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10th Anniversary HISAKA SOUTH EAST ASIA

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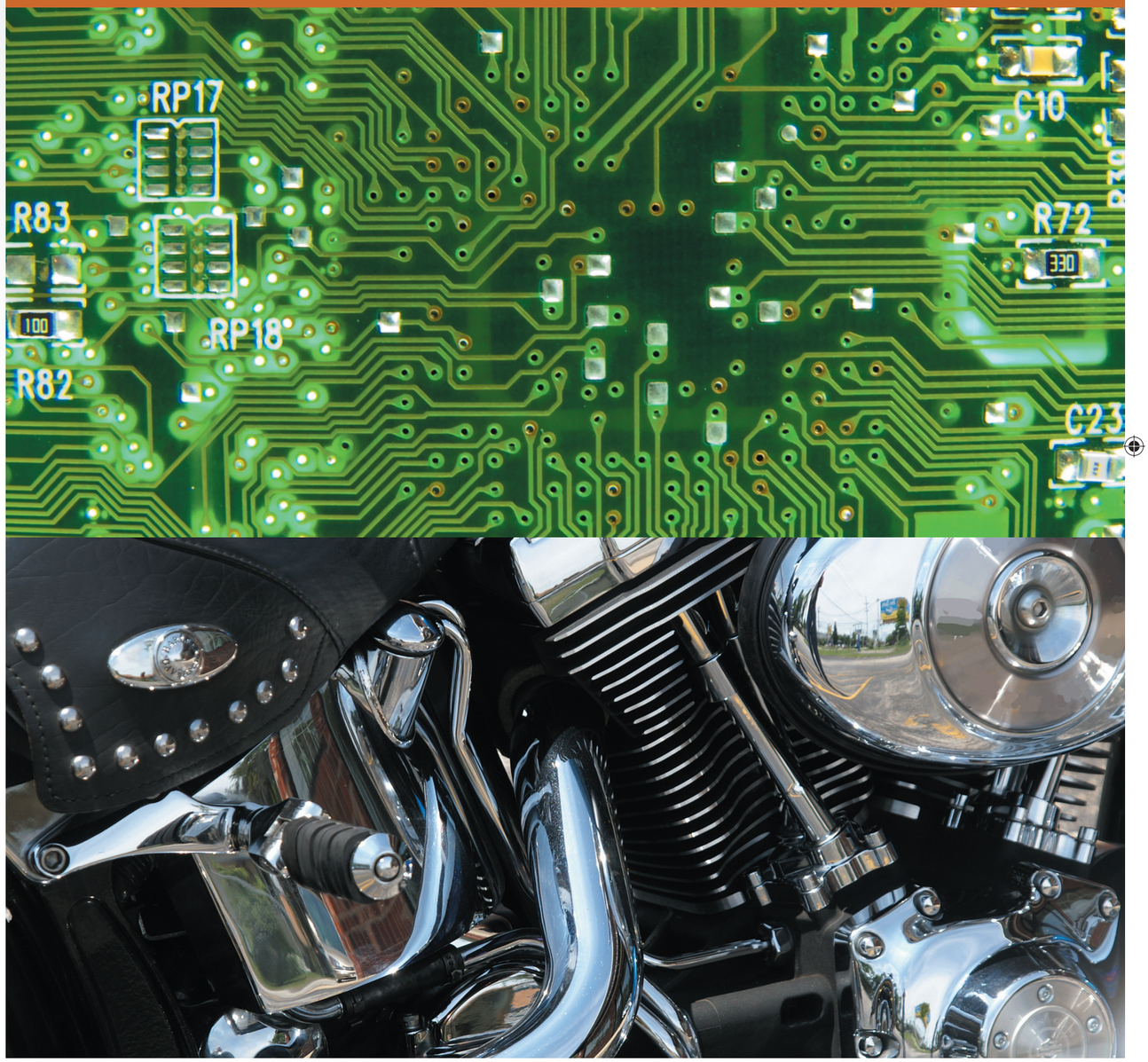
challenge for innovation

Plating Processes

Plate Heat Exchanger



HISAKA

Plating Processes and HISAKA Plate Heat Exchanger

Plating is a crucial modern surface covering technology in which a metal is deposited on a conductive surface. Plating places an important role in:

* Decorating object
* Corrosion and degradation prevention
* Hardening object
* Alter conductivity
* Minimise friction

Therefore, plating can be used in various industries, ranging from:

i. Common household items and accessories
ii. Automobiles
iii. Computers and communication devices
iv. Precision instruments
v. Aerospace hardware

However, it is crucial to note that the plating materials used in plating process are extremely corrosive as the metals are either dissolved electrically or chemically. Therefore, plating equipment requires to high corrosion resistance in order to meet the production requirements.

HISAKA Plates Heat Exchanger is ideal for plating processes because of:

i. High corrosion resistance
ii. Excellent heat exchange efficiency
iii. Accurate temperature control
iv. Enables high adjustment precision
v. Lightweight, compact and ease of maintenance

HISAKA WORKS is a comprehensive and integrated manufacturer of plate heat exchangers having the most advanced production facilities.

Overview of HISAKA WORKS Konoike Plant

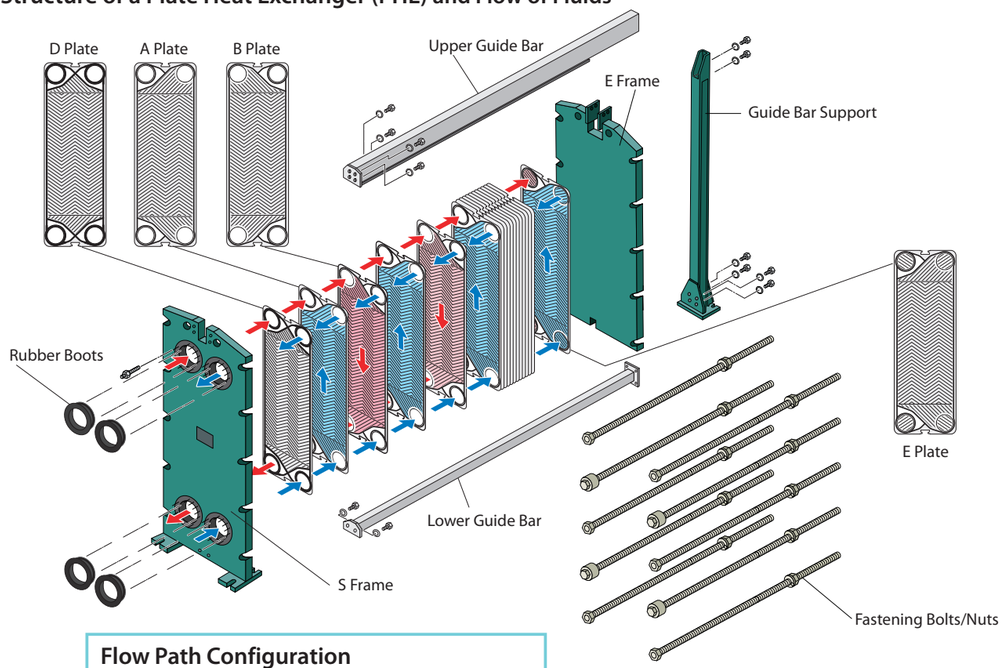
HISAKA Plate Heat Exchanger

Structure of a Plate Heat Exchanger (PHE)

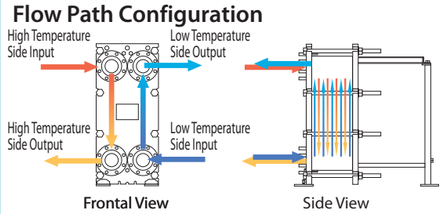
Plate heat exchangers (PHE) plates:
- Pressed thin metal plates that have convex and concave wave patterns (herringbone patterns)
- Made of corrosion resistant materials, such as stainless steel or titanium
- Perimeter of the plates is sealed with synthetic rubber gaskets (slit in or glue on method)
- Suspended perfectly on both upper and lower guide bars
- Fastened and compressed by a fixed and moving frame

Mechanisms:
* Counter current flow of high temperature fluid and low temperature fluid flowing against each plates. This phenomenon ensures heat transfer to take place.
* Gaskets ensure that the flowing fluids do not intermix.

Structure of a Plate Heat Exchanger (PHE) and Flow of Fluids



Flow Path Configuration



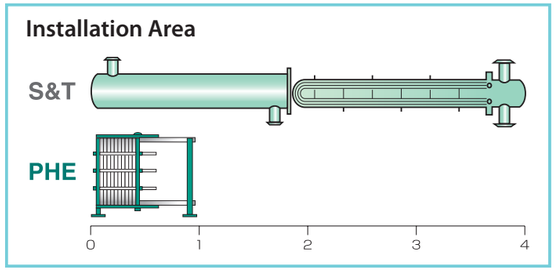
The fluid flows alternately through the flow path created between each plate and forms a countercurrent of the high temperature fluid and the low temperature fluid between every other plate to perform the heat exchange.

Advantages of Plate Heat Exchangers (PHE)

1. High-Performance
- Pressed - moulded herringbone patterns enhance heat conduction performance (heat transfer coefficient), hence able to reduce heat conduction surface area.

2. Lightweight and Compact
- Compressed thin heat transferring plates
- Limited fluid capacity
- Smaller heat transferring surface area

→ This realizes reduction in installation space, making installation and maintenance easier



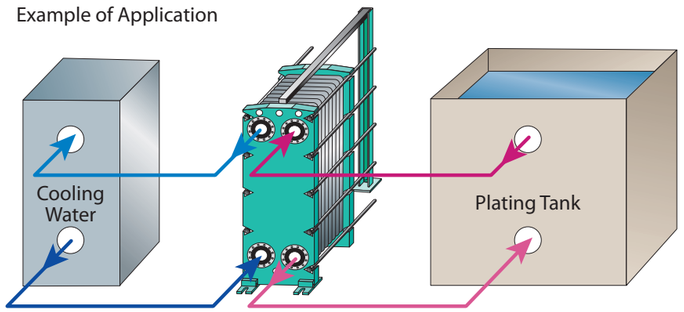
3. Quick Start - Up
- Limited fluid capacity per unit allows quick operation start up, and also possible to correspond to changes in operating conditions with high precision.

4. Excellent Maintainability
- Assembly and disassembly are made convenient by simply removing the fastening bolts
- Maintenance are thereby made easy, even for visual inspections and cleaning

5. Easy Modification of Capabilities
- Flexibility in modifying the heat transferring surface area by simply increasing or decreasing the number of plates

PLATING PROCESSES

Example of Application



Bath temperature used during plating process has to be constant in order to prevent plating defects such as low gloss, adherence inconsistencies, and uneven color distribution.

Corrugated tubes (material: lead) of highly corrosion - resistant materials, electrical heaters, jackets, shell and tube heat exchangers (material: stainless steel, carbide, titanium and etc) are commonly used to control the temperature of the plating bath. Reasons being are as follow:

1. Capacities are insufficient for large plating volumes, along with high heat generation
2. High heat transfer capacities require the system to increase in size and installation space
3. Larger unit of highly corrosion - resistant heat exchanger would translate to increase production cost and installation cost
4. Larger volume capacity then translate to difficulties in quality control, especially in terms of temperature control

Plate Heat Exchangers (PHE) are more ideal because of the following reasons:

1. PHE has the same heat transfer capacities
2. PHE is lightweight (only 1/3 of the weight of shell and tube exchanger) and compact (only 1/4 of the installation space required)
3. PHE is more economical even with the installation of highly corrosion - resistant materials
4. PHE offers great flexibility (and hence quality control) to control temperature of the plating tank due to lesser input volume of plating liquid required
5. PHE also enables quick machine activation due to lesser fluid volume involved; which in turns greatly reduce the operation time and ultimately save more on operating cost

Processes → Degreasing → Rinse → Acid Dipping → Electrolytic Degreasing → Acid Activating → Plating → Drying

Plate heat exchangers are used to cool the electrolytic solution by safeguarding the heat generated from the generation of currents lower than a certain temperature.

Plate Heat Exchangers for the Plating Industry

Chrome Plating

Chrome plating is a finishing treatment on a metal surface with either the usage of electrolytic deposition of chromium anhydride (sargant bath) or fluorinated chromic acid (fluoride bath) to:

1. Improve decorativeness
2. Increase corrosion
3. Increase wear resistance

However, when chromic acids are concerned, highly corrosion - resistant plate and gasket materials are needed for optimal functionality of the heat exchanger.

Plate Material *)

- **Chromic Anhydride (Sargent Bath)**
  Plate: TP270
  Gasket: Fluororubber (EPDM application)
- **Fluorinated chromic acid (Fluoride Bath)**
  Plate: SUS317L
  Gasket: Fluororubber (EPDM application)

⚠ As fluorinated chromic acid which is highly corrosive in relation to metal is contained, it is expected that the corrosion resistance life of the plates will be shorter than in ordinary applications.

Sulfuric Acid Copper Plating

Sulphuric acid copper plating is essential in microelectronic industry where electronic components are inserted into printed circuit boards (PCB) and soldered to pads on the opposite side either by manual assembly or by automated insertion mount machines.

Sulphuric acid also acts as an electrolyte to facilitate plastic plating processes via strike plating method. The plate material recommended for this plating process is titanium, as to prevent electrolytic corrosions.

Plate Material *)
Plate: TP270 Gasket: EPDM

Nickel Plating

Similarly, nickel plating is also used to:

1. Improve decorativeness
2. Enhance corrosion resistance
3. Improve wear resistance

Plate heat exchanger functions in electrolytic plating which precipitates metal nickel by injecting currents in the electrolyte containing nickel ions.

Plate Material *)
Plate: TP270 Gasket: EPDM

Zinc Plating

Zinc plating is the most reliable, effective and economical preventative measure of corrosion and rust by forming a barrier and acting as sacrificial anode when the barrier is damaged.

Zinc plating can be done in either alkaline environment (zincate bath) or acidic environment (acidic bath). However, since plating conducted under acid environment is more effective, titanium plates are recommended to prevent electrolytic corrosion.

Plate Material *)

- **Zincate Bath**
  Plate: SUS316 Gasket: EPDM
- **Acidic Zinc Bath**
  Plate: TP270 Gasket: EPDM

Tin Plating

Tin plating has been used extensively in food industry due to its non-toxic, ductile and corrosion resistant properties. Consequently, it is used to protect both ferrous (eg: copper and nickel) and other nonferrous surface metals.

Similarly, tin plating can be conducted in other alkaline or acidic environment, yet, it works best under acidic conditions. Therefore, titanium plate is recommended.

Plate Material *)

- **Acid Bath**
  Plate: TP270 Gasket: EPDM
- **Alkali Bath**
  Plate: SUS316 Gasket: EPDM

*) A commonly used material. The material will differ depending on operating requirements.