

Global Solutions for Industrial Refrigeration with “Natural Refrigerants”

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Mayekawa Mfg. Co., Ltd.
Kuniaki Kawamura

Head Office of MAYEKAWA Japan



Founded: 1924
Location: Tokyo, Japan
Turnover: \$1.5 Billion
Employees: 3,350 (33 countries)

History



1924
Vertical low speed reciprocating refrigeration compressor



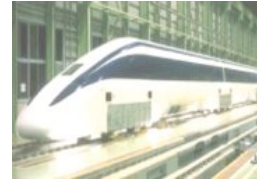
1964
Screw compressor



1978
Ultra low temperature accelerator



Refrigerated cargo vessel



Maglev train



Rocket fuel



1998
Nagano Olympic Winter Games



1958
Multi-cylinder reciprocating compressor



Offshore platform



Freezer



Chicken whole leg deboning robot



Comprehensive food production system

1924

1960

1970

1980

1985

1990

2000

- Established in 1924, Capital 1,000,000,000 yen, Number of employees (2,200 domestic employees and 1,150 overseas employees), 57 Domestic offices and 82 overseas offices
- Manufacturing and sales of various gas compressors based on industrial compressors (More than 40% share of the international market)
- Plant engineering and consulting engineering services for agricultural and livestock industries, food industries and energy industries
- The manufacturer of individually make-to-order type industrial goods (capital goods)

Synergy Expansion of Business Fields



Around the world



Main operations

Mayekawa is doing business globally, having 57 domestic offices and 3 plants, and 90 overseas offices including 8 plants.

- Corporate offices
3-14-15 Botan, Koto-ku,
Tokyo 135-8482, Japan
Established in 1924
Capital 1,000,000,000 yen
President Tadashi Maekawa

Domestic plant: Moriya,
Higashi-Hiroshima, Saku
Overseas plant: Mexico,
Brazil, USA, Belgium, South
Korea



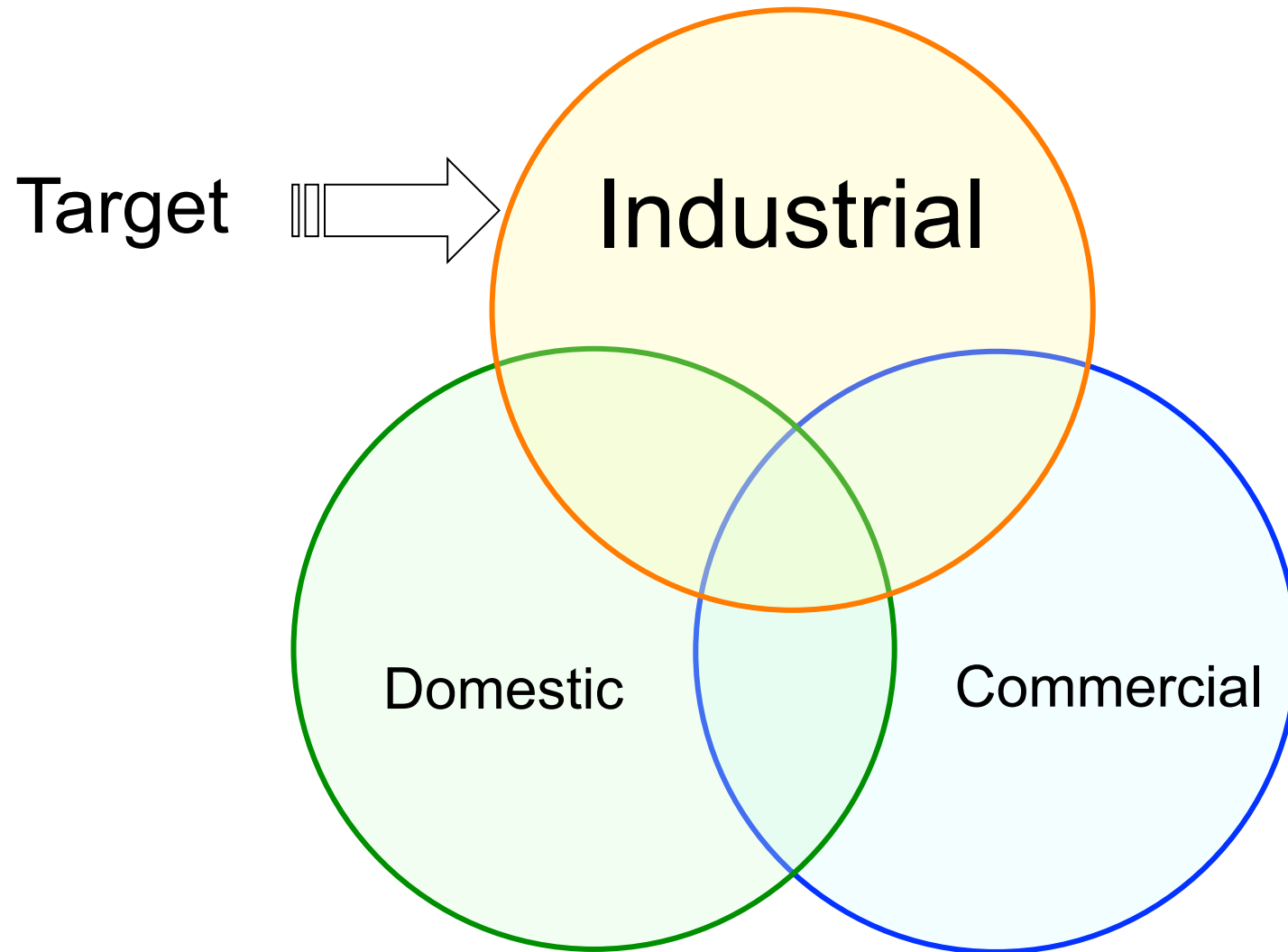
Brazil plant



Moriya plant

T

Industrial Refrigeration with Natural Refrigerants



The comparison of CFC refrigerants and natural refrigerants

	HCFC	HFC	NWFs
The name of refrigerant	R22	R134a,R410A R407C,R404A	NH ₃ ,CO ₂ ,HC H ₂ O,AIR
Ozone depletion potential (ODP)	0.055	0	0
Global warming potential (GWP)	1810	1770~3920	0~3
Leakage	Much	Much	No NH ₃ is found when leaked
Odor/Smell	No	No	NH ₃ : Sharp odor
Flammability	No	No/Lower	NH ₃ :Lower flammability HC : Higher flammability
Coefficient of performance (COP)	1.00	0.90	1.05~1.2(NH ₃)

* GWP used here is a 100-year GWP based on the data from Japan Fluorocarbon Manufacturers Association (JFMA). <http://www.ifma.org/database/table.html>

* COP is the comparison value when R22=1.

What is Industrial Refrigeration?

- Long operation time (6000-8000hr/y)
- Variable operation conditions
- Frequency unloading operation
 - Required
 - High performance
 - High Reliability
 - Long Life

Development Concepts

- High efficiency
- Low refrigerant charge
- Less leakage
- High reliability

Commitment on Natural Refrigerants



- NH** Semi-Hermetic Screw Compressor Unit
- CO** Commercial / Industrial Eco-Cute System
- H₂O** Adsorption Chiller
- HC** Commercial / Industrial Air-Conditioning / Water-Supply Heat Pump
- Air** Dehumidifying Air Refrigerant System [Air Ref]

"Natural Five" Refrigerants and Product Solutions

Refrigerant (Natural Five)	NH ₃ R-717	CO ₂ R-744	HC Hydrocarbon	H ₂ O R-718	Air R-728
90°C		Utility hot water			
60°C	Utility hot water Heating		Utility hot water Heating HVAC	Heat recovery	
10°C	Chilled water Ice making	Chilled water Ice making		Chiller	
-15°C	Cold storage, Freezer, Fish boat				
-25°C	Specific Refrigeration needs				
-40°C	Freezer, Freeze-dry, Super Low temp storage				
-50°C			Cryogenics		Cryogenics
-60°C					
-100°C					
Notes		•Eco-Cute	•Nat'l Proj. •Butane + Propane	•Nat'l Proj. •Adsorption •Heat recovery	•Nat'l Proj. •Air-cycle

NH₃

- High Efficiency: Compressors and IPM Motors
- Low Charge:
 - * Secondary Refrigerant System(CO₂)
 - * Direct Expansion System
- Less Leakage: Hermetic Motors
- High reliability: 5 years mentenanse free

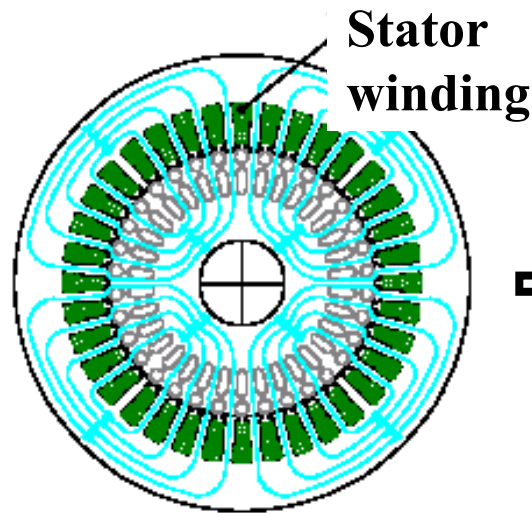
Ammonia

Semi-hermetic Refrigeration Package

2007 Ministry of the Environment
[Enterprise of Technical Development Against Global Warming]

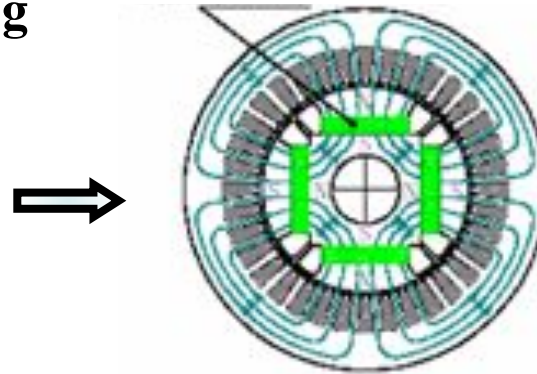


High Efficiency Motor (IPM motor)



Conventional Motor

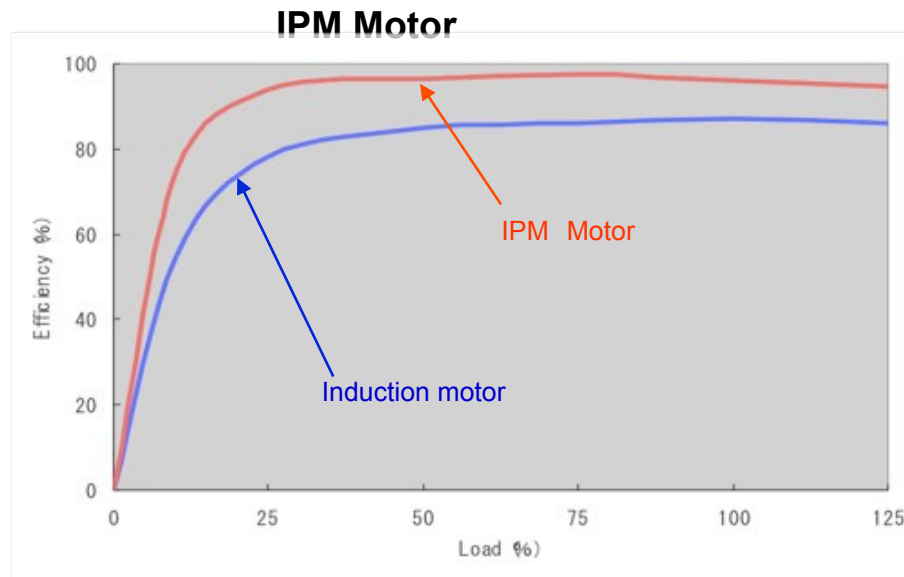
Rare earth permanent magnet



Rotor

Benefits of IPM motor

- 5~10% better in efficiency
- 40% smaller in size
- Higher speed possible

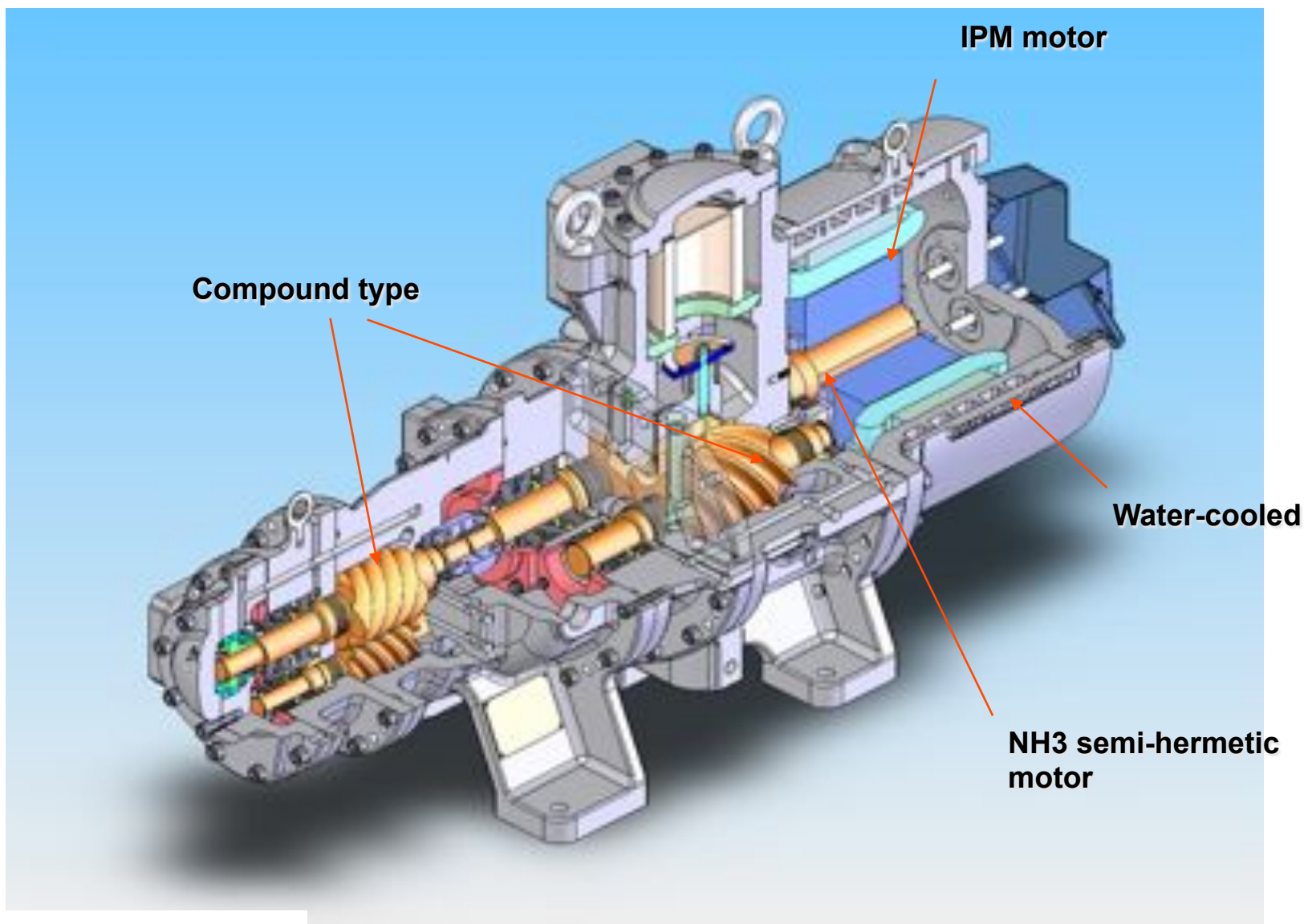


Stator

Moment of inertia is reduced, rotational response, power factor, motor efficiency improved

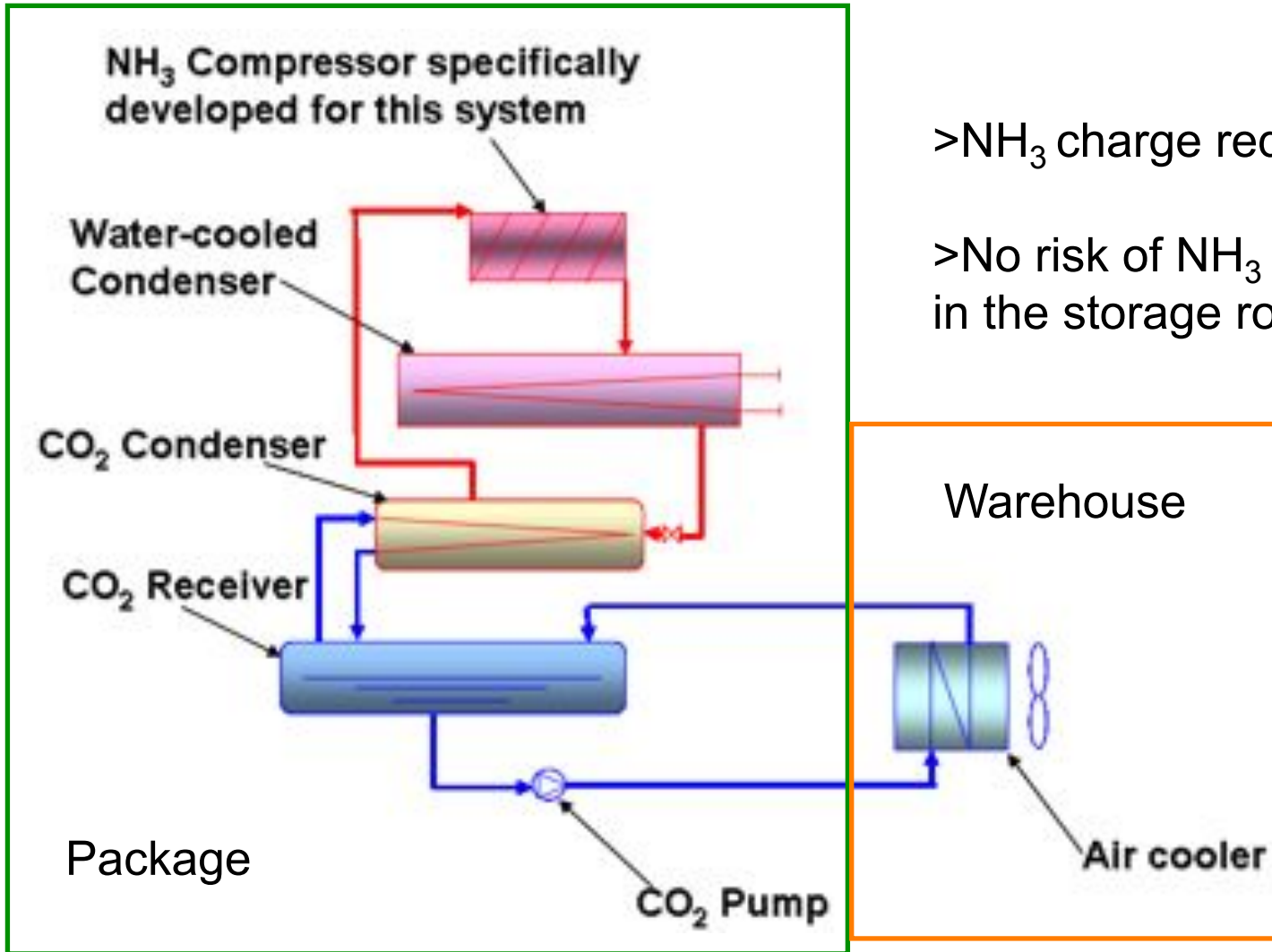


NH3 Compressor with IPM motor



Application

NH₃/CO₂ system



>NH₃ charge reduction

>No risk of NH₃ leaking in the storage room

Installation in Japan



Distribution center



30% Reduction of CO2 Emission

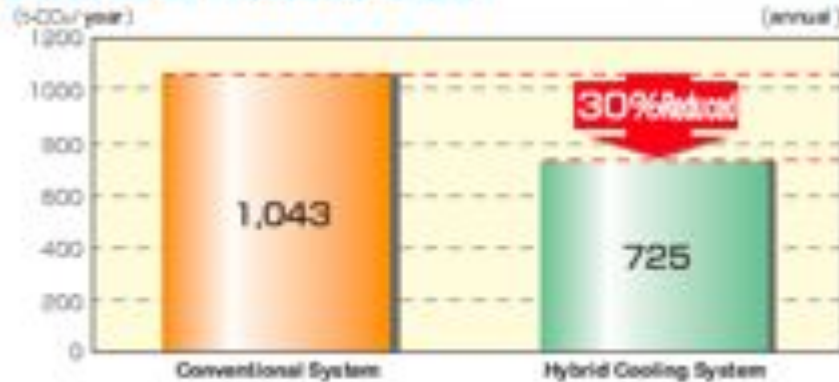
Hybrid Cooling System Using NewTon3000



Target : Industrial Refrigerated Warehouses (for Class F)

- Improved Safety : By developing [Semi-hermetic compressor], Mayekawa improved the problem of refrigerant leak.
- Non-Freon : A system in which ammonia circulates as the primary refrigerant and CO₂ as the secondary refrigerant.
- Energy Saving : As a unit exclusively for the refrigerated warehouse, CO₂ 2.0 at Class F. Compared to conventional Freon refrigerants, about 20% energy saving.

Efforts to Reduce CO2



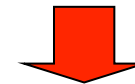
Case Study

10,000t Refrigerated Warehouse
Inside Temperature: -25°C

Power Consumption

< Conventional System >	< Hybrid Cooling System >
317kW	222kW

Installation in Japan

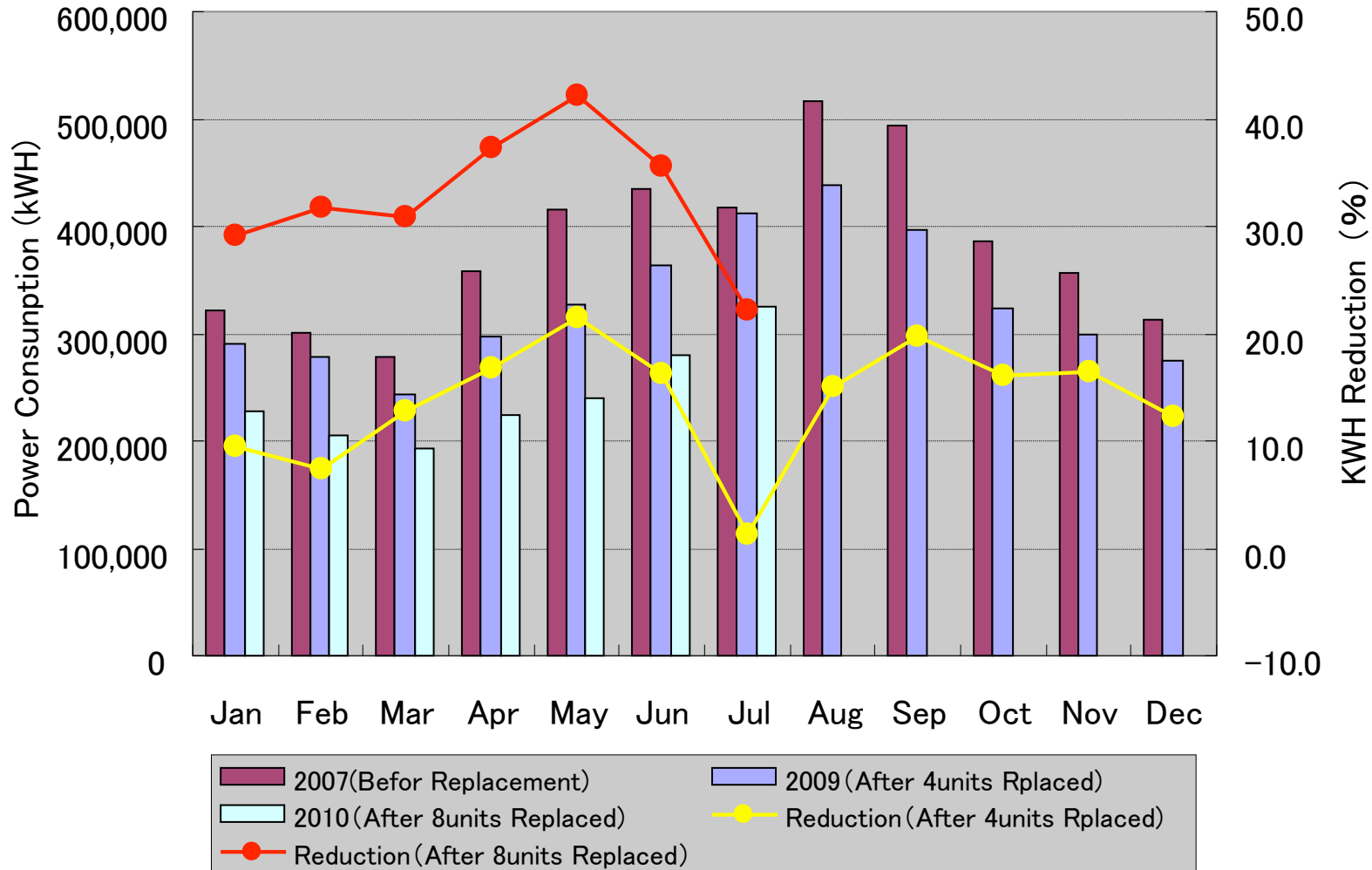


Existing
Refrigerant : HCFC-22
Machine : F1610C-8sets
System : Dry Expansion

8sets of NewTon3000 replaced.
4sets in 2008
4sets in 2009

Reduction of Power Consumption

Renewal Example



* Based the bill of Tokyo Power Co.

* Total Power consumption, incl carriers, lights, office machines, etc.

* Storage capacity : "1 ton = 0.4 m³"

CO₂

- Hot water and Hot dry air supply Heat-Pump
- Source : Air and Water

Carbon dioxide

“CO2 Heat Pump”

unimo



Eco-Cute “unimo A/W”



Eco-Cute “unimo W/W”



CO2 Heat Pump in Switzerland



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MEDIEN**

Zürcher Unterländer Die Tageszeitung für das Zürcher Unterland und amtliches Publikationsorgan der Bezirke Nidach und
redaktion@zuonline.ch sport@zuonline.ch abo@zuonline.ch



FRONT ZU

- Schlagzeilen
- Dickpunkt
- Kommentare
- Foren

REGIONAL

- Furtaler
- Gletscher
- Rümlingen

BEZOGENS

- Sport
- Mixer
- Agenda

UNFRAGEN

- Aktuelle
- Bisherige

LINKS

- ZU-Links
- Leserlinks

MARKTPLATZ

- Branchenbox
- Online Inserate
- Fotomanager

» ZÜRCHER UNTERLÄNDER » SCHLAGZEILEN VOM DONNERSTAG, 15. DEZEMBER 2005

Donnerstag, 15. Dezember 2005

Niederhasli: Warmes Wasser im GC-Campus durch moderne Technologie

CO2-Wärmepumpe installiert

Im GC-Campus in Niederhasli liefert eine der ersten CO2-Wärmepumpen in der Schweiz pro Tag 4000 Liter Warmwasser. Die Maschine stammt aus Japan.

Inga Struve



EWZ-Projektleiter Georg Dubacher (von links), Masao Maekawa, Vorsitzender der japanischen Firma Mycom, und EWZ-Direktor Conrad Ammann erläutern die CO2-Wärmepumpe. (David Beer)

GOOD

...

WEIT

Niederhasli
Wasser durch ...

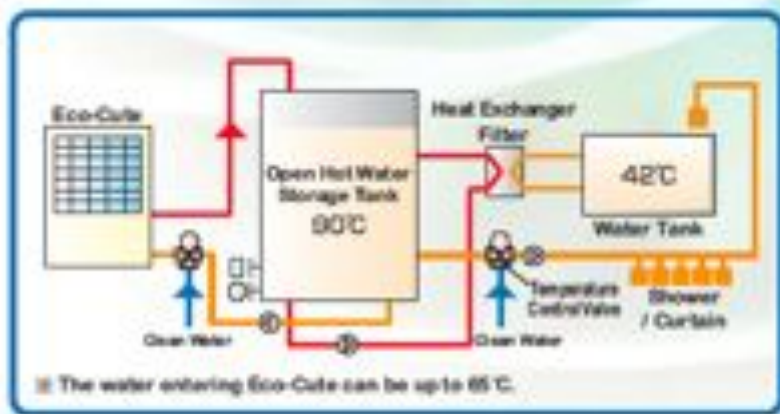
Büro
Zürcher
Arbeits
Planen

Büro
Compu
Planen

Steuer
Compu
wender
bericht

Obere
Ferien
Eindire

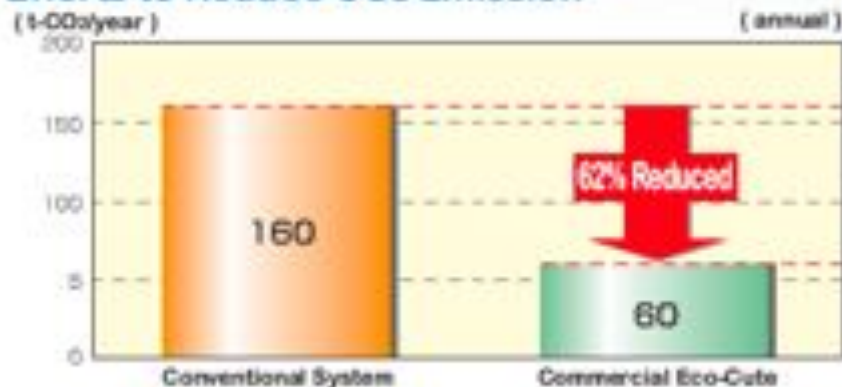
62% Reduction of CO2 Emission



Targets: Hospitals, hotels, welfare institutions, sports facilities, bathing facilities, facilities for boarding, food factories, etc.

- The best water supply ability in Japan (Air heat source 80kW, water heat source 90kW).
- Very little CO₂ emission, compared with equipments run by burning the energy source. Emission could be cut by more than 60% than heavy-oil boilers.
- 24h heating operation (Water entering Eco-Cute at 65°C, exiting at 90°C).
- Flexible design of water supply system and storage tanks to meet your needs.
- Entering medium to large-scale water supply market as the electric equipment replacing hot-water boilers. The complete electrification is possible.

Efforts to Reduce CO₂ Emission



Case Study

A Company Housing where Hot Water Supply is 20m³/day
The Number of People: 200

<Conventional System>	<Commercial Eco-Cute>
Fuel Oil Boiler	Crude Oil Equivalent
Crude Oil Equivalent	Crude Oil Equivalent
59,040 ℓ / yr	22,153 ℓ / yr

H₂O

- Ad-sorption Chiller Utilizing Solar Energy

Water

Adsorption Chiller Packaged Unit

2005
~2007 NEDO [Research and Development of New System Utilizing Solar Energy]



Installation in Japan



Air conditioner for shopping mall



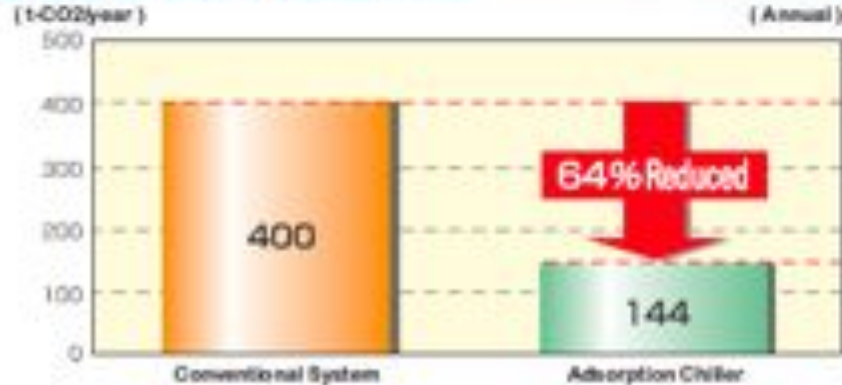
64% Reduction of CO2 Emission

Cooling System by Adsorption Chiller Using Solar Energy



- Targets :** Industrial furnace, incinerator, distillation tower, air-conditioning or cooling using warm discharged water from cooling water of engines etc.
- produces cool water from low-temperature heat source (below 75°C).
 - water as refrigerant, silica gel as adsorbent, therefore environmentally friendly.
 - The body itself needs little electricity. Also, almost ZERO maintenance cost.

Efforts to Reduce CO2 Emission

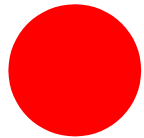


Case Study

100USRT Industrial Process Cooling
Cold Water Temperature : 9 °C

Power Consumption

<Conventional System> R134a Cooling Water	<Adsorption Chiller>
100kW	36kW



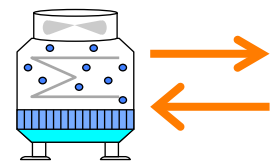
INSTALLATION IN MEXICO

SUSTAINABLE REFRIGERATION SYSTEM

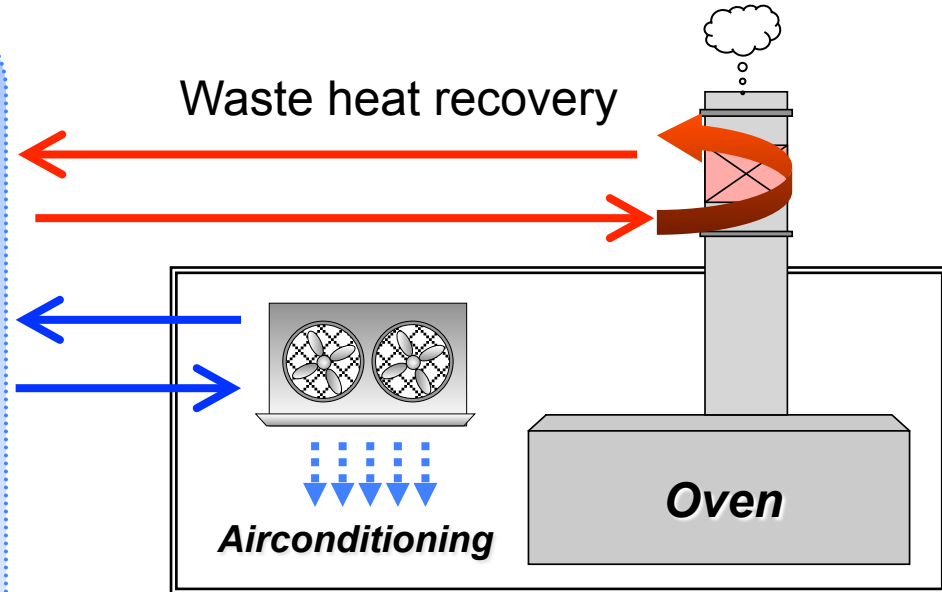


Waste heat recovery Adsorption chiller for airconditioning

- *Recovery waste heat from oven*
- *Supply chilled water for factory airconditioning*



Cooling tower



Gamesa snack factory, Mexico
Pepsico group



HC

- Mixed Refrigerants Heat-Pump
(Butane and Propane)

Hydrocarbon

Hydrocarbon Refrigerant Packaged Unit

2005
~2007 NEDO [Energy-Saving Non-Freon Air-Conditioning and Refrigeration System]

([Industrial Technology Development Subsidizing Company])



Installation in Japan



At International Media Center of G8 Toyako summit in Hokkaido



Employed a cooling unit taking advantage of 7,000 tons of snow stocked underground, and as its subsystem, our environment-friendly building air-conditioner was introduced

14% Reduction of CO2 Emission

Cooling C O P	COP=3.7 (Air-Cooled)
Heating C O P	COP=3.7 (Air-Source)
Supplying Water C O P	COP=3.3 (Supplying temperature 65°C, air-source)

Targets: Commercial / Industrial Air-Conditioning, Water-Supply

Supply Temperature	Applications	Suitable Markets
70°C	65°C Hot Water-Supply / Heating System	Food factories, hotels
50°C	45°C Heating System	Office buildings, factories
0°C	+7°C Chilled Water Chiller System	Office buildings, factories
-5°C	Chilled Water Chiller / Supercooling Making System	Food factories
-15°C	Ice on Coil Ice Thermal Storage System	Food factories

Efforts to Reduce CO2 Emission
(t-CO2/year)



Case Study

40USRT Chilled Water Supply Machine
Chilled Water Temperature : 7°C

Power Consumption

< Conventional System >
R134a
Chilled Water Supply Machine
43kW

< Hydro Carbon >
36kW

AIR

- Air Cycle Refrigeration System
- For Low Temperature Applications
-50 ~ -100 °C

AIR

Air Cycle Refrigeration Packaged Unit

2003 Developed at [Technical Strategy for Rationalization of Energy Consumption Project]
~2005 NEDO



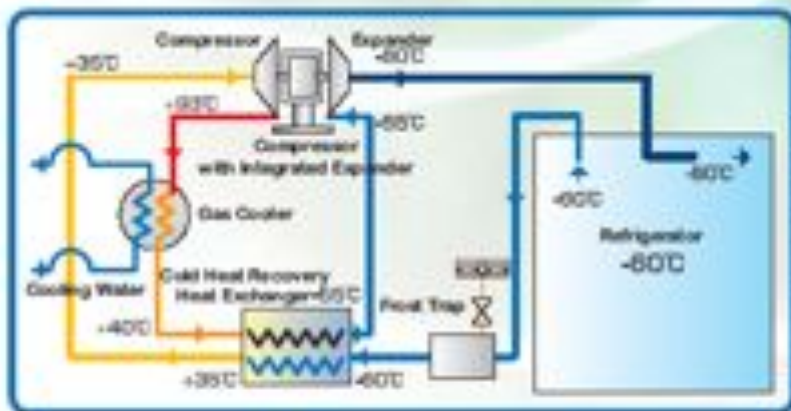
Installation in Japan



-60°C ultralow cold storage



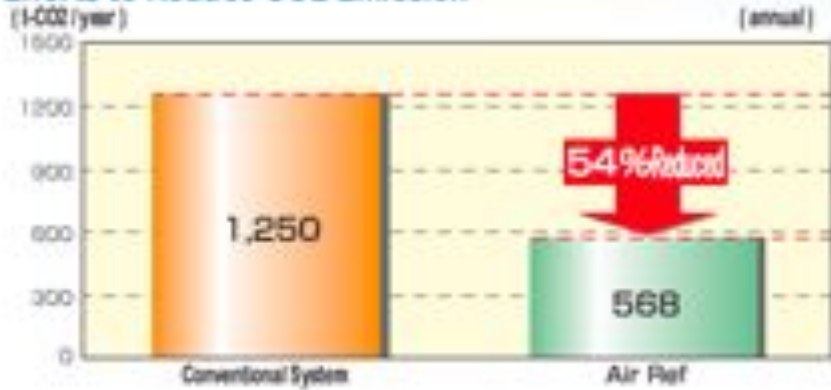
54% Reduction of CO2 Emission



Target: Ultra cold refrigerator for tunas and bonitos, rapid freezer, frost-破碎 etc.

- Using [Air] as the ultimate natural refrigerant, [Air Ref] is safe and eco-people-friendly.
- Due to the turbo compressor with integrated expander, high COP can be achieved, saving energy by 50% comparing the conventional types.
- Due to its low operating pressure, exempt from legal regulations.
- Directly cooling the air, Air Ref does not require a fan coil unit or piping for refrigerant in the storage.
- Dehumidifying agent reduces frosting in the storage. Defrosting is not required.

Efforts to Reduce CO2 Emission



Case Study

2,000 ton Refrigerator Interior Temperature : -60°C	
Power Consumption	
< Conventional System > R22 2 Stage Compression Refrigerator	< Air Ref >
281 kW	128 kW

Conclusion

In the industrial refrigeration application natural refrigerants can be selected without green house gas.

In the view of prevention of global warming we would like to offer a proposal below;

1. Promoting natural working fluids aggressively in the proven industrial field

Thank you very much for
your Attention.

MAYEKAWA

NATURE IS WHAT WE DESIGN FOR



みんなで止めよう温暖化

チーム・マイナス6% www.team-6.jp