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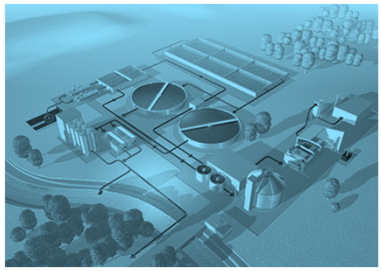
Sustainable wastewater-management



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1. What is your company manufacturing?
2. How ready is your company for the new regulations?

2

Overview workshop series

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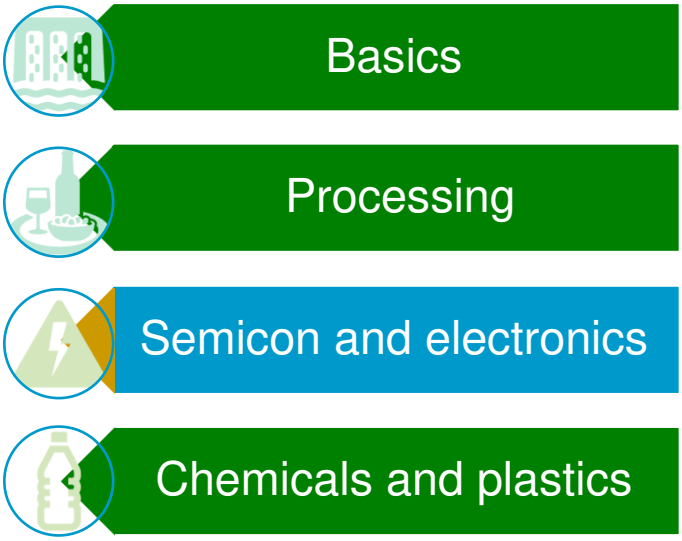

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Waste Water Technologies

Semicon and electronics
21.07.2021

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Content of this presentation

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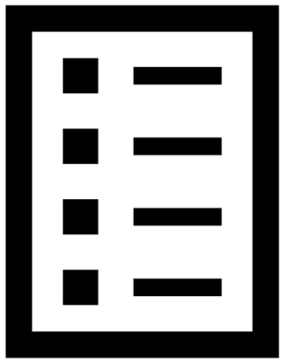
Agenda

- Electric sector
- Wastewater
  - Categories
  - Challenges
  - Treatment step
- Treatment options
- summary

Semicon and electronics



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Water – Waste water

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Introduction

Industrial waste water

- serious pollution problems
- negatives effects to the ecosystem
- human's life

Required limitation for

- Colour
- Turbidity
- Temperature
- Odour
- pH
- total solids (suspended and dissolved)
- Hardness
- chemical oxygen demand (COD)
- …

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Categories

High-concentration

- wastewater may sometimes be concentrated further, treated, and recycled or disposed as solid wastes.

Medium-concentration

- may be threated on site or discharged into public sewers.

Low-concentration

- such as indirect cooling water may be discharged without any treatment.

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Challenges
High load of

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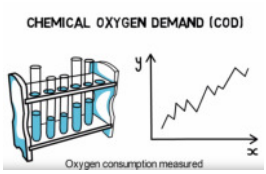
cyanide

Toxic metals

Chemical oxygen demand



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Challenges
Harmful wastewater

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Challenges
Cost of treatment

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Challenges
ressources, example

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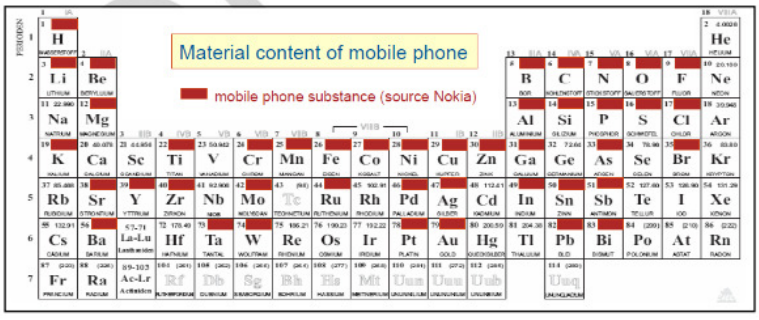
Figure 2.10: Metals in a mobile phone



Source: Hagelüken & Buchert (2008)

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Challenges
Life-cycle-approach

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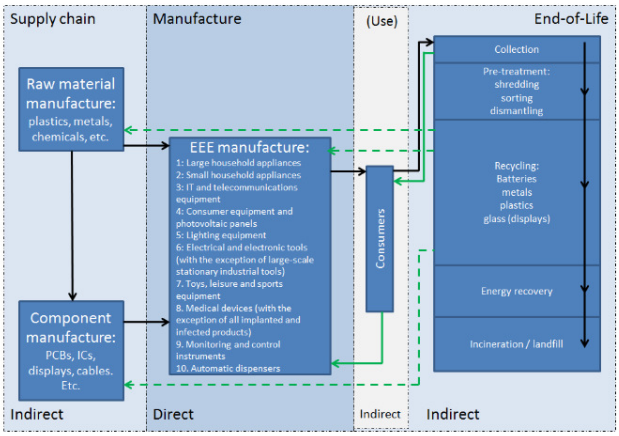
Figure 2.15. Overview of Input and Output Flows of Sector Activities (Manufacturers' Perspective)



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Challenges
Environmental aspects

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Table 2.3. Environmental Aspects and Associated Environmental Pressures (Manufacturers' Perspective)

Most relevant environmental aspects	Related main environmental pressures
Component manufacturing and assembly	Resource efficiency Water Waste Emissions to air Energy and climate change Hazardous substances
Final product assembly	Energy and climate change
Plant utilities	Resource efficiency Water Waste Emissions to air Energy and climate change Biodiversity
Site management	Water Waste Emissions to air Energy and climate change Biodiversity
Sourcing of materials and components	Resource efficiency Biodiversity
Supply chain management	Resource efficiency Energy and climate change

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Challenges
Environmental pressure

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Table 4.1. Overview of the Developed BEMPs for EEE Manufacturing and the Addressed Environmental Pressures

	BEMP	Environmental pressures addressed						
		Resource efficiency	Water	Waste	Emissions to air	Energy & climate change	Bio-diversity	Hazardous sub-stances
	MANUFACTURING							
4.2.1	Energy-efficient cleanroom technology	x				x		
4.2.2	Energy-efficient cooling technology	x				x		
4.2.3	Energy-efficient reflow soldering	x			x	x		
4.2.4	On-site copper recycling in process chemicals	x	x	x				
4.2.5	Cascade rinsing systems and water use optimisation		x	x				
4.2.6	Minimising perfluorocompound emissions				x	x		x
4.2.7	Rational and efficient use of compressed air	x				x		
4.2.8	Protecting and enhancing biodiversity						x	
4.2.9	Use of renewable energy	x				x		
4.2.10	Optimised waste management within manufacturing facilities			x				

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Challenges
Rising water demand

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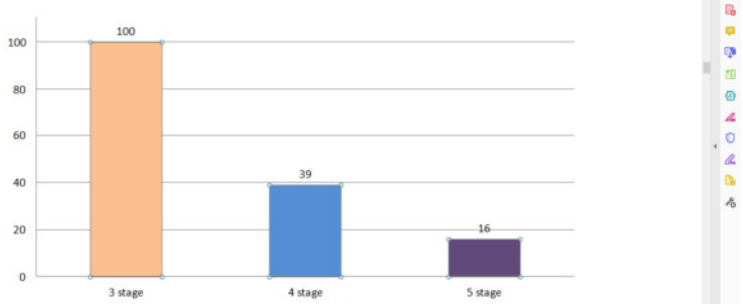
the reduction exceeds 80%, while the remaining rinsing water demand is less than 1 litre m² PCB (Wolfer 2014).

Figure 4.10. Comparison of water consumption in cascade rinsing systems comprising 3, 4 and 5 rinsing tanks



Source: Wolfer (2014)

The reduction of rinsing water also contributes to a reduction of waste water. However, it is

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Challenges
Financial effects

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Table 4.9. Water saving measures in cascade rinsing systems and their pay-back periods in a specific company

Water Savings achieved through:	Pay-back period in years
Installation of a 4-stage cascade rinsing system in new installations	2–3
Installations of a 5-stage cascade rinsing system in new installations	> 3
Water savings measures in existing installations if implementation (development of software tool, plant modifications) can be done in-house	< 1
Water savings measures in existing installations if implementation (development of software tool, plant modifications) cannot be done in-house	~ 2

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Philippines
Water boby – treatment obligations

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Table 1. Water Body Classification and Usage of Freshwater

Classification	Intended Beneficial Use
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the latest PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	1. Fishery Water for the propagation and growth of fish and other aquatic resources 2. Recreational Water Class II – For boating, fishing, or similar activities *3. For agriculture, irrigation, and livestock watering*
Class D	Navigable waters

Note: For unclassified water bodies, classification shall be based on the beneficial use as determined by the Environmental Management Bureau (EMB).

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Philippines example: for electronic

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PSIC Code	Industry Category	Significant Parameters
08914	Rock phosphate mining	pH, COD, Total Suspended Solids, Ammonia, Phosphate, Fluoride, Surfactants
C. Manufacturing		
10110	Slaughtering and meat packing	Temperature, pH, BOD, Total Suspended Solids, Ammonia, Nitrate, Phosphate, Oil and Grease
10120	**Production processing and preserving of meat and meat products**	Temperature, pH, BOD, Total Suspended Solids, Oil and Grease
1020	Processing and preserving of fish, crustaceans and mollusks (except carrageenan)	Temperature, pH, BOD, Total Suspended Solids, Nitrate, Oil and Grease
10205	Processing of seaweeds; manufacture of agar-agar or carrageenan	Temperature, pH, COD, Total Suspended Solids
1030	Processing and preserving of fruits and vegetables	Temperature, pH, BOD, Total Suspended Solids, Oil and Grease
104	Manufacture of vegetable and animal oils and fats	Temperature, pH, BOD, Total Suspended Solids, Nitrate, Ammonia, Oil and Grease

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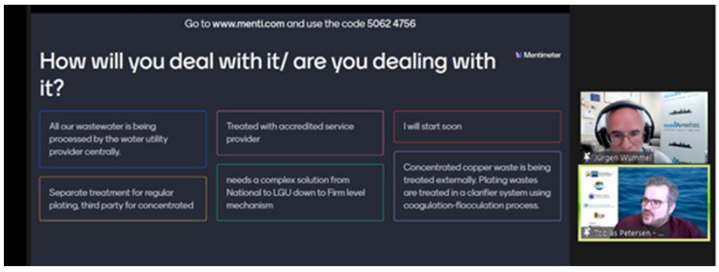
1. What kind of waste is your main challenge?
2. How will you deal with it/ are you dealing with it?



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Treatments options

- Discharge directly to a municipal treatment plant
- Pretreatment and discharge to a municipal treatment plant
- Treatment plan on site
- Stream discharge or land application

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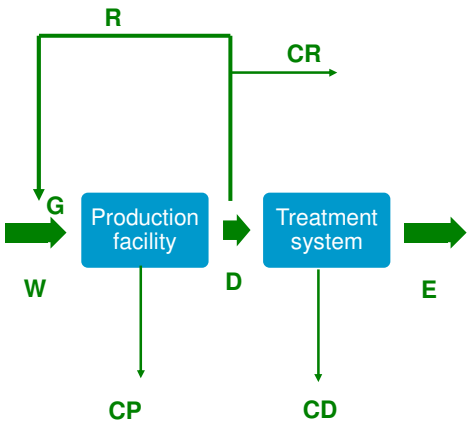
Water and sanitation cycle



	description
W	Intake Water
R	Recirculated water
G	Gross watter applied
CR	Consumtive use for recirculation system
CP	Consumtive use for production system
CD	Consumtive use for waste water disposal s system
D	Waste water discharge from the production process
E	Final effluent from the production unit (available for reuse?)

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Waste water philosophy

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Traditional sanitary approach

- if you are a processor you produce wastewaters, and for that you have to develop processes and equipment to treat that wastewater.

Better approach

- The most important aspect of this approach is that wastewater problems are generally associated with organics (BOD) in the effluent which are products diluted in water.

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Treatment steps

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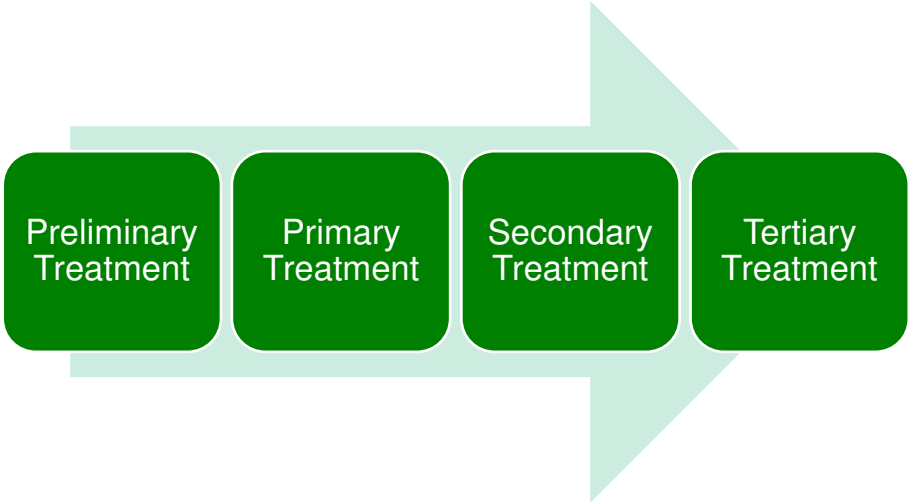

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Primary treatment

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- Removal of settleable solids and floating material (removal of organic and inorganic suspended solids)
- Primary sedimentation tanks (rectangular or circular)
- Primary sludge (typically 3 to 5% solids concentration)
- Efficiencies: TSS (50 – 70 %) ; BOD5 (20 – 50 %); Bacterial removal (25 – 75 %)
- Enhanced Primary Treatment (with added chemicals: alum, iron salts flocculation)
- Physic-chemical treatment (inorganic loaded wastewater)

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Secondary treatment (Biological)

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Attached-growth treatment (Bio-film) processes

- Biological treatment processes
- Microorganisms responsible for the conversion of the organic matter are attached to some inert medium,
- Materials: rocks or specially designed ceramic or plastic materials

Suspended-growth treatment (active sludge) processes

- Biological treatment processes
- Microorganisms responsible for the conversion of the organic matter are maintained in suspension within the liquid

Pond processes

- Biological treatment by natural processes, involving the use of bacteria (and/or algae)
- Several ponds: anaerobic, facultative, aerobic, maturation

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Tertiary treatment

Removal	Treatment method
Total suspended solids (TSS)	• Filtration and microscreening
Microorganisms	• Sand filtration • UV disinfection • Maturation ponds • Disinfection with chlorine or ozone • Membrane technologies (microfiltration)
Nitrogen	• Nitrification /denitrification
Phosphorus	• Chemical precipitation • Biological processes
Special substances	• Physical-chemical processes

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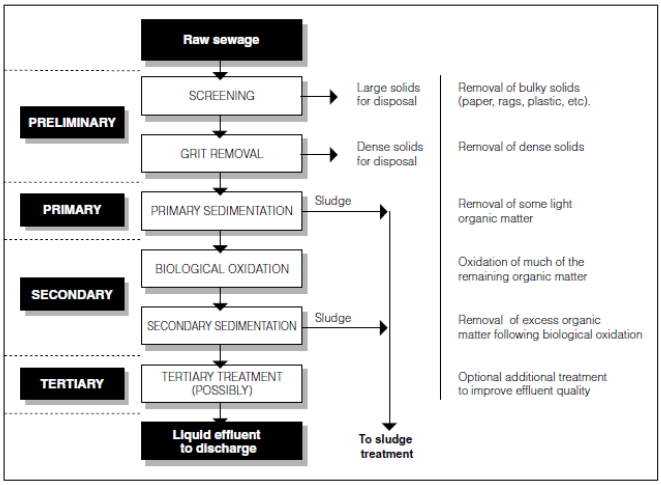
Wastwater treatment Options



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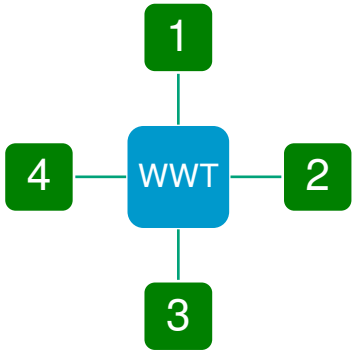
Treatment options in electrical sector

1. central final treatment in a biological wastewater treatment plant at the site.
2. central final treatment in a municipal wastewater treatment plant.
3. central final treatment of inorganic waste water in a mechanical-chemical sewage treatment plant.
4. decentralised treatment(s).



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Tretment options for electrical sector

Separation or clarification processes

- Mainly used in combination with other processes, either as a first stage (to protect downstream treatment plants from damage, clogging or contamination by solids) or for post-clarification (to remove solids or oils formed in a previous treatment stage)

(sand separation, sedimentation air flotation, filtration, microfiltration/Ultrafiltration, Oil/water separation)

Physico-chemical treatment methods

- for non-biodegradable waste-water, which are mainly used for inorganic or only biodegradable (or inhibiting) organic pollutants, often as a pre-treatment stage before a (central) biological wastewater treatment plant

(precipitation / sedimentation / filtration, crystallization, Chemical oxidation, wet oxidation, oxidation with supercritical water,…)

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Tretment options for electrical sector

Biological treatment

- Anaerobic degradation processes, such as anaerobic contact processes, UASB processes, fixed-bed processes, fluidized bed processes, and biological elimination of sulfur compounds and heavy metals;
- Aerobic degradation processes such as processes with fully mixed activated sludge, membrane bioreactor process, drip filter process, fluidized bed process, biofilter/fixed bed process;
- nitrification/denitrification;
- Central biological wastewater treatment

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Questions

I. What is the most economical and effective phosphate treatment?
II. What's the effective and efficient technology to remove Fats, Oil and Grease from the wastewater?
III. Is there new technology to treat the effluent discharge of water to recycle it in order to maximize or use it as potable water again?

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Wet-process

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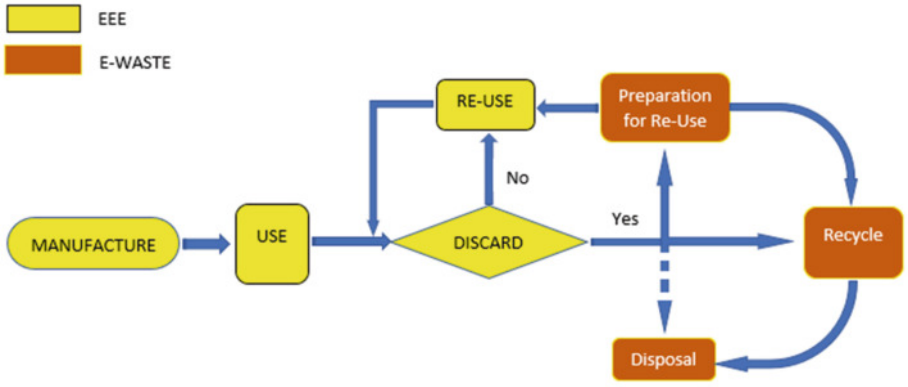

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Printed Circuit Board

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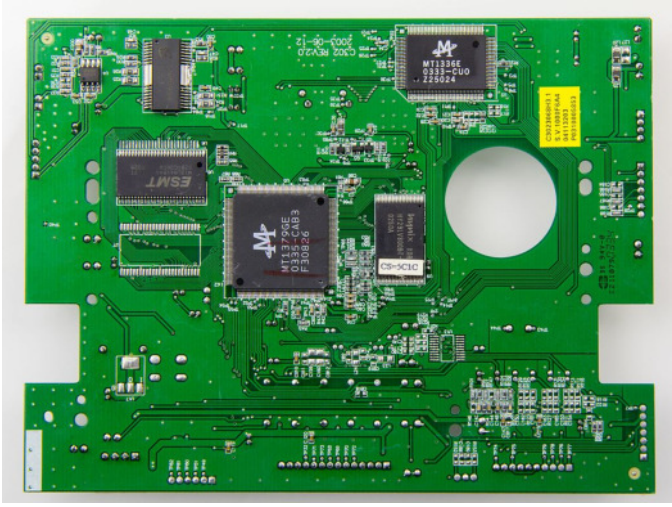

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WW Treatment Technologies for Toxic metals:

- Pre-treatment: Degreasing and pickling
- Physical / chemical treatment: screening, skimming, centrifuging, sedimentation, filtration, neutralisation, precipitation, coagulation and flocculation, Oxidation and reduction process
-
- Biological treatment: activation processes, biofiltration

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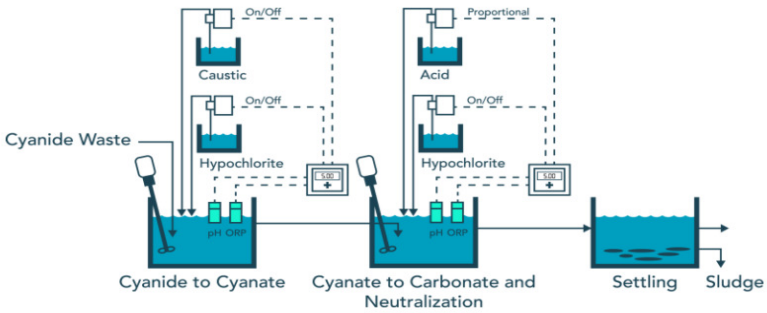
Wastewater Treatment Technologies for Cyanide

- WW treatment method: Alkaline Chlorination System (using Oxidation-Process)
- Cyanide → Cyanate → Carbon dioxide & Nitrogen



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Wastewater Treatment Technologies for high COD load

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- WW treatment method: Anaerobic Treatment Process
- Anaerobic wastewater treatment is mainly restricted to wastewater with a high organic loads with a COD concentration of 3,000 to 40,000 mg/l.
- Overview of different types of anaerobic reactors for treatment of industrial wastewater from industry.

Types of Reactor	COD-Loading Rate
Anaerobic Contact Process	2 – 4 kg COD/(m³ * d)
UASB-Reactor	5 – 15 kg COD/(m³ * d)
EGSB-Reactor	15 –25 kg COD/(m³ * d)
Anaerobic Filters/Fixed Bed Reactors	5 – 15 kg COD/(m³ * d)
Fluidised bed reactors	up to 50 kg COD/(m³ * d)

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General overview of ww treatment for EE industry

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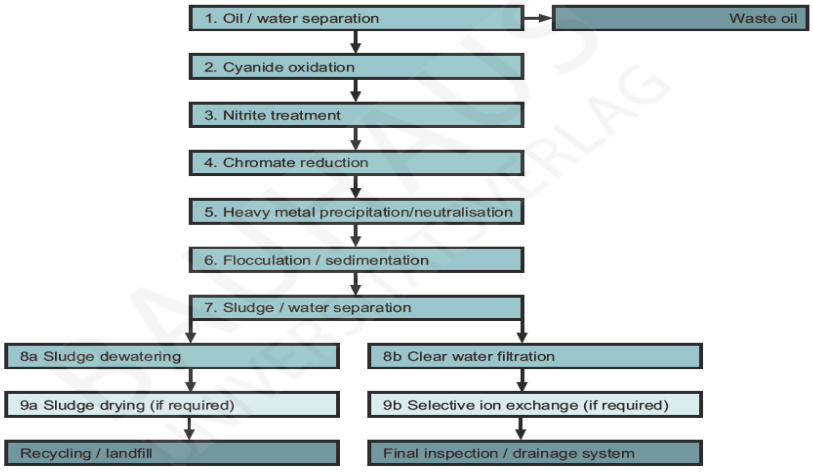

Stages in treating inorganically polluted wastewater

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Summary
General criteria for WWTP selection

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- Wastewater quality and quantity
- Typical efficiency and performance of the technology
- Reliability of the technology
- Manageability (by own or external)
- Financial sustainability, application in reuse schemes
- Regulatory determinants, special conditions

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Summary
Comparison of effluent quality in different WWTP

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WWTS	BOD	Suspended solids	Ammonia	Phosphorous	Faecal coliform
Septic tank	60%	40-70 mg/L	40-60 mg/L	6-7 mg/L	1-2 Log removal
Septic tank + soil	0-10 mg/L	0-10 mg/L	0-40 mg/L	0-2 mg/L	6-7 Log removal
Lagoons	20-30 mg/L	30-80 mg/L	20-30 mg/L	5-7 mg/L	3-5 Log removal
Wetlands	5-30 mg/L	5-20 mg/L	5-15 mg/L	0-10 mg/L	1-3 Log removal
Preliminary treatment	0% removal	0-10% removal	0% removal	0% removal	0 Log removal
Primary treatment	25-40 % removal	40-70 % removal	0-10 % removal	0-10 % removal	0-1 Log removal
Primary treatment chem. enhanced	45-65% removal	60-82% removal			
Secondary treatment	5-40 mg/L 86-98% removal	5-40 mg/L 89-97% removal	1-10 mg/L	5-10 mg/L	1-2 Log removal
Nutrient removal	5-30 mg/L	5-30 mg/L	0.1-5 mg/L	0.1-1 mg/L	0-1 Log removal
Disinfection	0% removal	0% removal	0% removal	0% removal	5-6 Log removal

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Summary Requirements

Preparation of Compliance Action Plan

- Minimum content of the compliance action plan to avail of the maximum 5-year grace period under Section 10 of DAO 2016-08:
  - a) description of the establishment,
  - b) process production flow (including flow rate, volume of discharge),
  - c) characterization or nature/description of wastewater,
  - d) modification of the WWTF, and
  - e) timeline of the project (corrective action), among others

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Summary Planning stage analysis

- Invest time in **assessing needs, resources and capabilities**.
- Evaluate the **characteristic factors** of the neighborhood.
- **Consider alternatives** for cluster WWT solutions (Off-site treatment), disposal and management
- Bear in mind the **cost** and **complexity** of **operations**, **maintenance**, and **management.**

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QUESTIONS & ANSWERS

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Thank you for your attention

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