














Cleaning in general –
Alkaline cleaner - Neutral cleaners

– Properties, Process Technology, Experiences

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Industrial Cleaning

Introduction

Composition of cleaners
Alkaline cleaners
Neutral cleaners
Passivation agents
Emulsion cleaners
Ecological aspects / Bath life time prolongation
Cleaning in praxis / Trouble shooting
Cleaner selection

Introduction

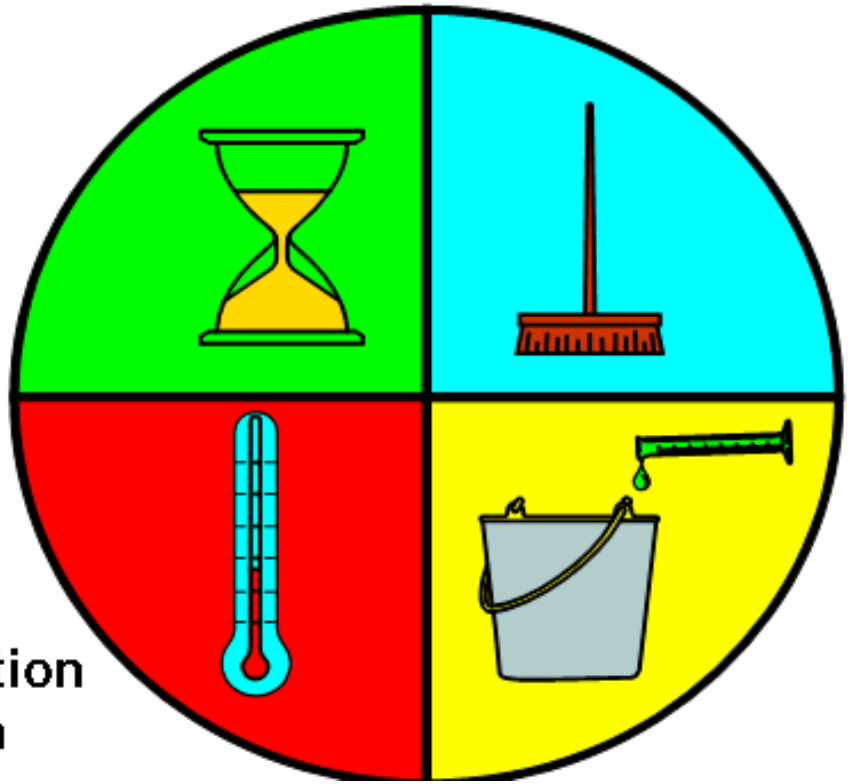
Industrial cleaning is a complicated system in in which mechanic, chemistry, temperature and treatment time work together to bring surfaces in a optical clean and chemical reactive condition.

Industrial cleaning is nothing what can be done beside without control and without care.
It's the most important step to fulfil chemical/technical processes.

Effective cleaning processes need permanent control and a high knowledge !

Parameters of Cleaning

Production process



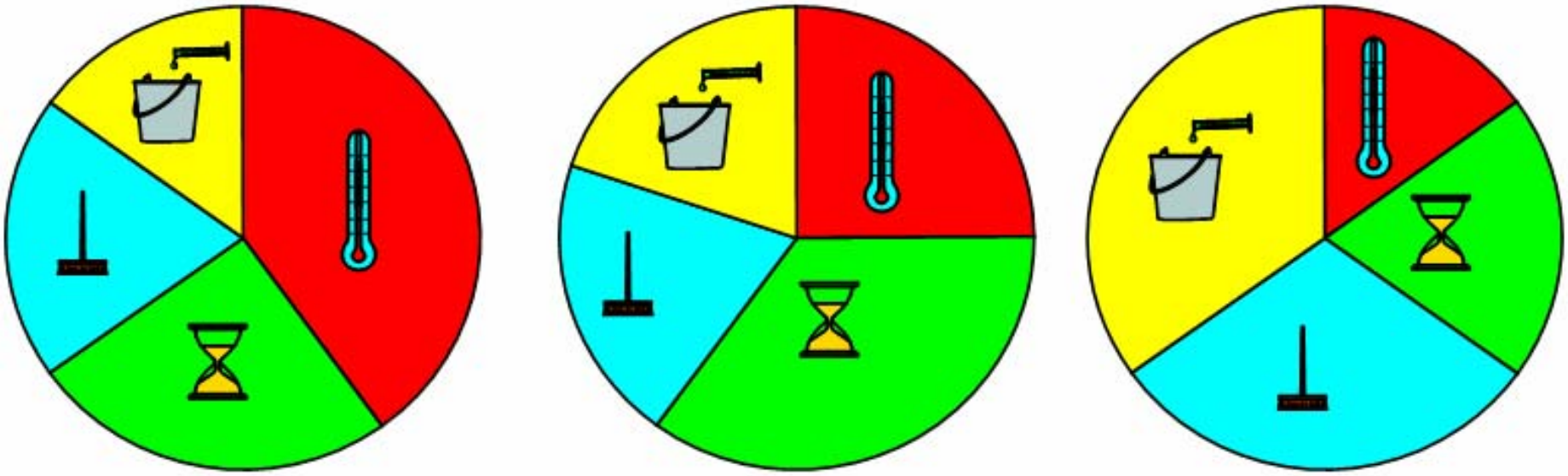
Plant technology
- spray
- high-pressure-spraying
- immersion
- ultrasonic
- electrolysation
- brush / wipe

Type of cleaner
- Builder
- Surfactants
- Saponification

Energy consumption
formation of foam

Parameters of Cleaning
Influences of changes

A change of one parameter in the working system will automatically need a change of other parameters to give the same result.



If other parameter will not be changed, the final cleaning result will get worse!

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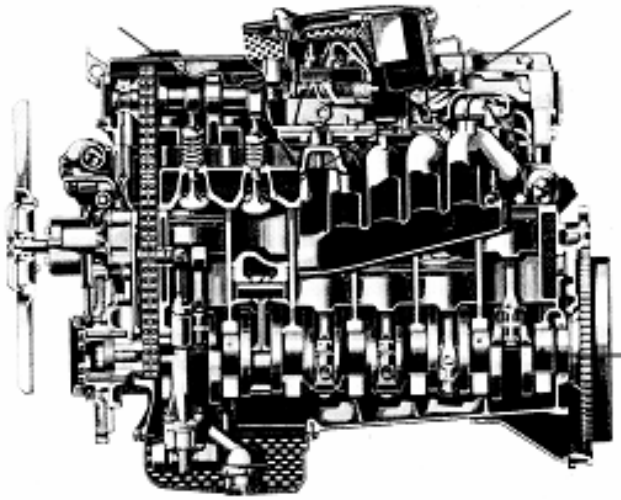
What and where do we clean?

Engine construction

Cam shaft

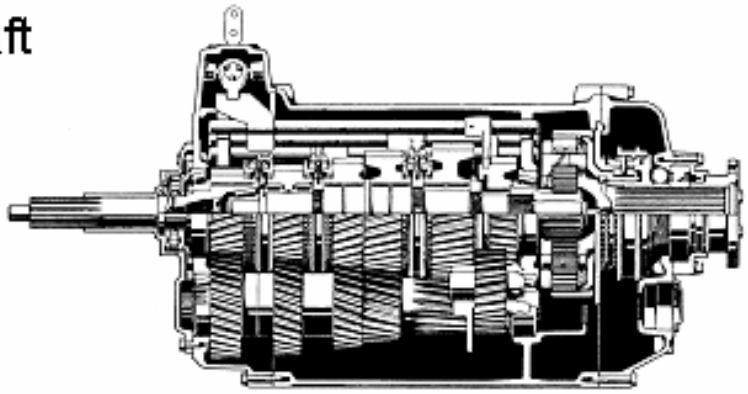
Cylinder head



Crank shaft

Gear boxes

Oils, Grease,
Abrasion,
Chips,
Oxides,
surrounding dirt



Types of cleaners

Aqueous cleaners

- alkaline
- neutral
- acid

Organic solvents

- Fluorine- / Chlorine- / Hydrocarbons (used as concentrate)
- low boiling polar solvents (used as concentrate)
- Emulsion cleaners (water miscible solvents/oils)

Basics of cleaning with aqueous solutions

- Water acts primarily as transport/rinse aid
- Surfactants reduce the surface tension of water
  - ➢ better wetting of the surface of the work piece
  - ➢ separation of the soil from the surface by penetrating and roll-up
- Builders have a good soil deposition effect and support the dispersion of the dirt particles
- Complexing agents reduce the water hardness

Composition of Cleaners

Builder Substances

- Phosphates
- Silicates
- Borate, carbonate
- Alkalinity

Surfactants

Complexing agents

Corrosion protection additives

Antifoaming/Defoaming gents

Classification of Cleaners

acid cleaners/pickles

- pH-value 1,5 to 6

neutral cleaners

- pH-value 7 to 10

alkaline cleaners

- pH-values above 11

Alkalinity and Builders

Alkalinity (sodium-hydroxide, potassium hydroxide)

high pH-values

saponification of fat/grease

good cleaning properties

attack on non iron metals

Builder / Silicates

high soil deposition properties (dispersion, emulsification)

protect against re-deposition on the cleaned parts

reduce the attack on aluminium

forming of a layer can effect follow-up processing

precipitation of silicates (pH lower 10,5) impair filtration processes (UF)

Alkalinity and Builders

Builder / Phosphates

good dispersion of inorganic soil

improve the cleaning efficiency of surfactants

complexing properties, dehardening of water

the efficient „polyphosphates“ react with water (degradation)

attack on aluminium and non iron metals possible

Builder / Borates und Carbonates

stabilising („buffer“) the pH-value

cleaning of non iron metals

Alkalinity and Builders

Alkali:	- high pH - Saponification - Conductivity
Phosphate:	- Pigment removing - Complexing of Ca/Mg-Ions (Polyphosphate)
Carbonate:	- pH-Value stabilisation - Addition to slightly alkaline products
Borate:	- Buffer system for sensitive substrates like Aluminium
Silicate:	- very good dirt carrying properties - Inhibition against metal attack for Aluminium, Zink and Cupper

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Builder systems
Aging

Alkalinity

$$2\ NaOH + CO_2 \xrightarrow{H_2O} Na_2CO_3 + H_2O$$

pH 13 pH 11

Carbonisation

$$Na_2CO_3 + CO_2 \xleftrightarrow{H_2O} 2\ NaHCO_3 + H_2O$$

pH 11 pH 8,5

Silicates

$$Na_2SiO_3 + CO_2 \xrightarrow{H_2O} Na_2CO_3 + SiO_2$$

pH 12,5 pH 11 (8,5)

o-Phosphates

$$Na_3PO_4 + CO_2 \xrightarrow{H_2O} NaHCO_3 + Na_2HPO_4$$

Poly-Phosphates

$$Na_5P_3O_{10} \xrightarrow{H_2O} Na_3HP_2O_7 + Na_2HPO_4$$

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Surfactants

Cationic Surfactants

- good demulsifying properties
- defoaming
- attract to surfaces (may harm follow-up treatment)

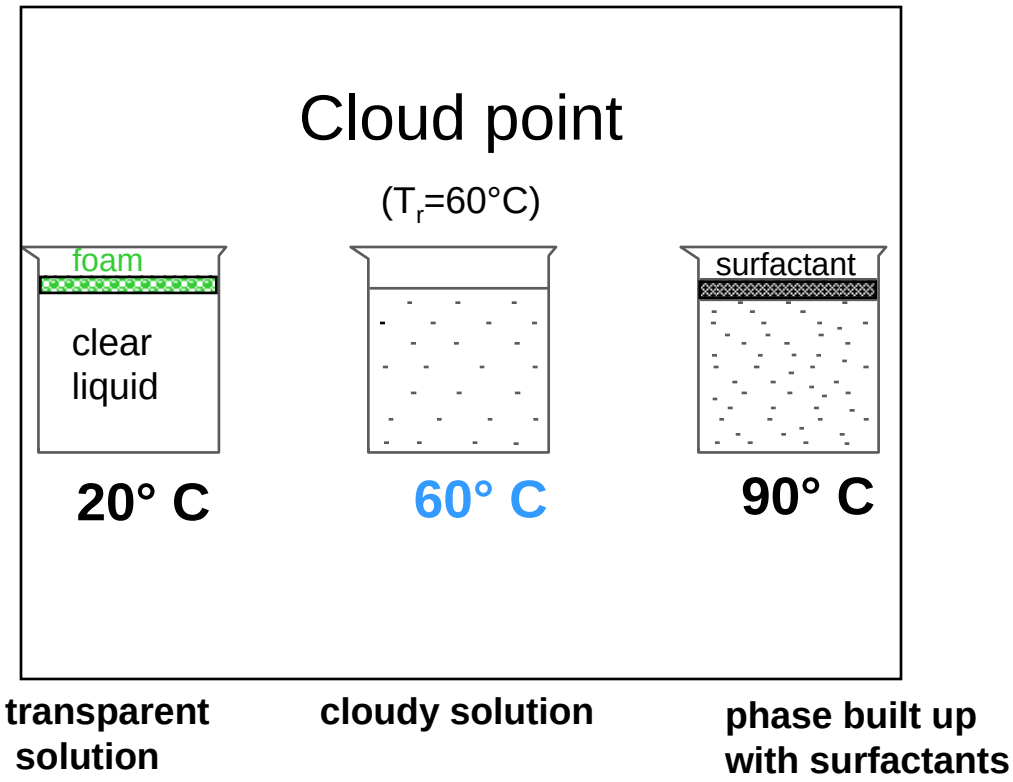
Anionic Surfactants

- „Soaps“
- high emulsifying properties
- good degreasing efficiency
- foaming
- (short bath life-time)

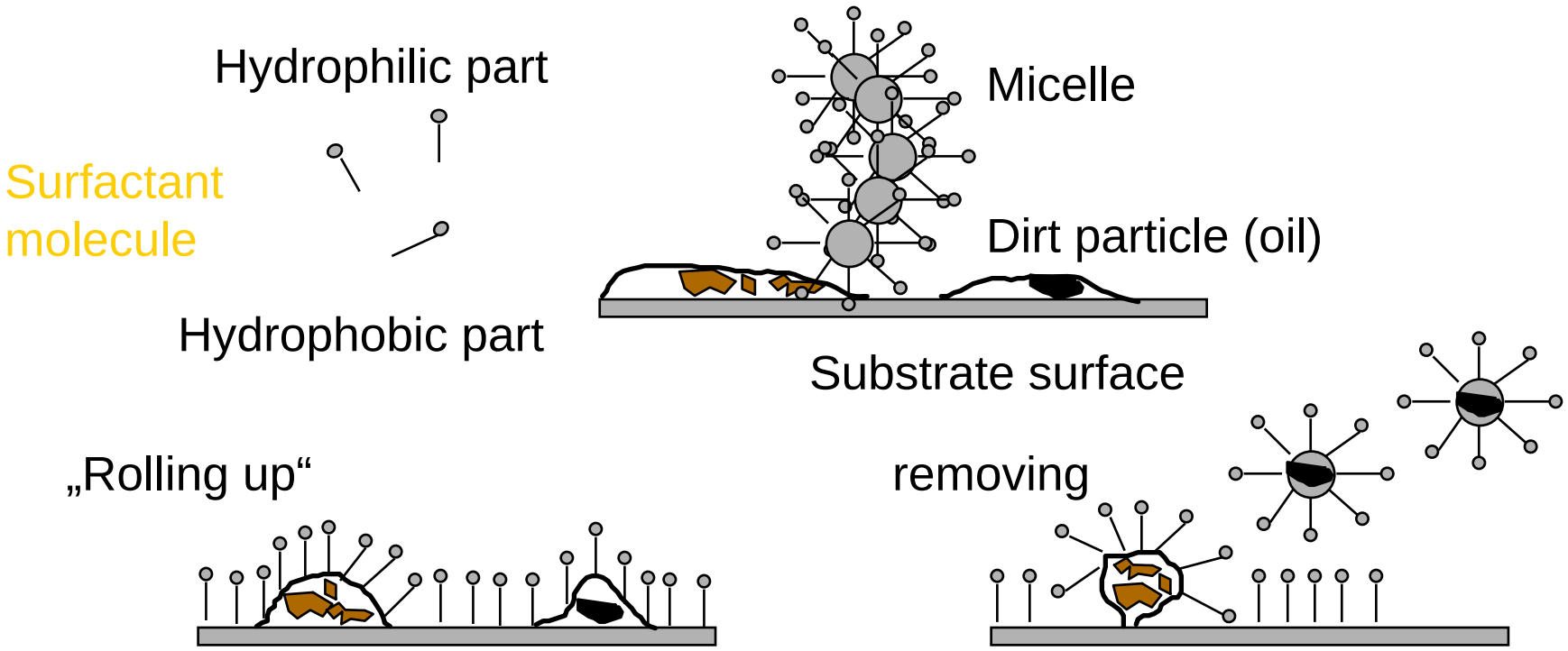
Non ionic surfactants

Non-ionic surfactants

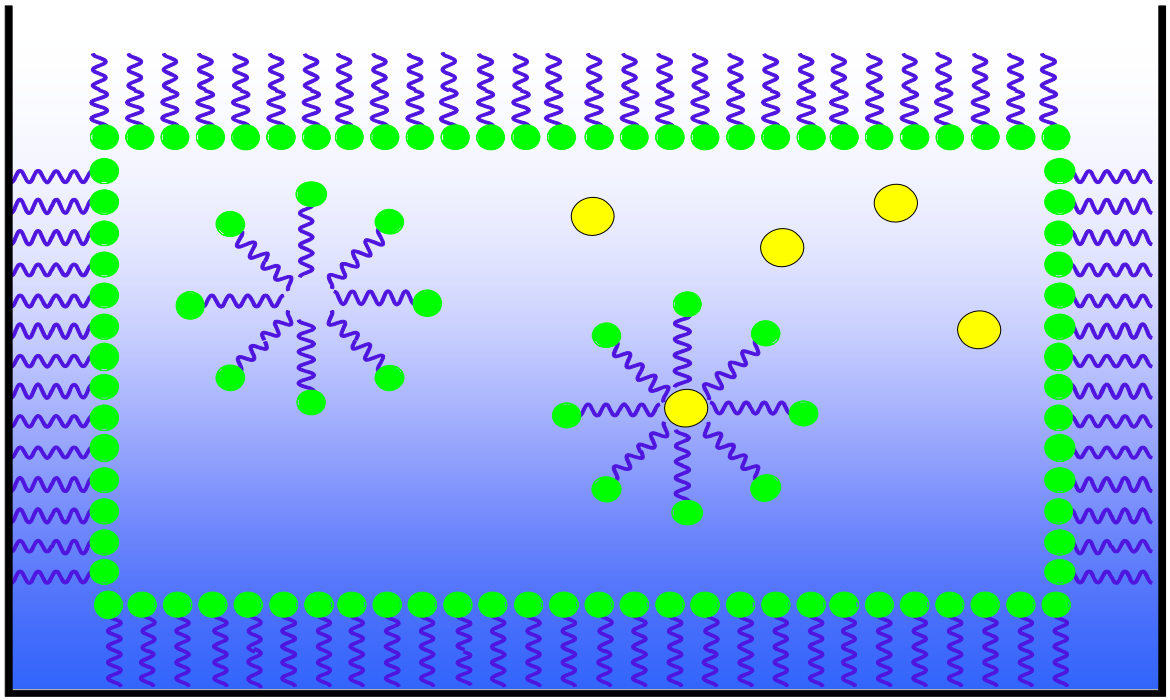
- most used surfactants
- usable in spray cleaners
- efficiency is depending on the temperature of the solution
- „cloud point“

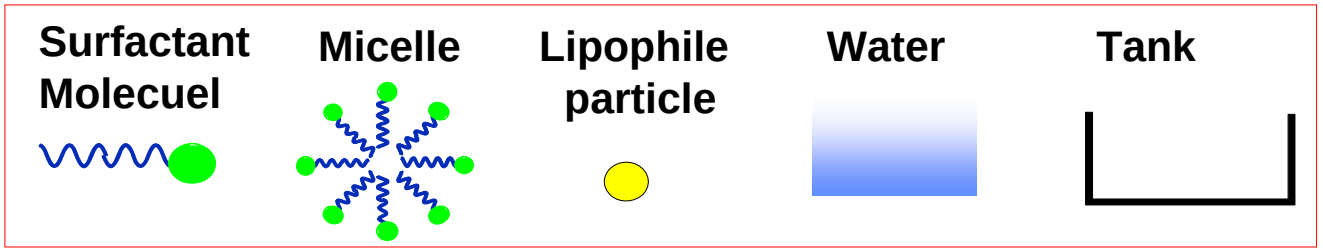


Non ionic surfactant
“Roll-up“-mechanisms



How does surfactant work ?





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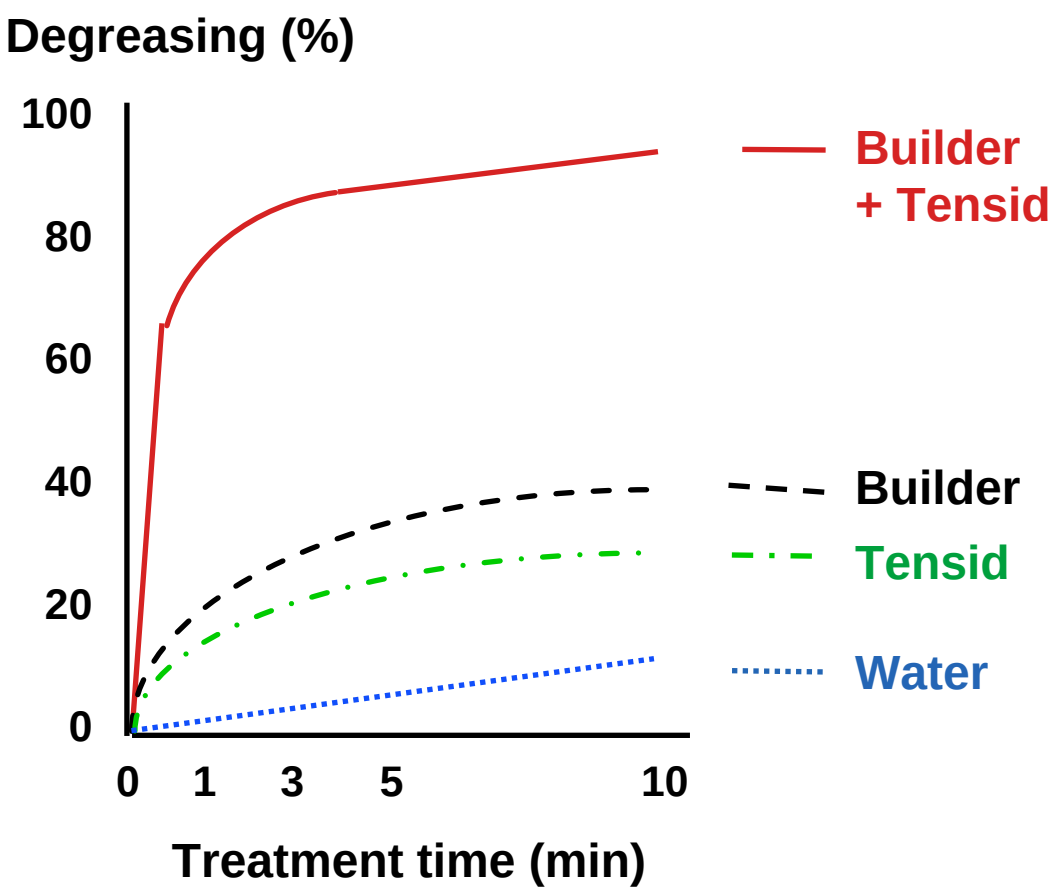
Synergism Builder / Surfactant



Concentration builder: 2,0 %
concentration tensid: 0,1 %
cleaning temperature: 60 °C

Lit. from:
Oberfläche-Surface 1984,
Rossmann: Reinigung starrer Oberflächen

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Reactions

Cleaning is a “high-tech” process – und not just a „waste collection“..

In cleaner baths are always several chemical reactions appearing like.:

Alkalinity react with Zink, Aluminium, Fatty acids, Acids, Ca-soap,
CO_2 from air, Cupper…….....
Surfactant react with Oil, Fat, other surfactants…..
Water hardness react with soap and complexing agents…….
Complexing agents react with water hardness and metal ions…..
Polyphosphate react with metal ions and hydrolyse slowly in hot water….
Silicate protect sensitive surfaces and precipitate if the pH drop……..

Cleaning is never easy !

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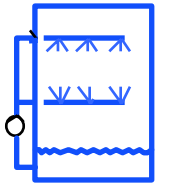
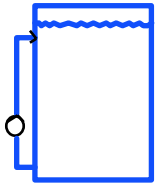
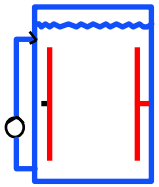
Cleaning Processes / Technology



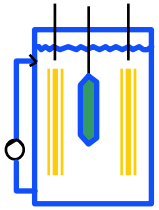
Spray: parts with even surfaces
high cleaning performance
foaming problem



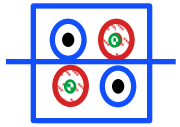
Immersion: lowest cleaning performance
flooding/pumping recommended



Ultrasonic: improves immersion cleaning
efficient for removing pigments
parts with uneven surfaces



Electrolyse: mechanical effect of gas formation
electromagnetic power



Brush: effective for abrasives and chips
high maintenance effort

Cleaning Processes / Technology

Choosing the right Cleaner

Material

steel/iron, non iron metals (material attack/corrosion protection)

Type of the dirt

oil, grease, abrasives, chips, oxides

Requirements

cleaning (max. allowed residue)

surface (gloss, attack)

Application / process

immersion (with brushes, ultrasonic...), spray...

Limits of local authorities

phosphate-, nitrate,- COD-Limits

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Variation of the Temperature

Melting point of grease should be reached

Reaction could be accelerated (doubled) by rising the temperature for 10°C

Has an influence on the time needed for drying

Butter effect……☺

Properties of various cleaners

Classification	pH-Value	Ingredients	Range of Application
Strong alkaline	10,5 - 13	• Alkalis • Silicates • Phophates • Chelating agents • Wetting agents	• Steel • Strong degree of soiling • High cleaning requirements
Mild alkaline	8 - 10	• Phosphates • Borates • Carbonates • Conditioners • Wetting agents	• Steel, Zinc, Aluminium and alloys • High cleaning requirements (Spray Application)
Neutral	7 - 9,5	• Wetting agents • Corrosion inhibitors • Phosphates • Solubilizer	• Steel and Zinc • Precleaning and corrosion prevention
Weak acidic	3,5 - 5,5	• Acidic alkali phosphates • Wetting agents • Accelerators	• Cleaning and phosphating of Steel and Zinc • Cleaning of Aluminium

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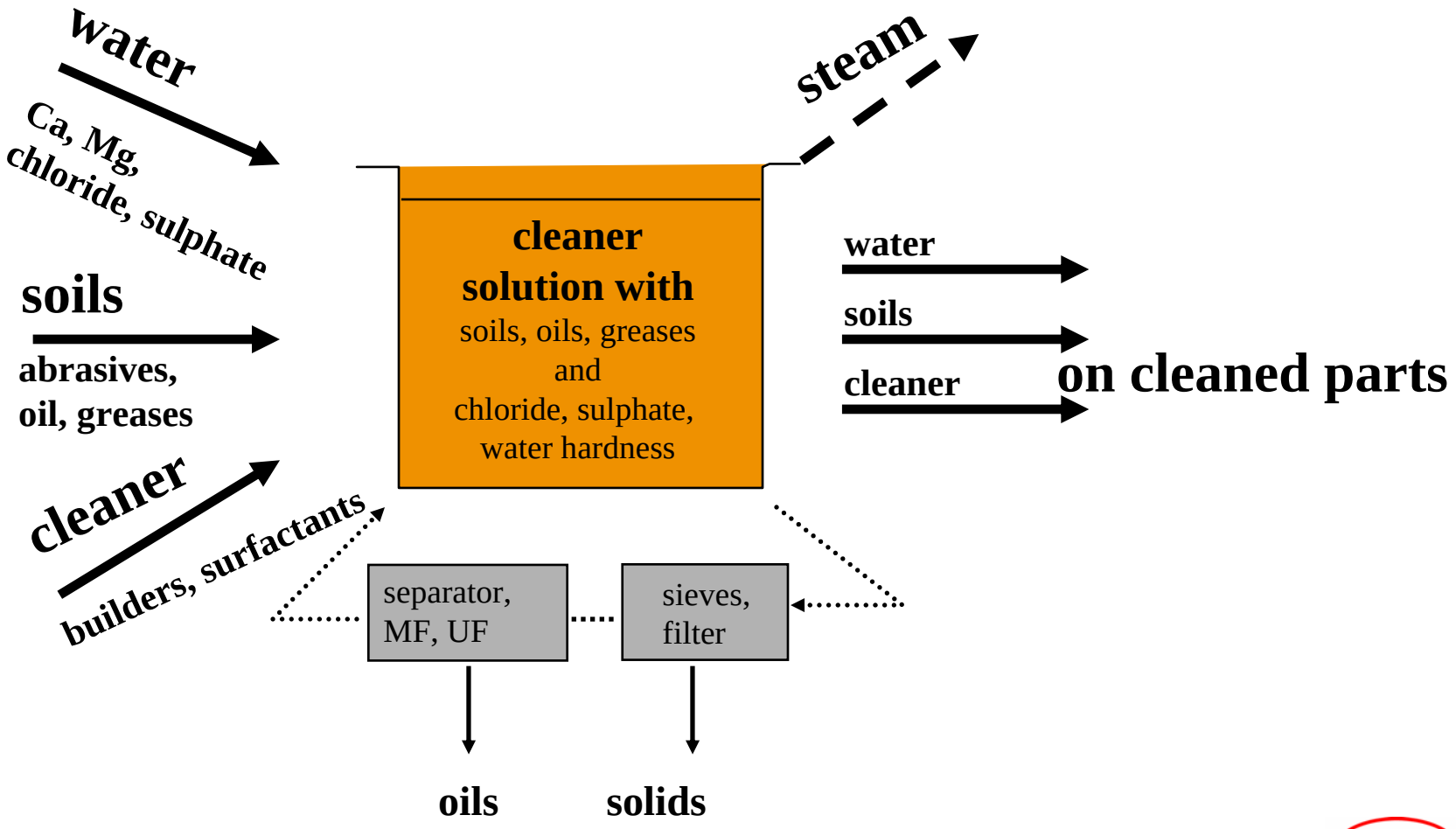
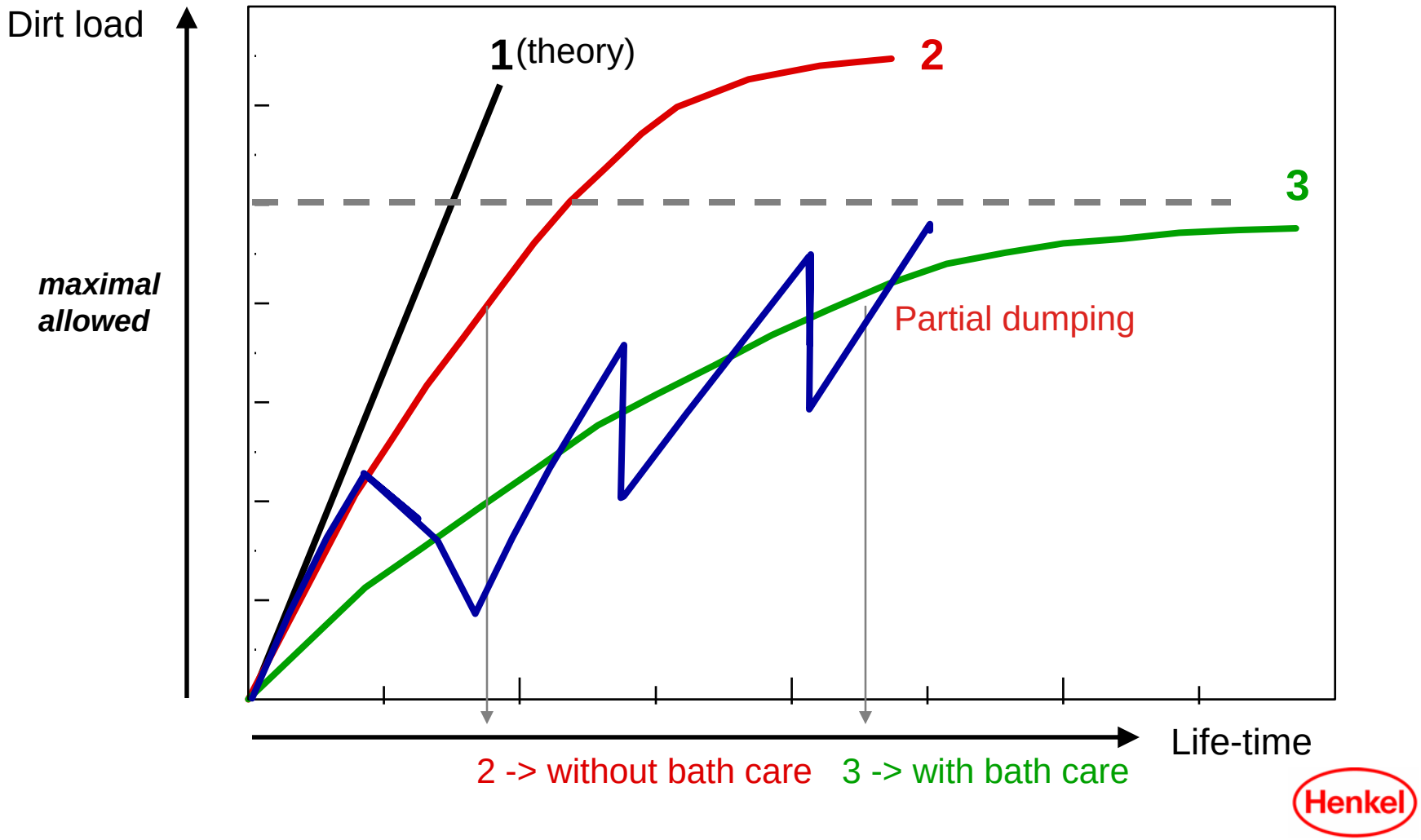
COFFE BREAK

Lifetime of Baths / Recycling



Dirt enrichment in a Cleaner bath



Methods for the bath life-time prolongation

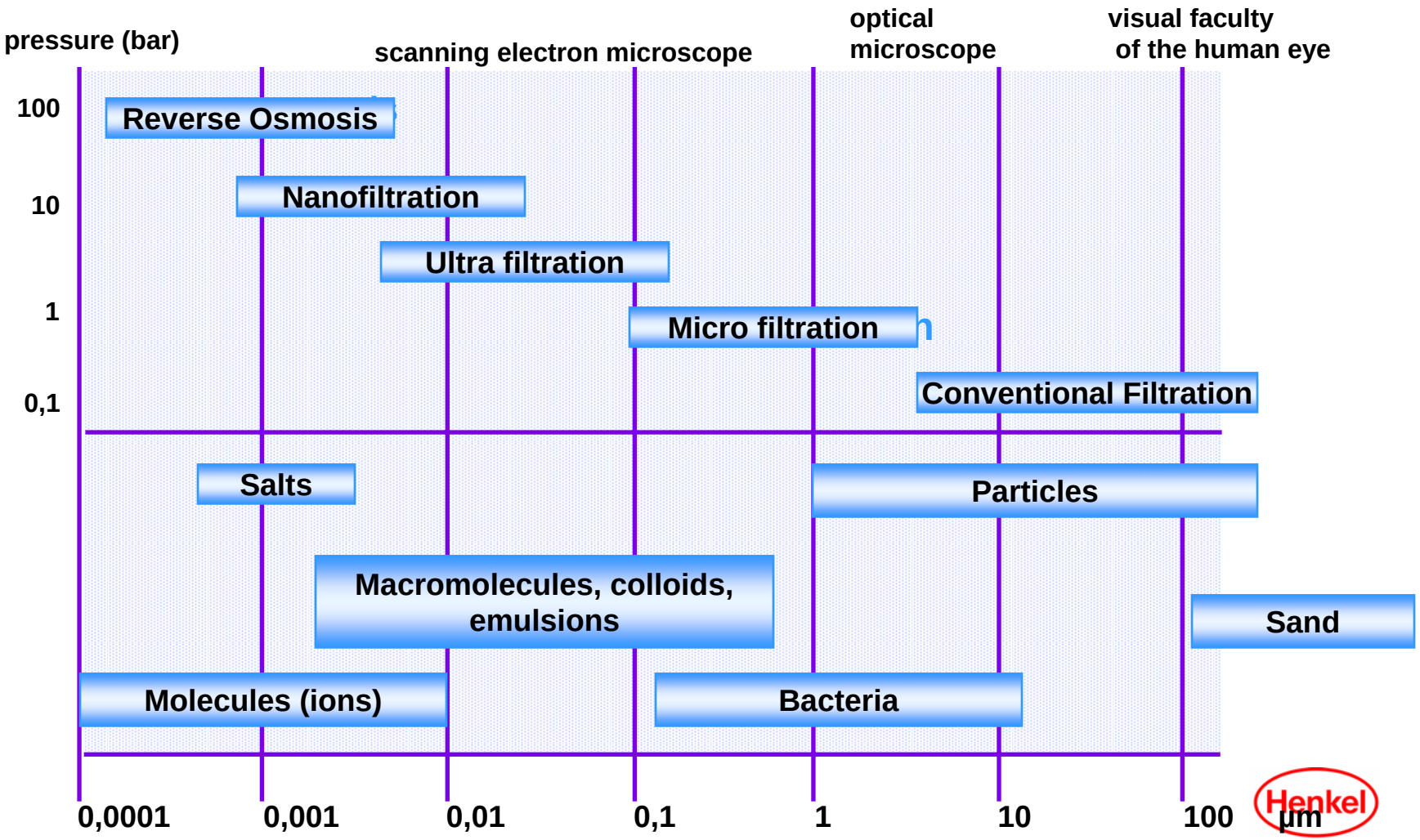
Classical processes

- Sedimentation / filtration; removing of particles
- Magnetic separators; removing of chips
- Skimmer/oil separators for demulsifying systems (=floating oils)
- Separators for mechanically dispersed oil (not for emulsions)

Bath care with membrane technologies (MF/UF)

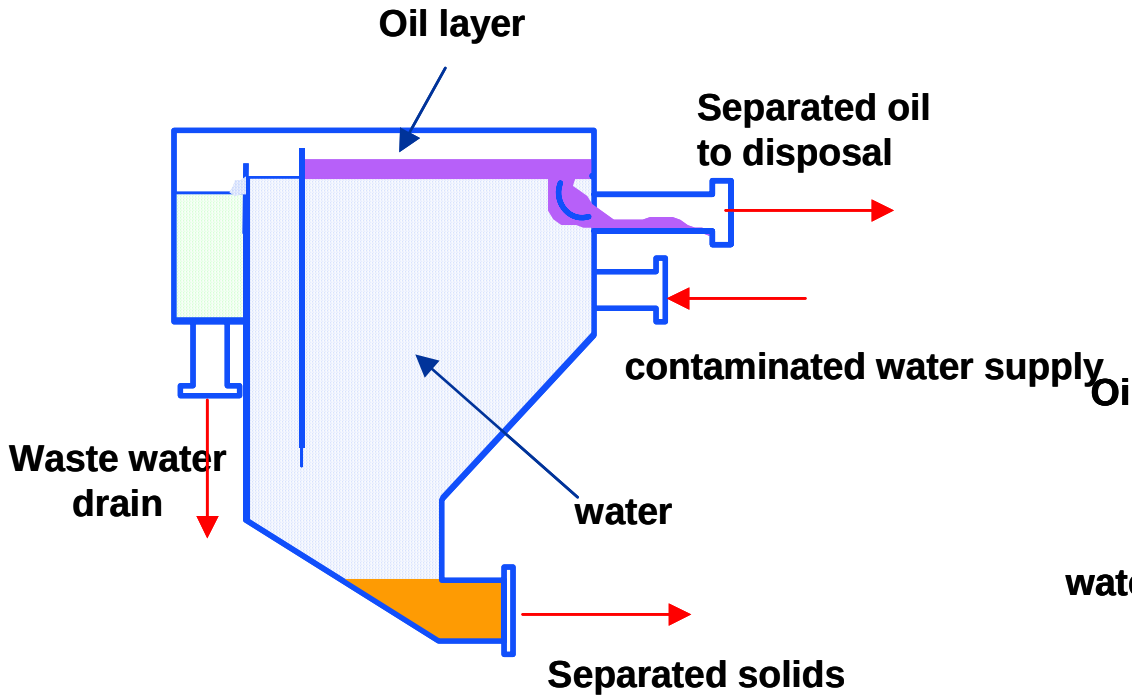
- For stable emulsified oils
- Low residual oil
- Compatibility cleaner / membrane material

Cut Points of Filter Systems

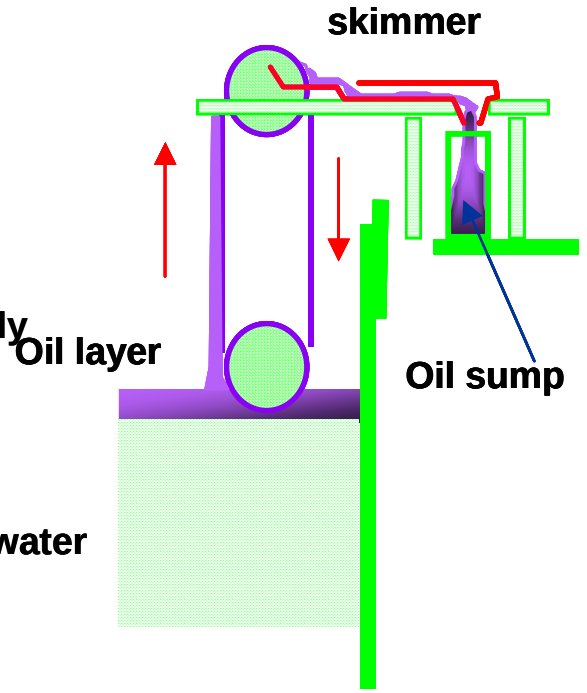


Bath care with classical processes

Skimmer / oil separator



Oil separator



band skimmer

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Bath care by membranes

Aqueous Cleaning in the Field
Bath Control

Product concentration

titration (concentration)

Epton -titration (surfactant)

conductivity (concentration)

pH-value

thin-layer chromatography

(content of surfactants)

Contamination of the bath

filtration (settling solids)

petrol ether extraction (oils/greases)

acid splitting (oils / greases)

chloride- / sulphate

Epton-titration (anionic surfactants)

AAS resp. photometry (metals)

cloud point (NIO-tensid)

refractometry (drag-in of emulsions / emulsifying oils)

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Aqueous Cleaning in the Field

Controlling the cleaning efficiency

Simple Field Methods

- Water break test (wetting behaviour)
- Wipe test (filter paper, textiles)
- Film removing test (Tesa-/Scotch-Tape-Test)

Further analysis

- Extractions (oils / fats)
- Combustion in oxygen-stream (oils / fats / carbon)
- Rub off test (filter paper, AAS: abrasives)
- Metal precipitation (steel sheet in acid copper solution)

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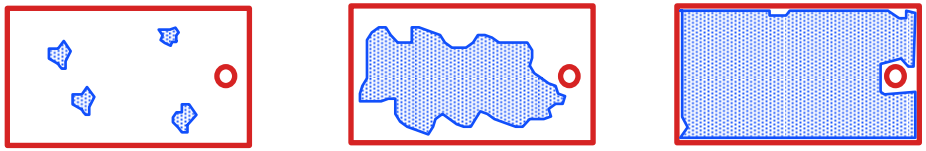
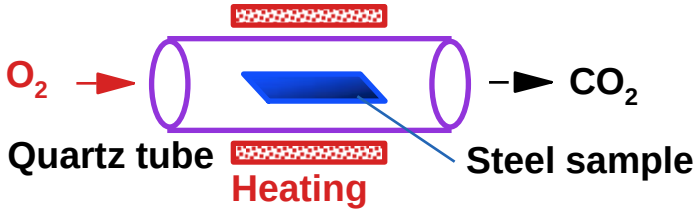
Aqueous Cleaning in the Field

Judging the surface quality

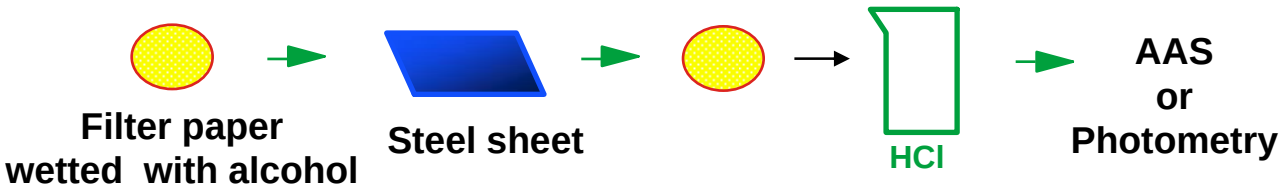
1. Water break test



2. Analysing the oil- resp. carbon layer by combustion



3. Measuring the abrasives from rolling by wiping test



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Water break test

Comparison: Clean and oily steel sheet

Passivated Zn sheet

Aqueous Cleaning in the Field
Controlling the Cleaning efficiency

Comparison between oily and pre-cleaned steel panel after dipping into corrosive bath

Test start

Test after 20 Minutes

Product Survey

Neutral cleaners

- P3-neutrapon...
- P3-neutrasel...
- P3-neutracare...
- P3-tensopon

Corrosion protective

- P3-prevox...
- P3-emulpon...
- P3-gero-cor 3

Alkaline Cleaners

- P3-upon...
- P3-saxin...
- P3-emalan...
- P3-galvaclean
- P3-percy
- Ridoline

Acidic cleaners/pickles

- Duridine...
- Chemacid...., Chemalyt...
- Chemapix
- P3-dimal...

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Product selection

Product selection:

Acidic – alkaline – neutral Cleaner
(depending on substrate and surface)

Spray-, Dip-, Ultrasonic-, High pressure cleaning
(depending on line and shape of parts)

Cleaner with/without inhibition against etching.
(depending on a need of etching reaction – rust on parts, uniform surface for Aluminium)

Selection of cleaner with surfactant and complex builder
(depending on dirt and possibilities in waste water plant)

Powder product, Liquid product

With surfactant, without surfactant

Product selection

Product name:

P3-neutrapon – P3-neutrasel → Neutral spray cleaner

P3-emalan – P3-galvaclean → Dip cleaner – low to high alkaline

P3-saxin – P3-upon → Spray cleaner – low to high alkaline

Ridoline → Spray cleaner, dip cleaner – in front of pre-treatment

P3-grato → high pressure , hot steam cleaner

P3-glin, P3-industril, P3-rimol → general cleaner – multifunctional

Chemacid, Chemalyt, Deoxidine, Porodox → acidic cleaner

P3-ultraperm → cleaner for ultra filtration membranes

Ridosol, P3-tensopon → surfactant additives for cleaner

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Neutral cleaners – general

Details on Friday 12.10.2007 – Presentation from Dorian Ronge

Acidic cleaner - general

Product selection → acidic cleaner – spray - dip application !

Chemacid 3400: → liquid product → dip application

→ good etching – Iron, Aluminium – include surfactant and inhibitor

Chemacid 3500: → liquid product → spray/dip application

→ good etching – Iron, Aluminium – free of surfactant – include inhibitor

Chemalyt 146: → liquid product → spray/dip application

→ use for Iron, Copper, Brass, Aluminium – plus surfactant and inhibitor

Deoxidine 827: → liquid product → dip/brush application

→ use for derusting before phosphating – based on citric acid

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Acidic cleaner - general

Product selection → acidic cleaner – spray - dip application !

Porodox → powder product → spray/dip application

Use for iron, steel, aluminium, copper, brass, hot dip galvanized, chromium-plated and tin-plated metal surfaces.

Mainly used for removing of scale in treatment line during maintenance processes.

Ridoline 241 → liquid product → spray/dip application

Use for Aluminium for etching and brightening. Include surfactant and Sulphuric-, Phosphoric and Fluoric acid.

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Trouble shooting

Low etching effect with bath in good conditions →

To high amount of rust and scale – increase concentration, increase temperature, increase reaction time, increase mechanic, change product.

Low etching effect with old bath →

To high amount of iron solved in the pickling bath.

Remove 50% of the bath and replace against new product + water.

New rust creation after pickling →

Rinsing water with to low acidity, parts dry on air after pickling –

Add alkalinity to rinsing water – reduce dripping time on air.

Medium alkaline spray and dip cleaner

Product selection → medium alkaline cleaner – spray/dip application!

P3-galvaclean 5176: → liquid product → dip application

→ very good cleaning of all substrates – Aluminium, Steel, galvanised Steel, Cupper, Brass, include phosphate and Surfactant

P3-upon 5800: → liquid product → spray application

→ Cleaner for steel and plastics - include phosphates and surfactant, widely used in spray lines.

Ridoline 2500 IT: → powder product → dip application

→ good cleaner for Steel, Aluminium and Zinc material, include Silicate

Ridoline 1562: → liquid product → spray/dip application

→ cleaner for all substrates – use with addition of surfactants.

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High alkaline spray and dip cleaner

Product selection → high alkaline cleaner – spray/dip application !

P3-emalan 5668: → liquid product → spray/dip application

→ High alkaline cleaner for Steel, addition of surfactant necessary

P3-galvaclean 65: → liquid product → dip application

→ High alkaline cleaner for electrolytic cleaning of Zn, Steel and Cupper. Free of surfactant.

P3-saxin 5520: → liquid product → spray application

→ Spray cleaner for Steel, Aluminium, Zinc and Cupper, with Silicate

P3-T 714: → powder product → dip application

→ High alkaline cleaner for Steel. Include Silicate and Surfactant

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High alkaline spray and dip cleaner

Product selection → high alkaline cleaner – spray/dip application !

Ridoline 1372: → powder product → spray/dip application

→ Widely used cleaner for all substrate. Include surfactant and phosphate.

Ridoline 2260 IT: → liquid product → spray application

→ Strong cleaner for Steel and Cupper. Not to use for Aluminium or galvanised substrate. Use in spray/dip processes, free of surfactant.

Ridoline 7163 CF 5: → liquid → spray/dip application

→ Multifunctional cleaner for all Steel, Aluminium and Zinc. Free of surfactant.

P3-galvaclean 4112: → liquid → spray/dip/HP/US application

→ Multifunctional cleaner for all Substrates including glass.

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Trouble shooting

Bad cleaning →

To low spray pressure, low product concentration, low surfactant concentration, low temperature, difficult shape of parts, pre-passivation on parts, to low bath mechanic in dip process, Carbonisation of NaOH

Foaming →

Low concentration on non ionic surfactant, drag in of fatty acid – reaction with alkalinity. Drag out of defoamer with oil-skimmer.

Surface of parts show spots and etching attack →

Wrong cleaner, Alkalinity to strong, Not inhibited against pickling attack.

Membrane cleaner

Product selection → membrane cleaner – dip application!

P3-ultraperm 010: → powder → dip application

→ High alkaline cleaner, include Alkali, Phosphate and surfactant.

P3-ultraperm 030: → powder product → dip application

→ Alkaline cleaner, include Alkali, Complex builder and surfactant.

P3-ultraperm 053: → powder product → dip application

→ Neutral product. Include enzymes to remove organic dirt.

P3-ultraperm 075: → liquid product → dip application

→ Highly acidic cleaner based on inorganic acids.Use for post rinse of membranes.

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Membrane cleaning - general

A bath cleaning procedure is often done with Micro-, Ultra-, or Nanofiltration.

Sense of such a filtration is to run a dirty cleaner bath through a membrane.

This membrane should block oil and dirt (retentate) – and the bath solution including builders and surfactants will pass.

This clean bath (permeate) will go back to the cleaner bath.

Also such membranes have to be cleaned from time to time.

This membranes are highly expensive and it is **absolutely necessary to see the instructions of the membrane supplier to be sure, that the membrane and the cleaning medium is compatible!**

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Solvent cleaner

Product selection → solvent cleaner – hand/dip application!

P3-scribex: → liquid product → dip/hand application

→ Remove graffiti, soiling of ballpoint pens and spray paints

P3-solvclean 101: → liquid product → dip application

→ Quick drying solvent mixture without emulsifier.Remove oil and polymer. Dries without leaving residues.

P3-solvclean 102: → liquid product → dip application

→ Solvent cleaner with corrosion protection oil. After cleaning a thin oil film remain on the surface of the cleaned part.

P3-solvclean KW: → liquid product → dip application

→ Very good solvent cleaner. Include surfactant.

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Solvent cleaner - general

This kind of cleaners are mostly used in repair shops.

They are usually used in buckets as dip cleaner or with paint brush or tissues to clean car or motorbike engines, heavy oily parts or others. Depending on the age of oil and grease such parts must be treated some minutes till several hours with the cleaner.

P3-scribex is a solvent cleaner used for removing of graffiti.
But the graffiti paints get more and more stable against chemical attack. To see the efficiency in practice, trials are strictly recommended.

Defoamer and Surfactants

Product selection → defoamer – surfactant – spray/dip application !

P3-cronisol 674: → liquid product → dip application

→ Defoamer → Universal use for cleaner bath and waste water treatment

P3-galvaclean 81: → liquid product → dip application

→ Surfactant mixture. Increase efficiency in acidic cleaner bath. Include Inhibitor. Can be used for all acids except nitric acid.

P3-tensopon 0555: → liquid product → spray application

→ Additive for acidic spray processes especially Iron phosphating. Suitable for all substrates.

Ridosol 27 B: → liquid product → dip application

→ Cleaning booster for dip processes. Suitable for all substrates

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Defoamer and Surfactants

Product selection → defoamer – surfactant – spray/dip application !

Ridosol 1270: → liquid product → spray application

→ cleaning booster → most used product from the list.

P3-emalan 0570: → liquid product → spray application

→ Surfactant mixture. Increase efficiency in alkaline cleaner bath up to 45°C.

Passivation – water based

Product selection → passivation – dip application !

P3-prevox 6738 N: → liquid product → spray/dip application

→ Suitable for Iron and cast iron. Organic and inorganic salts.

P3-prevox 6748: → liquid product → spray/dip application

→ Suitable for Iron and cast iron. Only organics. Use for leakage test.

Passivation in general:

Water based passivation products leave a slightly alkaline layer on the surface of parts after drying. This layer protects metal parts for a short time (temporary) against corrosion on air.

The parts must be stored in a warehouse with dry and room tempered climate.

Inhibitors

Product selection → inhibitors – hand/dip application !

Rodine 58: → liquid product → dip application

→ Inhibitor in sulphuric- and phosphoric acid – used for iron material

Rodine 60: → liquid product → dip application

→ Inhibitor in hydrochloric acid

Inhibitors – general Information:

Inhibitors create a thin protective layer on metallic surfaces.

This layer protect 90 – 99% against chemical attack of pickling bath on pure metal substrate. But inhibitor allow a solving of any kind of corrosion, scale and oxide layers on the parts.

Henkel

Pickling – general - trouble shooting

Pickling gives a high chemical attack on metallic substrates.

Inhibitors reduce the attack in the best way close to zero.

BUT: A reduction of pickling to 100% can never promised to the customer.

In every pickling operation the right inhibitor have to be chosen and the customer have to be informed, that all material what will have contact to the pickling bath (pumps, sealing material, tubes,…) can maybe have different behave with the product and maybe can be destroyed.

Special cleaner

Product selection → special cleaner – special application!

P3-grato12: → liquid product → high pressure

→ Neutral cleaner for all substrates including walls from buildings, plastics, aluminium facades……

P3-glin floor: → liquid product → brush machine

→ Neutral, good foaming cleaner for floor cleaning machines.

P3-manuvo: → powder product → dip application

→ Hand cleaner for removing oil and dirt from human skin.

Resume……

Cleaning is the most important step in chemical processes.

A huge knowledge of cleaning chemistry, line mechanic, substrates and reactions of dirt is necessary to support the customer and to be successful in the field.

Thank you