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10th Anniversary HISAKA SOUTH EAST ASIA

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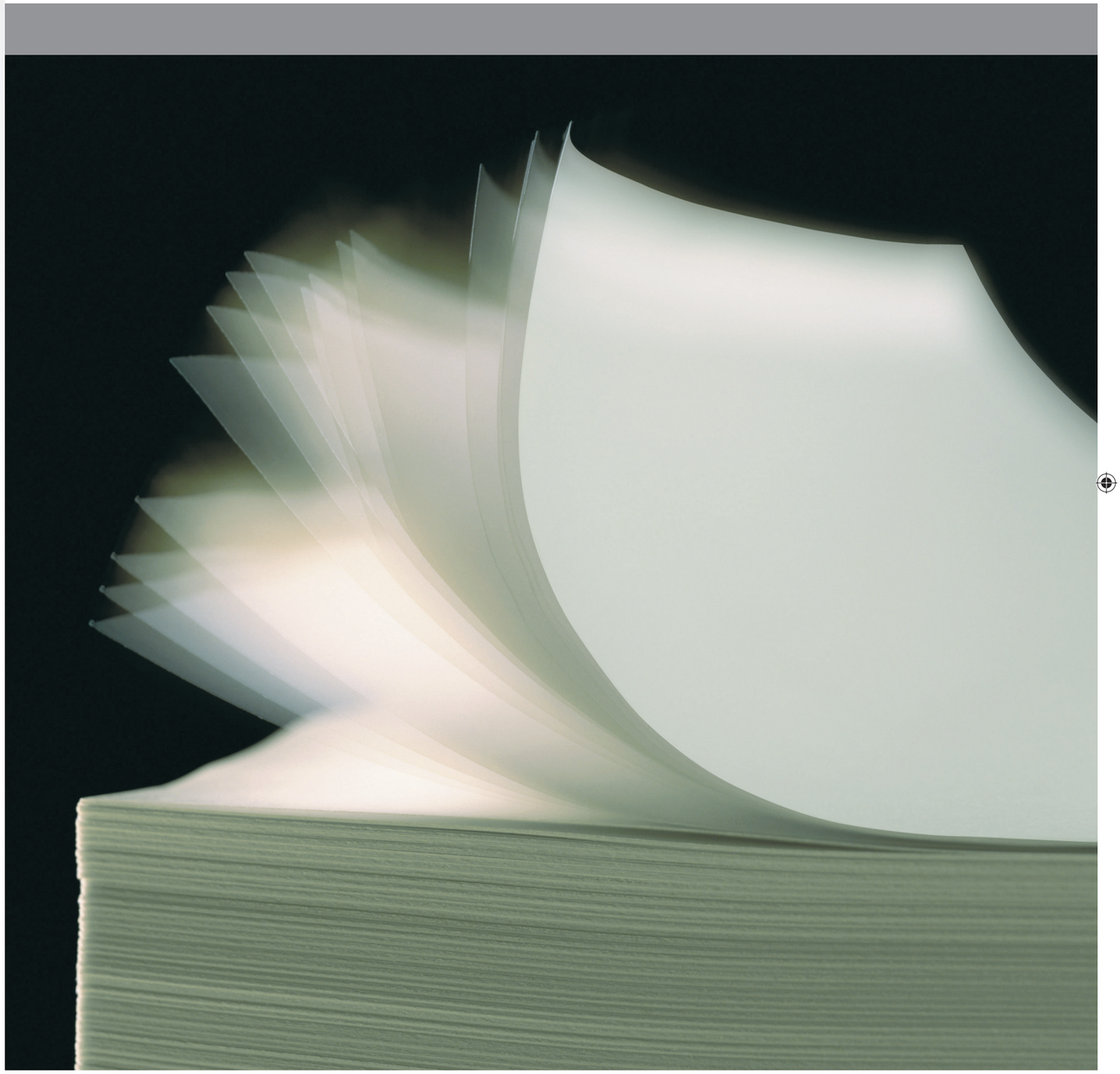
challenge for innovation

Pulp and Paper Manufacturing Industries

Plate Heat Exchanger



HISAKA

Pulp and Paper Industry

Papers are essential item in modern society. It was once predicted that paper will be eventually replaced with the evaluation of information technology, internet and television; yet, truth has indicated otherwise.

In pulp and paper industry, energy conservation is vital to ensure that papers can be produced with the least energy consumption and at the lowest possible cost to warrant the highest profit margin possible. Furthermore, with increasing environmental awareness from the local authorities, manufacturers are looking for high performing energy conservation systems that does not only provide competitive advantages, but also reduces on environmental stress.

Extensive research and developments have been conducted to ensure that all HISAKA Plate Heat Exchangers (PHEs):

1. Have high heat transfer efficiencies yet at a lower energy consumptions
2. Usable in biomass energy reproduction by recycling the energy produced from the pulps and paper productions

HISAKA's sincerities extended from providing the full range productions of high performance PHEs, to excellent after sales services and maintenance. As HISAKA's motto "Magokoro" explains - innovative technologies are sincerely delivered.

HISAKA Plate Heat Exchanger in Pulp and Paper Industry

Paper manufacturing can be broadly categorized into three main operations where HISAKA Plate Heat Exchangers (PHEs) are involved:

i. Digestion Process
ii. Bleaching Process
iii. Paper Making Process

HISAKA strives to provide high performance PHEs to warrant efficient energy and/or resources conversation and ultimately in reducing cost.

Digestion Process

Digestion process is the process where wooden chips are heated and dissolved in chemicals in order to extract pulps, which will later on serve as the raw material in paper production.

i. White liquor: a solution containing sodium hydroxide and sodium sulphide is added to the wooden chips to dissolve the fibres
ii. Fibres will be extracted through cooking under high temperature and pressure in a digester
iii. Approximately 50% of the initial volume will be processed into pulps while the remaning 50% will be discharged out as lean black liquor (a mixture of digestive chemicals, lignin and resin binders) in the pulp washer
   - This process however often emits foul gases such as hydrogen sulphides, methyl mercaptan, methyl sulphide & etc into the external environment, leading to increase environmental stess
   - Nevertheless, HISAKA YX-series PHE has high condensation capacities to efficiently condense these gases emitted from the digester and diffusion washer

Bleaching Process

Bleaching process mainly serves to remove and bleach any coloring components from the lignin-containing (unbleached) pulps in the digester. Chlorine dioxide is one of the most commonly used bleaching agent because:

- It is able to selectively react and eliminate lignin without damaging the wood fibres
- It provides color and brightness stability to the pulps

However, chlorine dioxide is unstable to be transported due to its volatile, flammable and corrosive properties; rendering it to be produced on - site at the mills by decomposing sodium chlorate in a strong acid solution. HISAKA titanium based WX - series is recommended for this process because:

i. Titanium based material provides high corrosion resistance because sodium chlorine is highly corrosive even at low concentrations
ii. The plates provides double protections by having fluorine resin cushioned gaskets (TCG) and are laser welded to one another
iii. Effective in bleaching processes that involves any chlorine - based chemicals
iv. Excellent heat exchanging capacity despite of its relatively small volume capacity as compared to shell and tube heat exchanger

Paper making Process

The digested and bleached pulps are then fed to a paper machine to be used as raw materials for paper production.

i. 2 - 3% of the pulp solution (has approximately 40% moisture content) will be pour onto a screen to ensure that the pulps align and form into sheets while the remaining moisture is drained by gravity
ii. A piece of cloth will then be placed along the sheeted pulps to press and compress and ultimately reducing the moisture content of the pulp to less than 20%
   - The drained water is known as white water as it contains bleached pulp components (solids), which is ideal to be cooled with HISAKA GX-series (multi - gaps)
   - HISAKA PHE also are employed to cool down the bearing lubricant of the rollers (in wiring and pressing processes) to prevent overheating of the lubricant
iii. The pressed paper will then pass through a dryer food to further remove the moisture content to approximately 8%
   - HISAKA PHEs are employed here for condensation purposes (YX-series) as well as for heat recovery (from the dryer steam)
iv. Speciality paper will then undergo special coating with special coating chemicals or liquid clay in the coating machine to improve printability of the paper
   - Calcium carbonate (CC) has been extensively used as coating agent due to its high brightness payoff and light scattering characteristics, hence it is often used as bleaches either in the form of ground calcium carbonate (GCC) or precipitated calcium carbonate (PCC)
   - HISAKA GX-series is recommended to cool the slurry from slaked lime (calcium hydroxide production) as well as to cool calcium carbonate slurry
v. Coated papers will then pass through a calendar to reduce thickness whilst smoothening the paper surface
vi. Lastly, it will then be wounded onto a reel and forming into paper rolls by a winder machine

Concentration Process

The lean black liquor discharged from the digester has significant reusable wood components (contributes to 1/2 to 1/3 of the combustible capabilities of crude oil) that can be concentrated to fuel boilers.

- Lean black liquor is wood waste liquid that has grown by absorbing water and carbon dioxide in the air
- It is carbon neutral during combustion, hence, expectably to greatly reduce carbon footprint

Precisely, the lean black liquor (concentration of approximately 20%) has to go through concentration process in an evaporator to create an approximate 70% concentration liquid for it to have the combustible capabilities to fuel the boilers.

HISAKA PHEs are greatly involved in these processes, for instance:

i. GX-series (multi-gap) is ideal as pre-haeters of lean black liquor prior feeding back to the evaporator to effectively utilise the black liquor
ii. YX-series (condenser) is ideal to condense steal vapor released from the evaporator
   -> the usage of PHE does not only save up on factory space, it is also able to increase production efficiency by reducing energy consumption

Chemical Recovering Process

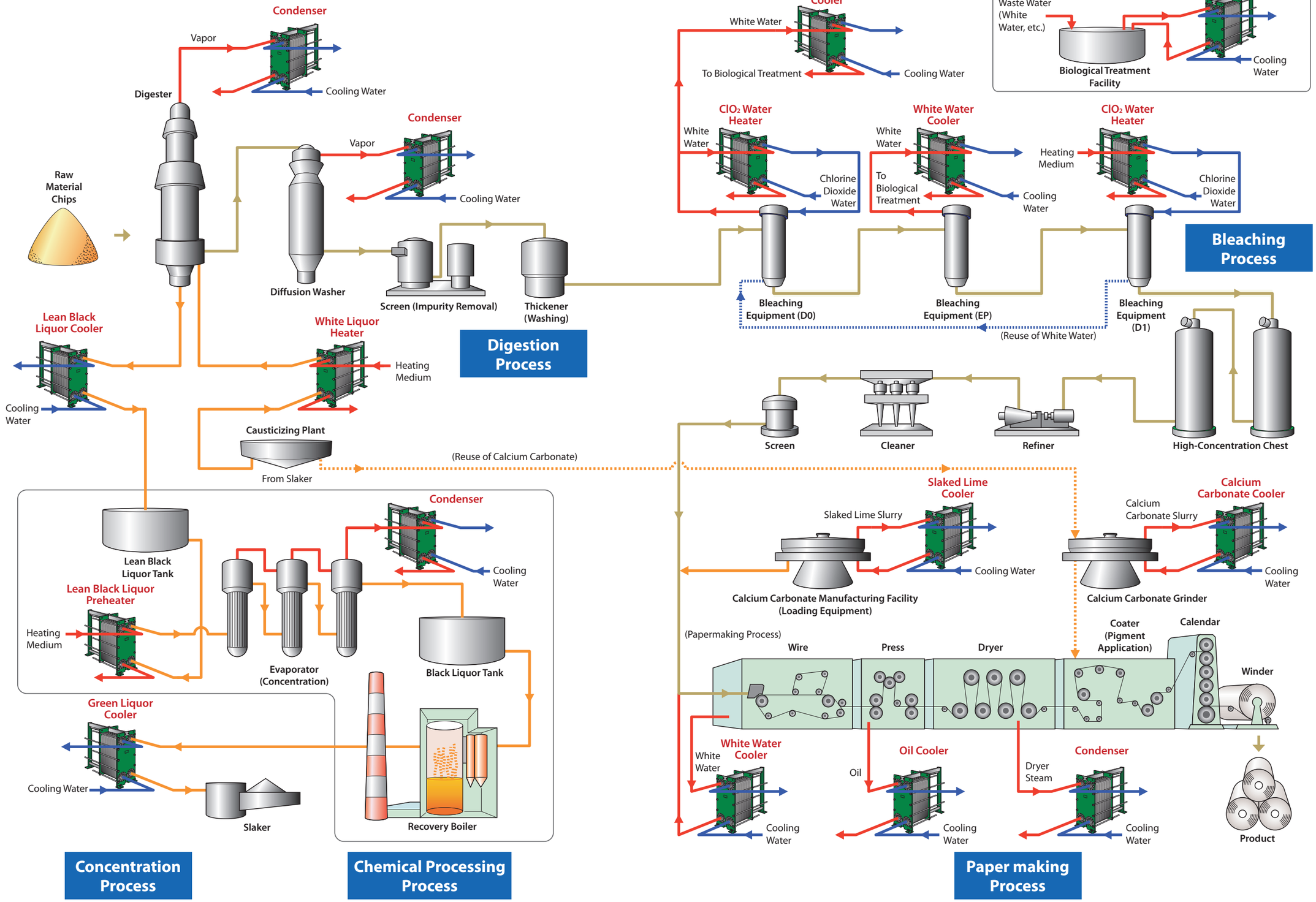
The condensed and combusted black liquor in a boiler will generate steam that can be further use to either generate electricity or to serve as a heat source for paper drying.

- The condensed black liquor is combusted in the furnace of soda collection boiler (simply as recovery boiler) or as black liquor recovery boiler
- It is possible to collect 98% or more of the used chemicals by gathering the combusted ashes
- Intense heat in the boiler furnace will then fuses the inorganic elements (residues remained at the bottom of the furnace) to form "green liquor" (smelt) when mixed with water
- The smelt will then undergo caustic treatment with quicklime (calcium oxide) to convert smelt back into white liquor which can therefore be reused to digest wood chips in the digester

HISAKA PHEs are also involved extensively in these processes, such as:

i. GX-series is ideal to cool the green liquor cooler which will then be used to cool the smelt from the collection boiler
ii. Others include blow water coolers and water supply pre-heaters

Pulp and Paper Manufacturing Processes



HISAKA Plate Heat Exchanger

Advantages of Plate Heat Exchangers

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.

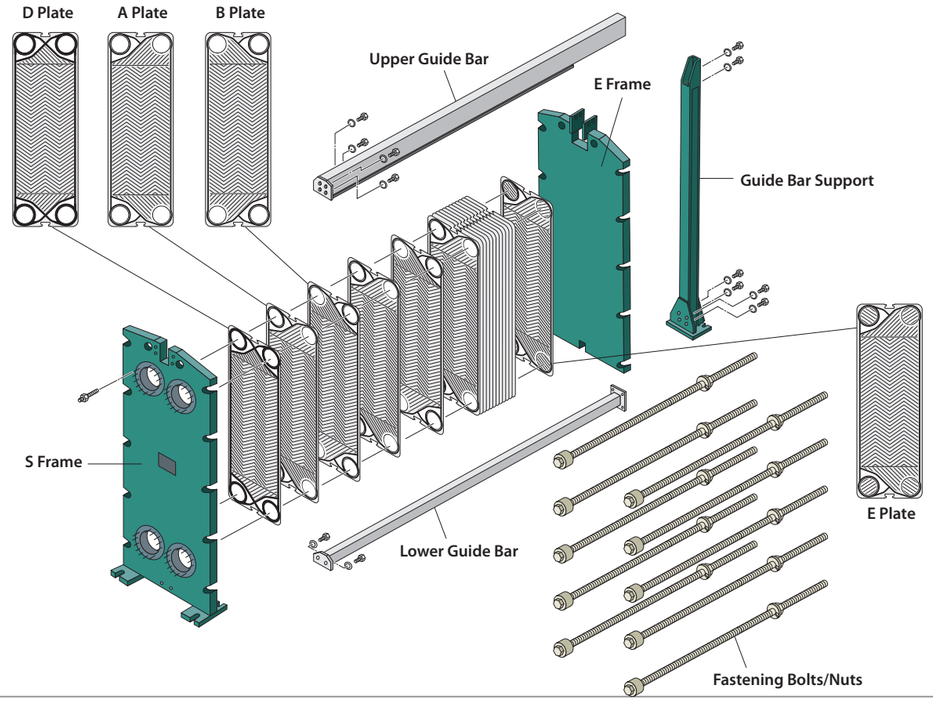
4. Excellent Maintainability

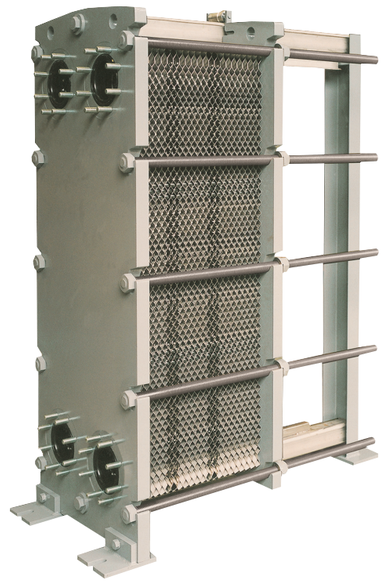
- Assembly and disassembly are made convenient by simply removing the fastening bolts
- Maintenance are thereby made easy, even for visual inspections and cleaning

5. Easy Modification of Capabilities

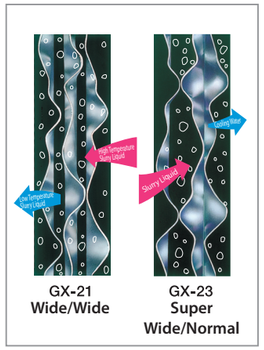
- Flexibility in modifying the heat transferring surface area by simply increasing or decreasing the number of plates

Structure of Plate Heat Exchanger

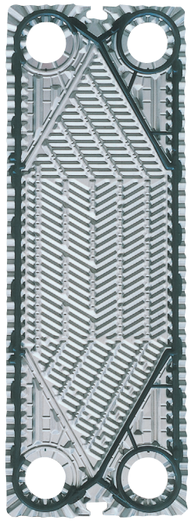




Principle of Multi-Gap



↑Multi-gap plates have few points of contact and enable configuration of broad gaps.



GX-20

HISAKA Multi-gap Plate Heat Exchanger (GX-SERIES)

HISAKA GX-series has wide plate gaps of up to 20 mm, made especially to allow flow of liquids containing fibres and solids (sludge) or even fluids that are prone to scaling.

Apart from having a wide gap, HISAKA GX-series has several other advantages such as:

1. Special plate corrugation pattern to ensure that the flowing medium from the plate channels to the plate gaps are flat, hence reducing the chances of clogging by the fibres or solids
   - An ideal combination of plates with different types of gaps (GX-23: super wide/normal; GX-21: wide/wide) can be done by altering the direction of the plates being assembled in order to minimize the contact points on each plate to make it best suit for a wide range of applications
2. Ideal in corrosive environments as the plates are made on corrosion - resistant materials such as titanium
3. Maintenance is made ease and convenient with the usage of slit-in gaskets

Welded Plate Heat Exchanger

HISAKA WX-series involves laser welding a couples of plates as an O-ring at the port holes between the plates in order to further stabilise the system for broader range of industrial applications, such as those involving dangerous fluids.

Conventional gasket sealing method at the port holes might not be sufficient, especially when dangerous fluids are involved. HISAKA WX-series does not only omit this worry, it also retains the benefits of conventional PHEs:

i. High performance assurance with the unique plate patterns to ensure even dispersion of the flowing liquids to the heat transfer area

ii. WX-series PHEs are capable of withstanding approximately twice the pressure compared to conventional gasket type PHE

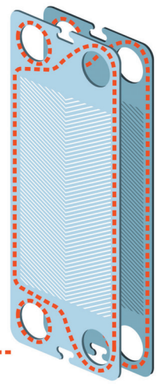
iii. There are two available ring gaskets options - synthetic rubber gaskets and fluorine resin cushion gaskets (TCG). TCG in particular has excellent chemical resistance and are capable of providing stable degree of sealing over a long period of time.

Principle of Welding by LASER Welding

Light
Amplification by
Stimulated
Emission of
Radiation

Melting and solidifying plates locally by collecting and projecting laser light as a heat source

① Rapid and deep weld penetration
② Minimal heat affected zones
③ Small welding distortion



Plates integrated by welding

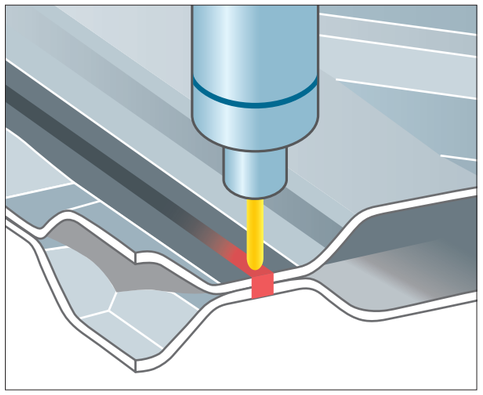


Plate Heat Exchanger for Condensation

HISAKA YX-series is specially made to be used as condensers, especially for heat exchange duties of large volumes of gas in vacuum systems or under low pressure.

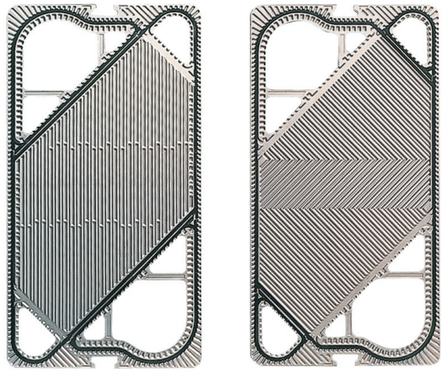
Since fluorine resin cushion gaskets (TCG) can be used, this make YX-series ideal for applications such as:

- Overhead condenser of a distillation tower
- Vapor condenser of a reaction vessel

As seen from the figure, the plate pattern on the vapor side and the cooling water side have been devised to warrant higher heat conduction performance than those of shell and tube heat exchangers.

- The coefficient of heat transfer on the vapor side is kept high whilst minimizing pressure loss. This is made possible even for cold condensation with the involvement of non-condensable and condensable vapor in vacuum
- The heat transfer coefficient can be increased by rising the degree of turbulence in the cooling water (coolant) side, hence, enabling a self-cleaning effect as dirt and/or other solids are difficult to adhere onto the plates
- It is possible to create a complete counter current flow by configuring the vapor and the cooling water to flow in opposite direction
- The inlet/outlet passage of the vapor plate are identical, hence, making it possible to use YX-series as a total condenser, but also as a cooling condenser for vapor containing non-condensable gases
- Flexibility in altering heat duties by increasing or decreasing the number of plates
- Half the amount of cooling water needed as compared to conventional PHE
- Wide application range as TCG can be used on both vapor and coolant side
- Ease of maintenance

Plate of YX-80



Cooling Water Side

Vapor Side