



All-welded Plate Heat Exchanger “XP Series”

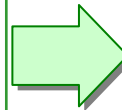
Energy & Water Company

Xenesys Inc.

- ▶ Low pressure loss and High heat transfer performance.
- ▶ Compact & Space-saving type Plate Heat Exchanger (PHE).
- ▶ No need to worry about leakage of liquid, gas and working fluid.
- ▶ “Gasketless” helps to reduce the cost of maintenance.

Agenda of General PHE / Tube type

- Need to reduce pressure loss at water side (reduce own power consumption & use at high flow rate)
- Need to reduce size and area to install
- No leakage and high pressure resistance
- High duty of maintenance (huge number of plates, gaskets)
- Erosion countermeasure and long-life against sea water
- Higher performance at phase-change condition (evaporation & condensation)



Solution by “XP Series”

- ✓ Heat transfer pattern with Low pressure loss
- ✓ Improvement of flow channel design
- ✓ Compact & Space saving type.
- ✓ Special made structure of Heat transfer pattern
- ✓ All-welded structure (gasketless)
- ✓ All-welded structure (gasketless)
- ✓ Developing Titanium made XP series
- ✓ Heat transfer pattern which is developed for phase change

Characteristic & advantage

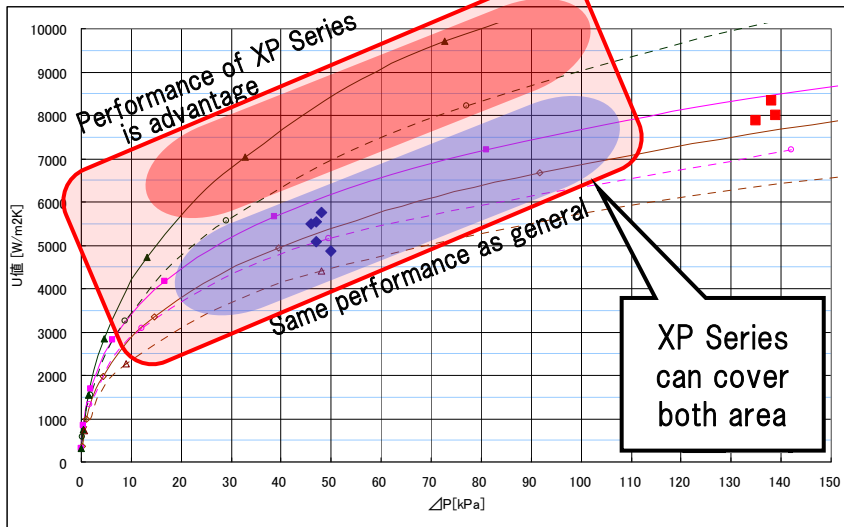
- Same heat transfer performance with more compact size XP series .

【Comparison of Area & Size】

Item	Unit	XP Series	General	S&T
Heat-transfer	m ²	440	Approx.100	2000
Installation area	m ²	4.3	8.3	30
Volume	m ³	11.2	30	94

- High heat transfer performance & Low pressure loss

- Possible to use XP series at high flow rate of heat source fluid
 - ⇒ Superior heat transfer performance
 - ⇒ Smaller heat transfer area
 - ⇒ Cost reduction
- Estimated heat transfer area and others of each heat exchanger under the same conditions.



【Characteristic & Advantage of XP Series】

Accepted Material

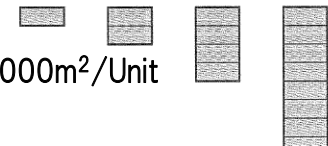
- SUS316L, SUS304L, Pure Titanium(Gr.1 & Gr.2), whatever.

All-welded

- No leakage under high pressure condition.
 - ⇒ Small size PHE : Maximum test pressure 30~50MPa
 - ⇒ Large size PHE : Maximum test pressure 10~30MPa
- Comparing with General PHE, XP series don't need to exchange gasket.

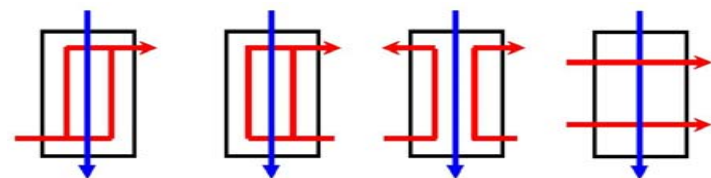
Size of Plate

- Our technology makes possible to manufacture various sizes of PHE easily with same tool.
- Length of Plate : 0.3m ~ 2.4m
- Width of Plate : 0.74m
- Heat transfer area : 1.4m² ~ Max 1000m²/Unit



Flexibility of Flow Patterns®

- Nozzle position & size are possible to change flexibly
- Changing flow patterns depending on customer request.



Advantages : Space-saving

XP Series realize high heat transfer performance under prescribed conditions, so it's possible to reduce heat transfer area. As the result, installation space will be smaller including pipes.

■ Example : Comparing with Liquid/ Liquid PHE
In case of Cooling system by sea water

■ Common conditions

Temp (water): $41^{\circ}\text{C} \rightarrow 35^{\circ}\text{C}$, $3300\text{m}^3/\text{h}$

Temp (sea water): $36^{\circ}\text{C} \leftarrow 30^{\circ}\text{C}$, $3300\text{m}^3/\text{h}$

Pressure loss: 80kPa Amount of heat : 23MW

Shell & Tube
Heat transfer area: 2000 m^2
U-Value: $2300\text{ W/m}^2\text{K}$
Size: $2.5\text{m} \times 15\text{m} \times 2.5\text{m} \times 1\text{ station}$

General PHE
Heat-transfer area: 1089 m^2
U-Value: $4224\text{ W/m}^2\text{K}$
Size: $1.6\text{m} \times 5.2\text{m} \times 3.6\text{m} \times 1\text{ station}$

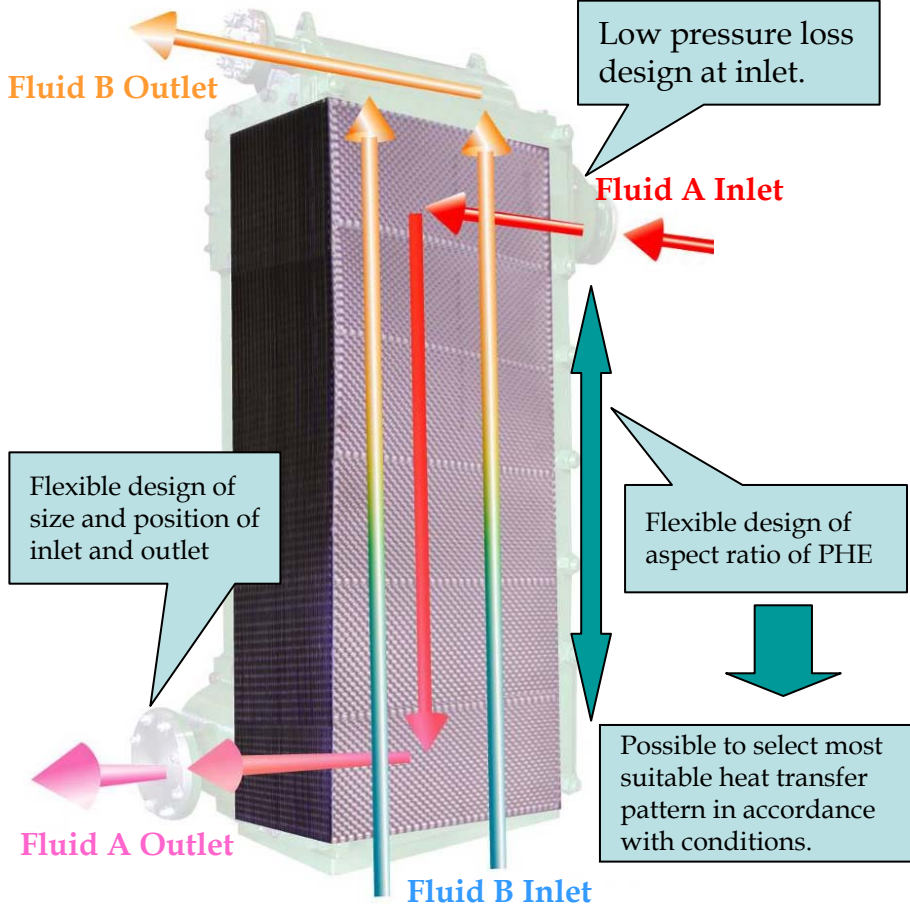
XP Series XP56R_7steps-60panels \times 2 stations
Heat-transfer area: 440 m^2 ($220\text{m}^2/\text{station}$)
U-Value: $10500\text{ W/m}^2\text{K}$
Size: $1.2\text{m} \times 1.8\text{m} \times 2.6\text{m} \times 2\text{ stations}$

Example of our products

- ▶ Depends on customer request, produce several types of XP Series.
- ▶ Depends on customer request, it's possible to change "Quality Control Level"

Example: Patterns of Flow

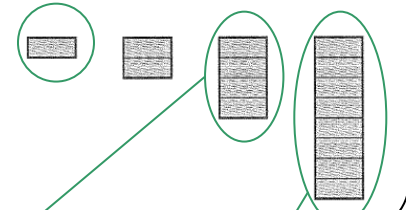
- **Box Type®**: Flexible design of aspect ratio and flow direction



【PHE for Mini-DTEC】

- Number of steps : 1 step
- Size : 0.3m x 0.73m

【Different sizes of Plate】



【PHE for Mini-DTEC】

- Number of steps : 4 steps
- Heat-transfer area : 63m²
- Size : 1.4m x 1.0m x 0.5m



【Large-size PHE made of Titanium】

- Number of steps : 8 steps
- Heat-transfer area : 437m²
- Size : 2.6m x 1.0m x 1.0m

- ▶ XP Series is “Pressure vessel”, depending on customer request, so we can follow various regulation and technical standard for the production, design and quality control.

ASME U-Stamp

- Certificated at March, 2004 (Renewed at March, 2011)
- IMARI Plant is the certified factory of ASME U-Stamp.
- Depending on customer request, it is possible to export XP Series with U-Stamp.

Electric Business Act

- Examined at November, 2008
- Applying to the manufacture of XP Series for the power generation project in Japan such as Mini-DTEC.

ISO9001

- Certified at January,2005
- Operating as in-house quality control system



【Pressure loss Test】



【Busting Test】



【Hydrostatic Test】

- ▶ Various inspections are incorporated in Manufacturing Process of XP Series, so we shall promise its reliable quality.

Manufacturing Process

1.1 Press

Sheet material (t0.4~t0.6mm) is formed by oil hydraulic press machine (2000ton) to be the heat transfer plate.

1.2 Panel Resistance Welding

Panel Welding is for bonding both ends of two heat transfer plates to be one panel. Qualified welder/operator perform with qualified welding procedure for all welding service.

1.3 Piling up Assembly

Assembling designated number of "Panels" to be one panel block.

1.4 Pile up Welding

Assembled panel block is bonded by special resistance welding technique.

Inspection Process

2.1 Material Inspection

All materials are verified for chemical and mechanical property by Material Test Report.

2.2 Helium Leak Test for Panel

After Panel Resistance Welding, it is verified that no crack for each panel by Helium Leak Test apparatus.

2.3 Groove and Visual Inspection

Before all welding service, it is verified within criteria by Groove Inspection. And after all welded, it is verified within criteria by Visual Inspection.

2.4 Helium Leak Test for Panel Block

After MIG Welding, it is verified without any leakage by Helium Leak Test.

- ▶ Various inspections are incorporated in Manufacturing Process of XP Series, so we shall promise its reliable quality.

Manufacturing Process

1.5 MIG robot welding

Operating MIG robot, specially-shaped welding joints are welded automatically with the stable welding bead and with few spatters.

Manufacturing and Inspection equipment

- Hydraulic Press(2,000ton)
- Special functioning tool
- Various Robots for Resistance Welding
- Jig for pile up and assembling
- Special Resistance Welding machine
- TIG Welding equipment
- Welding robot for MIG Welding
- Special welding power source for MIG
- Helium Leak Test machine and detector

Inspection Process

2.5 Penetrant Testing for Ti products

In case of products made of Titanium, qualified personnel verify the defection of weldment by Penetrant Testing in accordance with regulation requirement.

2.6 Pressure Test

Before shipment, we finally verify air tightness and excessive deformation by Hydrostatic or Pnematic Test in accordance with regulation requirement.



【Automatic Press Line】

- ▶ “XP Series” were developed for the power generation using Ammonia and so on. However, if it's applied to other purposes, it's possible to establish more economically feasible system.

Excellent Application / Use Condition

- ▶ XP Series is good at Titanium made to use sea water as heat source.

【CASE-1】

- Fluid : Ammonia & Ammonia water (Liquid, Vapor)
- Operating Pressure : Max 3MPa ※ small type XP = approx. 5MPa
- Temp Condition : Approx. 0~150°C

【CASE-2】

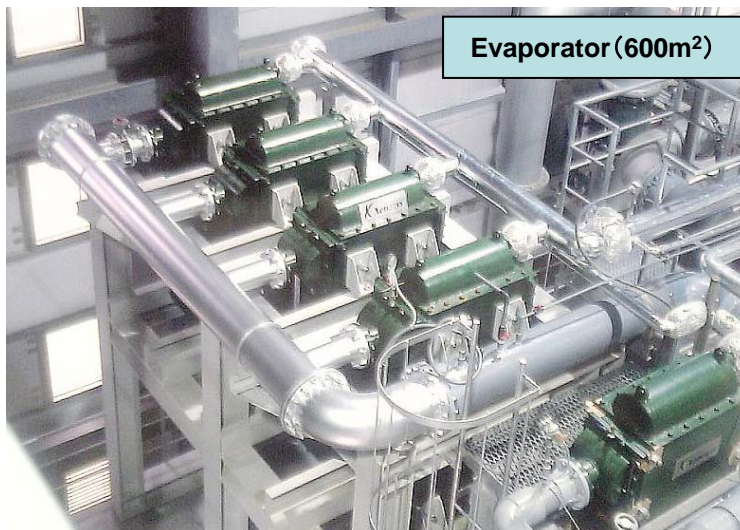
- Fluid : High Temp Side = Water vapor, Low Temp Side = Seawater
- Operating Pressure : Approx. 1MPa ※ Condenser for Vacuum vapor
- Temp Condition : Approx. 0~90°C

Applicable Purpose / Use Condition

- Fluid : Water, Seawater, Hydraulic oil, Corrosive fluid, Alkaline fluid
- Operating Pressure : Within approx. 5MPa ※ Depends on size of PHE
- Temp Condition : Approx. 0~150°C

OTEC

- ▶ OTEC (Ocean Thermal Energy Conversion)
 - XP Series is applicable for large scale Evaporator and Condenser for Ocean Thermal Energy Conversion.
 - Temperature condition :
 - Surface seawater (Warm source) 24~30°C
 - Deep seawater (Cold source) 4~10°C
 - Applicable for two phase condition of Ammonia/Water mixture.
 - XP Series made of Titanium were installed in Institute of Ocean Energy, Saga University, Japan. (March 2006)



Institute of Ocean Energy, Saga University, Japan
(30kW OTEC Experiment Plant)

DTEC

- ▶ DTEC (Discharged Thermal Energy Conversion)
 - Power generation system that utilizes low-temperature waste heat discharged from such as large industries.
 - XP Series is available for Evaporator, Condenser and regenerator of DTEC.
 - Temperature condition:
 - Heat source(waste heat) is approx.70~150°C
 - Cooling source(river and seawater) is approx.20~40°C

Mini-DTEC

- ▶ Small Discharged Thermal Energy Conversion (Mini-DTEC)
 - XP Series is installed in evaporator and condenser of Mini-DTEC.
 - Mini-DTEC is module type. It is easy to transport and install, and available for waste heat from industries and geothermal heat.

【Facility of Mini-DTEC】

- Waste heat source: hot water at 90°C
- Scale of generating power: 100kW class
- Installed in IMARI plant
- Turbine currently in development



- ▶ Applying XP Series to the fields as same as general PHE, it is possible to reduce heat transfer area with optimization study.

Liquid-Liquid PHE

- Lubricant Cooler for Various equipment
- Water Cooler for Various equipment
- Heater
- Condenser
- Oil cooler

Efficient use of discharged water

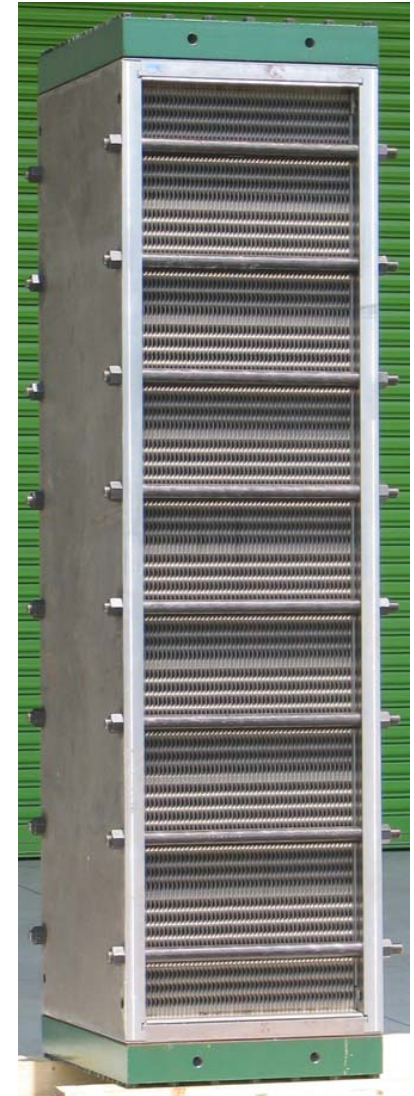
- PHE for refrigerator
- Heat pump/Regenerator for power generation process
- PHE for Ammonia related process

Condenser for desalination plant

- Condenser for desalination system using waste heat.
- Condenser for Flash evaporation desalination process.

【Condenser for desalination】

- Number of step: 8 steps
- Heat transfer area: 185m²
- Size : 2.6m x 0.8m x 0.85m



- ▶ Study result of installing XP Series to “Water–Seawater(SW)” cooling system.
- ▶ Example case calculating necessary heat transfer area based on some assumption when exchanging existing heat exchanger to XP Series.

Specification

· Basic Information

- Plant type : Furnace
- Application : Main cooling system
- Material : Titanium

· Main Specification

- Hot side : Fresh Water
(48.5°C ⇒ 40.0°C)
- Cold side : SW (34.0°C ⇒ 41.7°C)
- Heat Duty : 18,653[kW]

* Some assumptions such as pressure loss of existing heat exchanger are used for this study.

Study Result

· Existing Heat Exchanger

- Type : Plate-type (738.5m²)
- Pressure Loss : 10m (assumed)
- Pump consumption : 78kW × 2 (@ η = 0.70)

· XP Series (type XP56R)

- Type : Plate-type (502.7m²)
- Pressure Loss : 5m (assumed)
- Pump consumption : 39kW × 2 (@ η = 0.70)

Advantage of XP Series

- ▶ Reducing **32% of Heat transfer area**
- ▶ Saving **3.68 million ¥/ year**
= 39kW × 2 × 24 × 365 × 70W/kWh

- ▶ Study result of installing XP Series to “Oil–Seawater(SW)” cooling system.
- ▶ Example case calculating necessary heat transfer area based on some assumption when exchanging existing heat exchanger to XP Series.

Specification

·Basic Information

- Plant type : Steam Power Plant
- Application : Turbine Lube Oil Cooler
- Material : Titanium

·Main Specification

- Hot side : Lube Oil (58.5°C⇒46°C)
- Cold side : SW (29.0°C⇒32.4°C)
- Heat Duty : 941[kW]

* Some assumptions such as pressure loss of existing heat exchanger are used for this study.

Study Result

·Existing Heat Exchanger

- Type : Tube-type (185m²)
- Pressure Loss : 5m (assumed)
- Pump consumption : 6.5kW × 2 (@ η =0.70)

·XP Series (type XP56R)

- Type : Plate-type (78.6m²)
- Pressure Loss : 2m (assumed)
- Pump consumption : 2.5kW × 2 (@ η =0.70)

Advantage of XP Series

- ▶ Reducing **57% of Heat transfer area**
- ▶ Saving **0.38 million ¥/ year**
=4kW × 2 × 24 × 365 × 70W/kWh

Contact us

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Application (Name of System)		Hot Side	Cold Side
Fluid Name			
Total Heat exchanged	kW		
Total Fluid Flow	kg/h		
Vapor	kg/h		
Liquid	kg/h		
Operating Pressure	kPaG	Inlet	Inlet
		Outlet	Outlet
Operating Temperature	°C	Inlet	Inlet
		Outlet	Outlet
Pressure Drop Allowed	kPa		
Design/Test Pressure	kPaG	/	/
Company Name			
Name of Department			
Name of Person in charge			
Address			
Contact	TEL	FAX	
	E-mail		
MEMO			

Personal Information shall be used solely for the purposes below.

- 1) To reply to the request for estimation, consultation or sending documents.
- 2) To provide information of our products and services.



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