problems	A recommendation for cleaner technology by the authorities.	Environmental permit – anonymous (3980-Odense) (DK-2003)	
Thinner	Control emission of thinner	Reduced emission of thinner	The company may as a maximum emit 2.5 kg/hour solvents defined as thinner and must have records on amount of used solvents.	Environmental permit Europarts – (DK-2003)	
Painting	Maximum use of thinner	Less VOC problems	The company may as a maximum emit 6.0 kg/hour thinner.	Environmental permit – AC hydraulic AS (DK-2003)	

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Solvent records	Keep records of use of solvents	Control of use	The company must keep records of the daily use of solvents.	Environmental permit – AC hydraulic AVS (DK-2003)	
Thinner	Regeneration of thinner	Less consumption of thinner	The thinner must, as much as technical possible, be regenerated by the plant.	Environmental permit – Dymek (DK-2006)	
Close doors	Room sealing	Avoid spreading of paint and solvents	While painting, doors, windows and gates to the production location must be closed.	Environmental permit – Dymek (DK-2006)	
Pressure relations	Tight doors and gates	Avoid spreading of paint and solvents	Doors and gates to the open must be tight. The fraction between exhaust air and sucked in air must be so that there is a constant lower pressure during painting.	Environmental permit – Dymek (DK-2006)	
Alarm on filter	Alarm system connected with exhaust capacity	Drop in exhaust capacity revealed so indoor air problems reduced	There must be installed supervision of the exhaust capacity connected to an alarm system that reacts with light or sound if the capacity drops. At the same time painting must be stopped.	Environmental permit –Dymek (DK-2006)	
Regeneration of solvent	Reuse the solvent until saturated with enamel, where after it is re-generated in the company's own facility	Earlier approx. 15,000 was disposed of that is now regenerated	A BAT that the company describes it uses in the environmental application that is approved.	Environmental permit – CN autolakering (DK-2008)	
Substitution of paint	Use of water based paint	No (Less) organic materials in air	It is stated – in the environmental application that is approved – that water based paint is used.	Environmental permit – Europarts (DK-2003)	
Immerse finishing					
Water based	Change from solvent based to water based paints	Less VOC problems. Now only the primer is based on solvents	A cleaner technology that the company describes it uses in the environmental application.	Environmental permit – AC hydraulic AVS (DK-2003)	

