

Preparation of Surfaces Before Treatments

(Cleaning Processes)

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Features that should be considered in the selection of the cleaning process:

- Environmental and health effects of cleaning material
- Recognition of dirt and determination of its properties
- Recognition of substrate (base material)
- Required cleaning degree (level)
- Total cleaning surface area
- Effects of former processes
- Effects of latter processes
- Capacities of existing system
- Cost of cleaning process

Cleaning of oils (fats), petroleum contaminants and dirts

Sources of organic dirtiness:

- Cutting and machining liquids
- Rolling and pressing lubricants
- Protective matters
- Other kind of lubricants

Vapour Cleaning

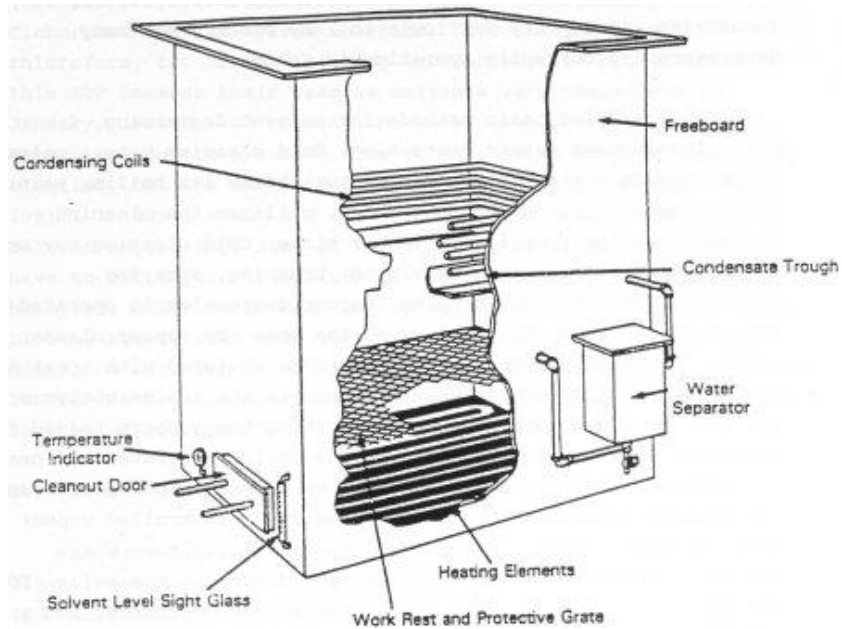
Mineral and grease oils can be removed with organic solvents.

Organic solvents:

- Trichlorethylene
- Methylenechloride
- Trichlor-Trifluoreethylene

Substrate material is dipped into solvent vapour then rinsed.

Vapour Cleaning



Cleaning with solvents (in liquid form)

It is a dissolving process of dirtiness with organic solvents.

Organic solvents:

- Trichlorethylene
- Methyl alcohol
- Toluene
- Benzene

Application methods

- Dipping
- Sliding or brushing
- Spraying

Cleaning with acids

- It can be used alone or with other cleaning techniques.
- Acids have dissolving ability of oxides which other solvents do not.

Mineral acids:

- Hydrochloric acid (HCl)
- Sulfuric acid (H_2SO_4)
- Phosphoric acid (H_3PO_4)

Organic acids:

- Citric acid ($\text{C}_6\text{H}_8\text{O}_7$)
- Tartaric acid ($\text{C}_4\text{H}_6\text{O}_6$)
- Acetic acid (CH_3COOH)
- Oxalic acid ($\text{C}_2\text{H}_2\text{O}_4$)

Cleaning with acids

- Phosphoric acid and its mixture solutions can remove grease, oil and paints residues also thick rust layers on steel and iron surfaces. It forms a phosphate layer on the surface. This layer is protective and appropriate for painting.
- For stainless steels nitric acid (HNO_3) and hydrofluoric acid (HF) mixtures are used.

Cleaning with alkaline solutions (Caustic Cleaning)

- Alkaline cleaning is a common method for various surface dirtiness.
- They are not as effective as solvents for cleaning of heavy carbonized oils and greases.
- For steels, solvent is used in high alkaline degrees.
- For Zn and Al alkaline degree must be low.
- Spraying, electrolytic, wetting or rotating brushing techniques are used.
- For all materials cleaning temperatures must be between 70-95°C
- Hydroxides are the simplest, very strong and common alkaline solvents.

$\text{NaOH} - \text{KOH} \rightarrow \text{Caustic soda}$

Cleaning with emulsions

- This is combination of organic and alkaline cleaning techniques. Emulsions of organic solvents are prepared in liquid soap solutions.
- Organic solvent + Potassium Oleate
(Basic component) (Emulsion maker)
- Process temperature is between 60-80 °C

Cleaning of steel surfaces from rust and rolling oxide scales (Descaling)

- Corrosion products rust and ironized components which forms during hot rolling cannot be cleaned with oil dissolving solvents.
- These layers can be cleaned with
 - mechanical,
 - thermal and
 - chemical techniques.

Mechanical cleaning

- Scraping
- Wire brushing
- Grinding
- Bead blasting and shot blasting

Shot blasting: Silica (SiO_2), alumina (Al_2O_3), steel, silicon carbide (SiC), glass beads, dry ice or soda particles are blasted with high pressurized air.

Thermal cleaning

There are three ways for thermal cleaning

Cleaning with flame: Oxyacetylene flame is used. Oxide scale is removed from the surface with sudden heating. After that, wire brushing is applied. This technique is used for wide surfaces and constructions.

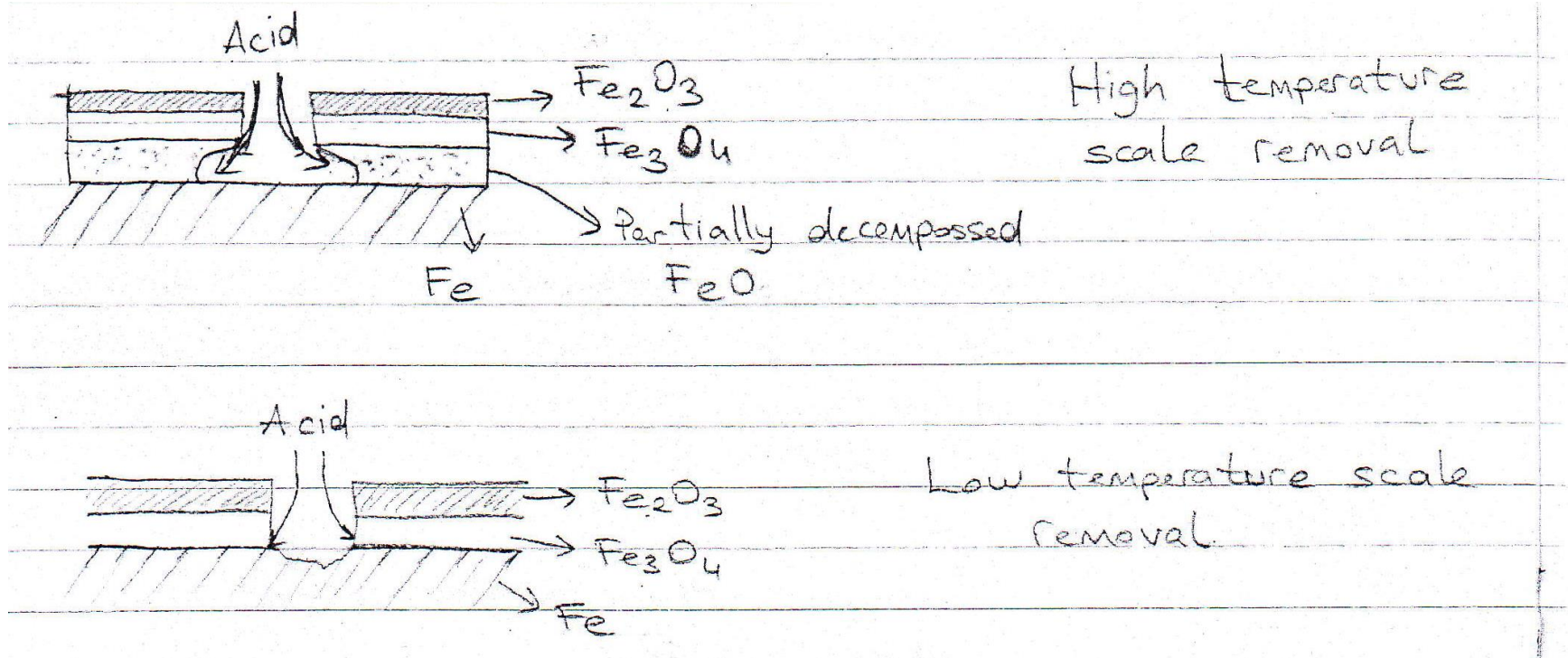
Cleaning with induction: Steel part surface is heated up to 175 °C with induction coil then cold water is sprayed to hot surface, this cause peel of oxide scale.

Cleaning with laser: High intensive laser spot is applied to rusty steel surfaces. Laser beam rapidly evaporates scale layer.

Chemical cleaning (Pickling)

- It is used to clean multilayer oxides from steel surfaces
- 3-10 % sulfuric acid (H_2SO_4) is used at 85-90 °C for 5-20 min. hydrochloric acid (HCl) acid solution can be added to this solution.
- At low temperatures HCl can be used alone
- 10-20% Phosphoric acid (H_3PO_4) can be used at 90 °C

Mechanism of scale removal with acid



Video links

- <https://www.youtube.com/watch?v=j-mWJvRswQ4>
- <https://www.youtube.com/watch?v=pfVnBsVJJt0>
- <https://www.youtube.com/watch?v=jEFWMLQ3Wjw>
- <https://www.youtube.com/watch?v=gTbE316-Dow>
- <https://www.youtube.com/watch?v=JD2L9qhCCGE>
- <https://www.youtube.com/watch?v=upqgnYpfKY0>
- <https://www.youtube.com/watch?v=j0w4XPx-pwQ>
- <https://www.youtube.com/watch?v=pzITsCUaIlk>
- <https://www.youtube.com/watch?v=zTtliHZcl4o>
- <https://www.youtube.com/watch?v=YRVHvaCG0M>
- <https://www.youtube.com/watch?v=l3cOslg-gUY>
- <https://www.youtube.com/watch?v=CKbuRAyKRuU>
- <https://www.youtube.com/watch?v=CLaBFkeHG0A>
- <https://www.youtube.com/watch?v=QSinoUm6LIQ>