AICHELIN
Heat Treatment Systems

Cleaning equipment

for the cleaning of parts
before and after heat treatment

RELIABILITY AT WORK

AICHELIN Cleaning equipment

Flawlessly clean surfaces are the deciding factor for the quality of end-products when parts are to be heat treated.

1. Cleaning methods

Water based cleaning systems have met with general acceptance for parts cleaning before and after heat treatment. Due to reasons of environmental protection and cost, they have largely replaced the systems that work with halogenated hydrocarbons or cold cleaners (aromatic hydrocarbons).

In hardening plants, water based cleaning has proven itself to be the best cleaning method, from both the economical as well as ecological standpoints.

The quality of part cleaning is influenced by a range of parameters - the most important of

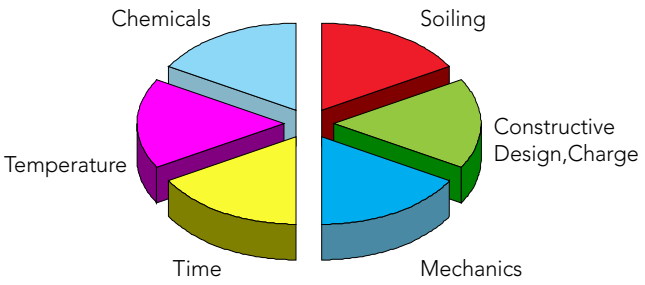


Fig.1 - Quality parameters of part cleaning

which are depicted in figure 1.

The correct cleaning of the parts before heat treatment ensures that the furnace atmosphere remains free from the influence of foreign substances and the exchange of materials can occur on the surface without impediment. Especially cooling lubricants and chips from previous mechanical processing have to be removed in order to achieve this.

After heat treatment, the parts have to be cleaned, dried and, where necessary, treated with corrosion protection, depending on the requirements of the subsequent manufacturing stages.

2. Cleaning agents

For the most part, demulsified systems have proven themselves in practice for cleaning with aqueous cleaning methods. Only these ensure a low oil-load in the washing solution, which prevents re-greasing of the parts.
All water based cleaners are subject to very stringent requirements. In general, one can differentiate between two groups of cleaners:

- Alkaline cleaners, so called builder systems, based on KOH or NaOH as well as inorganic salts, such as phosphates, silicates, borates, etc.
- Organic neutral cleaners, which are comprised of non-ionic surface-active agents and are generally including additives, such as biocides or corrosion-preventative additives.

The preferred application of both product lines is depicted in fig. 2. Organic cleaners (surfactants) are preferred for the degreasing of moderately

Greasing and impurities	Chemical basis for removal	
	Tenside	Builder / complexing agent
Saponifiable animal and plant oils and fats	▲	▲
Non-saponifiable mineral oil and fats	▲	
Emulsifiers and lubricating components / cooling lubricants	▲	
Inorganic slip agents and metallic soaps		▲
Corrosion protection agents	▲	▲
Pigments, metal abrasions, graphite, MoS_2		▲
By products from greasing and impurities / Polymerizate	▲	▲
Chips	-	-
Buffing dust / Cleaning abrasive residues		▲
Oxides / Corrosion products	-	-

Fig. 2 - Selection of cleaning systems

soiled components before heat treatment. Alkaline cleaners (Builders) are preferred for heavy-duty cleaning requirements and cleaning of pigment soiling. Residues of some inorganic components can leave passive films behind for the subsequent thermo-chemical treatments.

In many cases, it has been shown that a combination of builder components and surfactants can lead to a better cleaning effect, and, such systems are also most suitable for universal usage.

Accordingly, the selection of the cleaner must be matched to the subsequent treatment stage.

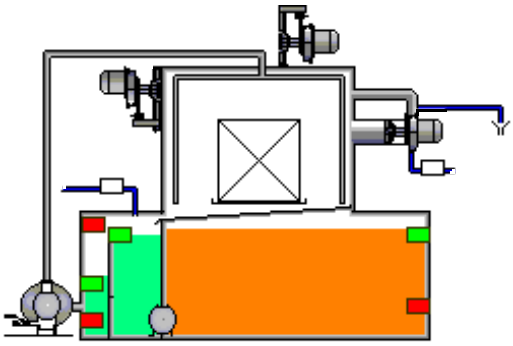
AICHELN's specialist staff will examine the individual cleaning requirements, undertake corresponding cleaning tests with your components and aid you in making an optimal choice.

Fig.3 - Chamber submersion spray-cleaning unit

3. Cleaning plants

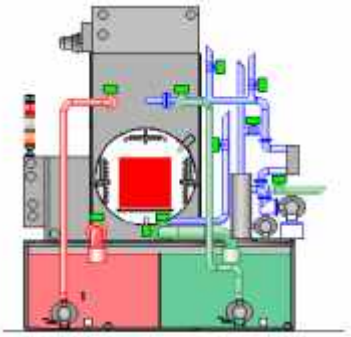
Based on the various requirements in relation to throughput performance, cleaning quality, flexibility, and environmental protection, AICHELIN has developed numerous cleaning units and successfully commissioned them for our customers.

In particularly, two series have been further developed, as a result of this immense experience:



➤ Submersion spray-cleaning units

- Type KEKTE electrically heated
- Type KEKTG gas heated
- Type KEKTD steam heated



➤ FLEXICLEAN® vacuum-cleaning units

- Type EKFE electrical heated
- Type EKFG gas heated
- Type EKFD steam heated

Both series are available as cellular or continuous units. They can be operated either as individual units or as part of a heat treatment line.

3.1 Submersion spray-cleaning units

Fig.4 - Chamber submersion spray unit integrated into a chamber furnace line

This plant is used for cleaning a wide spectrum of parts both before and after heat treatment. The essential components include an isolated container for two cleaning agents, a spraying chamber with a rotating spraying system positioned above, sink / swinging platform, heating for submerged and spraying agents, level control, and an oil separation unit.

3.1.1 Design characteristics

Fig.5 - Charge room chamber submersion spray unit

- Oscillating system for dipping the charge in the cleaning bath
- Spraying system with rotating jet arms
- Vapor vent condenser (opt.)
- Re-dosing system on cleaning tank from spray tank
- Fresh water supply to spray tank
- Stainless steel design
- Oil separator for submersion bath
- Heater exchange without emptying the tank
- Operation produces almost no waste-water and exhaust air

3.1.2 Cleaning process

The charge to be cleaned is dipped into the cleaning fluid (medium 1). The oscillating movement serves to intensify the cleaning process. After the programmable oscillating time has elapsed, the charge is lifted into the spraying chamber and the cleaning residues that are stuck to it are removed by means of rotating spraying jets containing the second cleaning agent. A separation system serves to effectively prevent mixing of the agents.

After spraying and draining, the charge is dried by means of a vapour vent condenser. The warm, moist air is sucked out of the chamber and the water dissipated. The air is subsequently re-

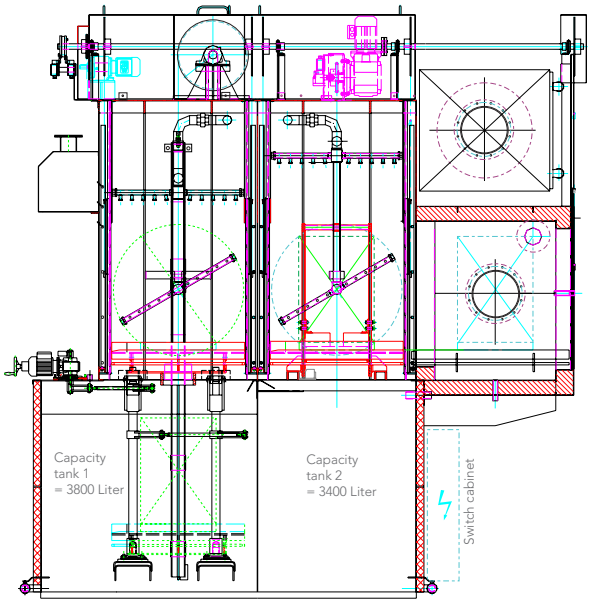


Fig.6 - Continuous submersion spray cleaning unit

heated and blown onto the charge by means of a diffuser.

The container filling levels are monitored by means of level sensors and, where necessary, refilled with fresh water.

The continuous plant first sprays with medium 1 and then medium 2.

3.1.3 Oil separation

The separation of cleaned oil is undertaken by

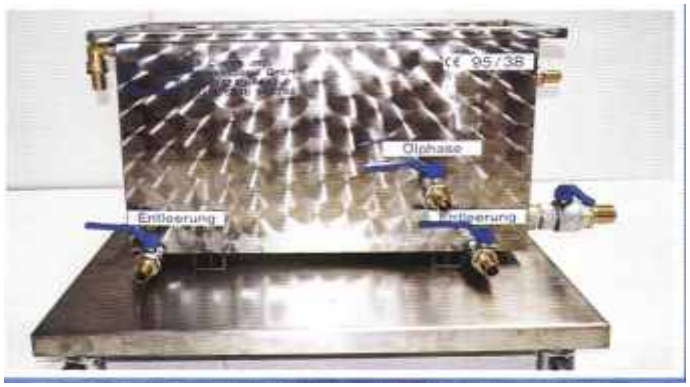


Fig.7 - Coalescence oil separator

means of a disk-phase separator with a capacity of approximately 800 litres per hour. The separator works on the principle of gravity and coalescence (the flowing together of droplets).

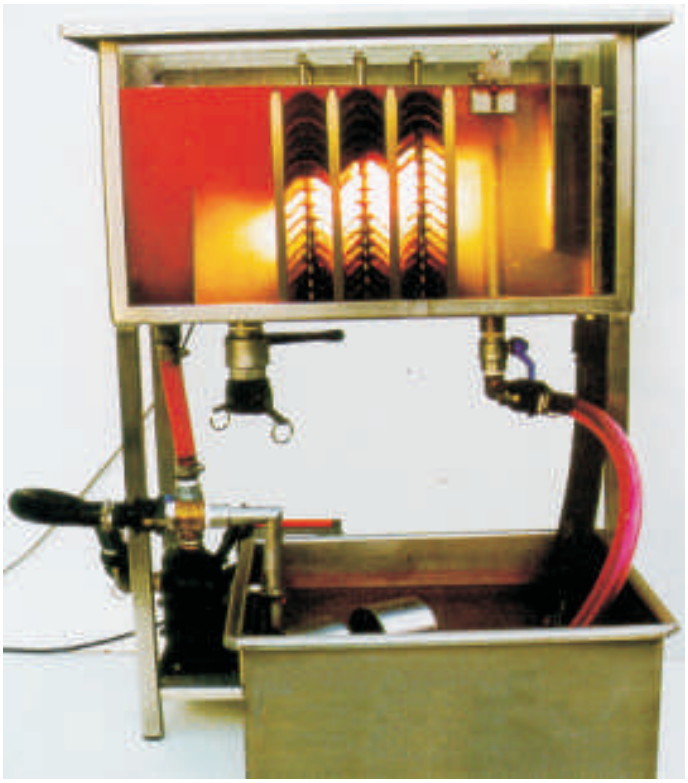


Fig.8 - 3-phase separator (interior view)

All materials that have a density difference of 5% to the cleaning medium will be separated. In doing so, phases with low density flow upwards, and phases with low-density sink downwards. Very small droplets join together and become larger droplets, according to the coalescence principle and thereby rise up above the profile slot and are separated.

Pigment soiling and chips are removable with a mechanical filter system with selectable porosity. An external circuit can be used with a centrifuge for heavy pigment soiling.

Fig.9 - Rear view chamber submersion spray cleaning unit with coalescence oil separator

Magnetic rods in the washing chamber have proven themselves reliable in reducing magnetic particles, such as chips on the charge.

3.2 Flexiclean®- cleaning units

Fig.10 - Charge room Flexiclean®- chamber unit

These patented units are used especially where highest levels of purity are required and / or geometrically complex components are to be cleaned.

The essential components include a vacuum-tight cleaning chamber, isolated tanks for two (optionally: three) cleaning agents, vacuum pump, spray pump and heating for each agent and an oil separation unit.

3.2.1 Design characteristics

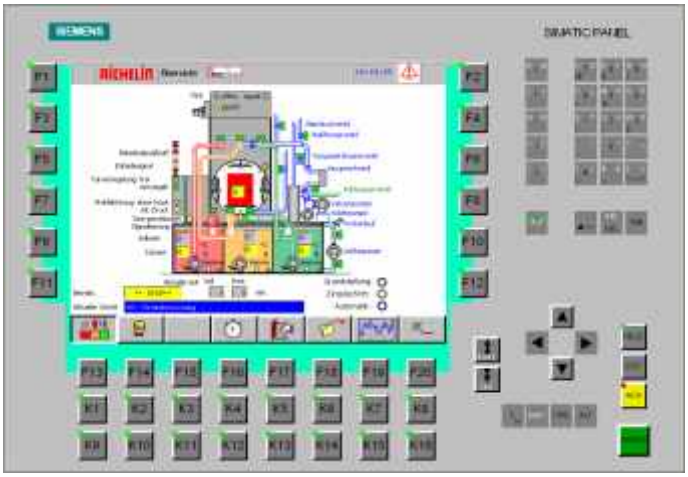


Fig. 11 - process visualization with Siemens MP 277

- Low-pressure boiling "VACUPEARL®" for improved cleaning effect, even in inaccessible areas.
- Vacuum drying unit for achieving completely dry components.
- Stainless steel design
- Oil separation for each cleaning agent (optional)
- Heater exchange without emptying the tank
- Operation produces almost no waste-water and exhaust air
- Short cycles and low energy consumption

3.2.2 Cleaning process

The cleaning cycle is dependent on the type and thickness of the soiling, the cleaning agent used and the desired degree of purity. A typical process could be undertaken as follows and is freely-programmable:

After pre-spraying the charge with the first cleaning agent, the container is filled with medium 1 and subsequently the low-pressure boiling process is started. After pressure is equalized, the chamber is emptied and the charge is sprayed again.

This cycle can be repeated with additional cleaning or rinsing fluids.

Afterwards the vacuum drying process is undertaken and the container is ventilated to remove the charge.

3.2.3 Low pressure boiling VACUPEARL®

The patented Vacupearl system works by creating a vacuum above the bath level. This causes the cleaning fluid to start to boil and steam bubbles form predominately on the workpiece surface of the charge.

Fig.12 - Flexiclean® with 2 medium tanks – rear view

This provides the following advantages:

- Increased fluid movement on the component surface
- Detergents are delivered directly to the workpiece and do not have to be diffused by the liquid barrier.
- Steam collects predominantly where the enclosed liquid quantities are relatively small in comparison to the surrounding part surface, such as for example, in blind holes, grooves, empty spaces, or between tightly loaded parts.
- The floatation effect brought about by the addition of air is further strengthened by the expanding volume of steam.

3.2.4 Vacuum drying

In order to achieve a good cleaning effect, the operating temperature should generally be between 80 – 85° C. The charge will then have enough residual heat to be used to evaporate the water on the parts. Vacuum drying enables even awkward areas, such as blind drill holes, thin lubrication holes and even suction chambers to be dried completely. Generally 0.1 – 0.3 % of the charge weight in water will stick to the workpieces. Vacuum drying allows up to 1 percent in weight of water to be dried off.

Absolutely dry components are required:

- Before vacuum heat treatments
- Before diffusion heat treatment processes
- Before low-temperature tempering processes
- Before work procedures where water residue is obstructive
- For corrosion protection, as only a dry passivant can protect the parts surface

Fig.13 Flexiclean® continuous cleaning unit integrated into a pusher type gas carburizing plant

3.2.5 Oil separation

The agent tank is connected by means of cascades. The first agent tank has an overflow chamber, in which the demulsified oil-cleaner mixture flows, and is then pumped out with a separation pump to the coalescence separator.

The cleaned fluid flows back into the agent tank and propels further floated oil to the overflow chamber. Integrated level sensors ensure that water or cleaning fluid is refilled from the agent storage tank, if the water level sinks.

4. Technical data

AICHELIN submersion spray cleaning units and AICHELIN Flexiclean cleaning units are optimally matched to AICHELIN's heat treatment plants, in terms of their physical size and charge dimensions. The following sizes are available as standard:

(additional sizes are available on request)

Size	Charge dimension WxLxH in mm	Gross charge kg
3	600 x 1100 x 650	650
4/1	700 x 1300 x 650	1000
4/2	700 x 1300 x 850	1000
4/3	700 x 1300 x 1150	1000
5/1	900 x 1500 x 650	1200
5/2	900 x 1500 x 850	1200
5/3	900 x 1500 x 1150	1800

5. Options

AICHELIN cleaning units distinguish themselves, among other things, in that they are technically, economically and ecologically matched to the requirements placed on them. A variety of additional special solutions has emerged during the production of over one hundred units that have been realized in the past years in close collaboration with our customers. This ensures that you will receive exactly the right equipment required for cleaning your components.

Examples of these optional features include:

- Stronger pumps for increased spraying pressure
- Alternate spraying of the charge
- Air ventilation with Flexiclean using injected cleaning fluid from below in the cleaning chamber
- Tilt platforms to empty ladled parts
- Tilt or rotation in the Flexiclean
- Drum equipment for small parts
- Vapor vent condenser drying
- One-way filter with and without magnetic inserts
- Dual-filter with and without return-flush equipment
- Magnetic rods for heavy-duty chips
- Oil separators for all media tanks
- Transfer pumping for media tanks
- Evaporation plant for salt bath cleaning
- Dosing device for cleaning agents
- External water preparation system by means of centrifuge
- Price reduction for normal steel design
- Design as injection machine only
- Collecting basin for maintaining local regulations

6. Integration

AICHELIN cleaning units can be easily integrated into existing heat treatment lines as shown here with an example of a continuous double-chamber furnace line.

In special cases, special cleaning units or pure injection washing machines can be selected and purchased from established suppliers, in combination with AICHELN's technical expertise.

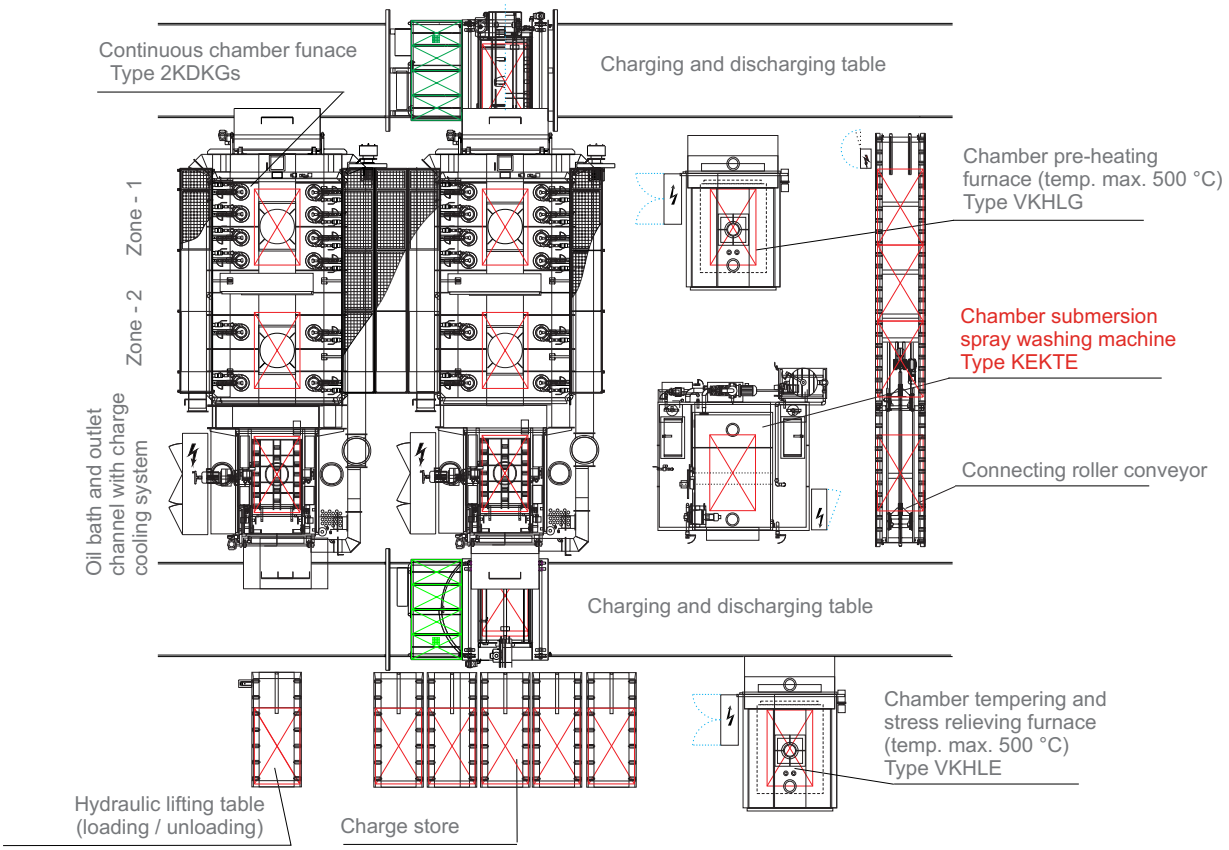


Fig.14 - Flexiclean® integrated in a double-chamber furnce line

We reserve the right to change dimensions and designs.
We will gladly provide additional technical data on request.

Cleaning equipment

Flexiclean with 3 medium tanks integrated into a chamber furnace nitriding line

Chamber submersion spray unit with vapor vent condenser drying

References

Flexiclean with 2 medium tanks integrated into a chamber furnace line

Chamber submersion spray unit integrated into a chamber furnace line

Cleaning equipment

for the cleaning of parts before and after heat treatment

AICHELIN Ges.m.b.H.
P.O. Box 210
A-2340 Mödling
Phone (+43) (2236) 236 46 - 0
Fax (+43) (2236) 22 22 9
info@aichelin.at

AICHELIN Service GmbH
P.O. Box 340
D-71603 Ludwigsburg
Phone (+49) (7141) 6437 - 0
Fax (+49) (7141) 6437 - 100
info@aichelin.de

NOXMAT GmbH
Ringstraße 7
D-09569 Oederan
Phone (+49) (37292) 65 03-0
Fax (+49) (37292) 65 03-29
info@noxmat.de

AICHELIN Heat Treatment Systems (Beijing) Co. Ltd.
10 00 86 Beijing, China
Phone (+86) (10) 8255 1421
Fax (+86) (10) 8255 1020
aichelin@china.com

SAFED Suisse SA
36, rue Emile-Boéchat
CH - 2800 Delémont
Phone (+41) (32) 421 44 60
Fax (+41) (32) 421 44 64
contact@safed.ch

EMA Indutec GmbH
Petersbergstrasse 9
D-74909 Meckesheim
Phone (+49) (6226) 788 - 0
Fax (+49) (6226) 788 - 100
info@ema-indutec.de

http://www.aichelin.com

TI90_3/Feb2011/E