

動態再循環式儲冰槽

Dynamic Recirculation Ice Storage Tank



儲冰蓄冷空調系統簡介 Introduction to the Ice Storage Air Conditioning System

儲冰蓄冷空調是以鹵水機利用晚上離峰電力運轉，將儲冰裝置內的水凍結成冰儲存冷能；當白天於電力負載尖峰時段有冷房需求時，再將所儲存的冰溶解以釋出冷能供應空調。一般建築物空調負荷尖峰時段也就是電力使用尖峰時段，所以採用儲冰空調系統，可以將原本尖峰空調所需大部分用電量移轉至夜間用電離峰時段。

舉例說明，採用傳統中央空調之建築物，其典型全日用電量趨勢如圖(一)所示，中午之最高空調負荷時段也正是用電最尖峰時段，其尖峰總用電量約為1380kW，大部分的電力消耗是來自於供應空調用電。如果採用儲冰系統，因為可以將部分空調用電（製冰機、冷卻水塔及部分泵用電）約600kW移轉到用電離峰時段，所以尖峰用電量可以降為780 kW左右，電力契約容量也可大幅降低。

尖峰時段空調全部以儲冰量來供應時，稱為全量儲冰系統，此系統供應空調期間，製冰機及相關附屬設備是不啟動，只運轉融冰泵及二次側設備如送風機或空調箱等，因此可移轉最多的尖峰電力，但系統需設置較多的設備與電力容量，其投資效益必須分析考量。

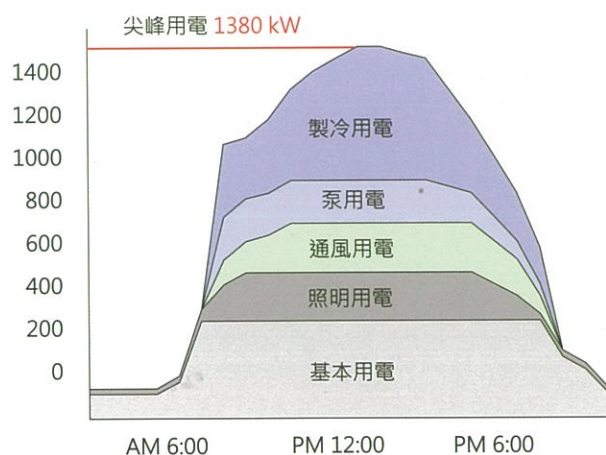
尖峰時段如部分空調容量仍以冰水機或是製水機於空調模式下運轉供應，此系統稱為分量儲冰系統。分量儲冰系統必須依據建築物空調負荷變化，以融冰或搭配主機運轉供冷來符合冷房需求，部分時間可能需要啟動主機，所以只能移轉部分電力，但設備與電力容量可以減少，避免多餘的投資，透過適當的評估設計，可以在最短時間內回收投資。

Ice thermal storage system is utilized by glycol chiller powered by off-peak electricity at midnight to freeze the water within the storage device into ice to store thermal energy. When there is cooling demand in daytime during electricity load period spike, the cooling load is supplied by melting ice to release thermal energy. During peak cooling load of buildings that is peak power consumption period, applying ice storage air conditioning system can transfer most of the electricity required into off-peak hours at midnight.

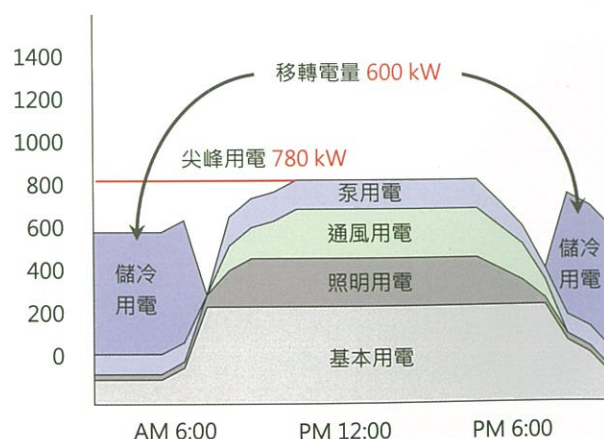
For instance, the typical full day power consumption trend is shown in Fig. 1 for buildings using traditional central air conditioning. The maximum cooling load at noon is exactly the peak power consumption hours. The peak total electricity consumption is about 1380 kW most coming from air conditioning system. By using of ice thermal storage system the power consumption of the HVAC (including glycol chiller, cooling tower, and part of pumps) about 600 KW will be shifted into off-peak hours, and the peak power consumption goes down to around 780 kW. The electricity contract capacity is also significantly reduced.

Full thermal storage refers to systems that the load is cooled totally from ice storage during on-peak hours. The chiller and related auxiliaries are turned off, only ice melt pumps and devices on secondary side will operate (such as FCU, AHU, etc.). This system can transfer the most peak power however need more devices and electricity capacity, so the investment benefit should be considered in the analysis.

Partial thermal storage refers to systems that portion of load is cooled by chiller or glycol chiller operated in cooling mode. In partial thermal storage system the cooling demand is satisfied by melting ice or in conjunction with chiller base on the buildings load profile. The chiller may need to actuate in some period, and only partial power consumption will be shifted. However, the devices and electricity capacity required are less and result in avoiding unnecessary investment. Through appropriate evaluation design, the investment will return in the shortest time.



圖一、一般空調系統用電時間趨勢圖
Demand profile of general A/C system



圖二、儲冰蓄冷空調系統用電時間趨勢圖
Demand profile of ice storage A/C system

儲冰蓄冷空調系統優點 Benefits of the Ice Storage Air Conditioning System

一、平衡尖離峰用電；提高電網效率

儲冰系統是利用夜間運轉製冰機儲冰蓄冷，大部分消耗的電力是夜間離峰電力，因此可平衡尖離峰用電量。採用儲冰系統既可避免尖峰電力負載過高而須增設電廠或產生限電危機；同時也可平衡區域供電，而降低電力傳輸損失以提升電網效率。

二、節省電費；減緩電價調漲負擔

儲冰蓄冷系統除可享有較低之離峰電價外，台電公司還給予夜間離峰電價六折優惠以作為獎勵，長期下來可節省可觀之流動電費。同時，因部分尖峰電力需量已移轉至離峰時段，所以可減少電力契約容量申請，節省基本電費支出。

儲冰系統電價相對較低，因此將來如果電價有調漲，其調漲額度也相對較小，因此採用儲冰系統可有效降低電價上漲所造成之成本負擔，確保投資經濟效益。

三、提高系統設備利用率

空調系統設備容量均依據設計日尖峰負荷，再加上安全裕度來選用。但以全年度空調負載分佈來說，最高尖峰負荷只發生在夏月部分日子而已，可能使得主機等設備在大部分情況下是處於低效率的部分負荷運行，或是停用，對整個供冷系統來說，顯得相當不經濟也浪費資源。

如果採用分量儲冰空調系統，將部分尖峰空調負載利用離峰用電儲冰蓄冷，於尖峰時段融冰供冷來補充主機供應不足之冷能，如此可提高設備利用率，減少初期投資成本並加速回收；同時可使主機在大多數的情況下高效率滿載運行，對整個空調系統的節能與節費也十分有利。

四、具備援與容量擴充

儲冰槽因蓄存有冷能，所以一旦日間發生意外停電或限電時，啟用小功率發電機帶動循環水泵及空調箱或冷風機，即可滿足部分緊急空調需求。同時，冷量可蓄存也有利於將來空調系統容量擴充，在一定條件下，將來可能不需要增加任何設備即可達成尖峰供冷量增加的需求。

1. Balances peak power consumption; Improves power grid efficiency

Ice thermal storage system utilizes glycol chiller to generate ice for storing thermal energy at midnight, the most power consumption is off-peak electricity and therefore balances on-peak electricity. Ice storage systems can avoid over peak power load which needs an additional power plants or causes power rationing crisis. Meanwhile it also balances power supply and reduces electricity loss to enhance the grid efficiency.

2. Reduced energy cost; Lowers the burden of rising electricity price

Apart from enjoying a lower off-peak electricity price, Taiwan power company offers a 60 percent discount to be given as a reward for ice thermal storage system. It will save considerable electricity cost for a long term period. Meanwhile, as part of peak power demand has been transferred to off-peak periods, therefore reducing the power contract capacity, saving basic electricity expenses. The electricity price of ice storage system is relatively low, so if electricity price increases in the future, the raise amount is relatively small. So using of ice storage system can effectively reduce the burden of costs for rising price and ensure investment efficiency.

3. Improves equipment utilization

Air conditioning equipment capacity is based on the design daily peak load, plus a safety margin. Considering annual air conditioning load profile, the highest peak demand occurs only in some period of summer season. It may cause chiller running at low efficiency condition under partial load or shut down. For entire cooling system, it is quite uneconomic and wastes the resources.

When using partial thermal storage system, ice is generated by off-peak electricity and melted to provide cooling in peak hours for overcoming the short cooling supply from chiller. Thus improves equipment utilization, reducing initial investment costs and accelerating recovery. Meanwhile in most cases, when chiller operated in high efficiency at full load is beneficial for saving energy and costs for entire air conditioning system.

4. Backup and capacity expansion

Ice storage tank has storing cooling capacity, so once an unexpected power failure or power rationing occurs in daytime, it can meet the urgent demand for air conditioning by small horsepower generators to drive circulation pumps and AHU or FCU. Meanwhile, the storable cooling capacity is conducive to the future capacity expansion of air conditioning system. In certain conditions, it is possible to meet an increase in peak cooling demand without any additional equipment.

動態儲冰槽簡介 Introduction to the Dynamic Recirculation Ice Storage Tank

儲冰槽由多層多迴路之PE盤管環繞於槽體內部而組成，槽內PE管外周圍充滿乾淨的水，PE管內部則由乙二醇溶液等鹵水循環。儲冰槽是利用夜間離峰用電運轉壓縮機產生低於 0°C 以下之低溫鹵水，利用儲冰泵循環於PE管內部吸收外部水之熱量，最後水產生相變化凍結成冰以儲存大量潛熱。在日間尖峰用電期間，儲冰槽內鹵水再以融冰泵循環與二次側較高溫回水於板式熱交換器進行熱交換，將已儲存的冰融解以釋放出冷能提供空調負荷需求。其目的是為在尖峰期間減少或停止運轉主機壓縮機的目的，而將空調用電由尖峰時間移轉到離峰時間，如此不但可降低尖峰用電，減少電力契約容量；同時也可以享受離峰用電優惠電價以節省電費。

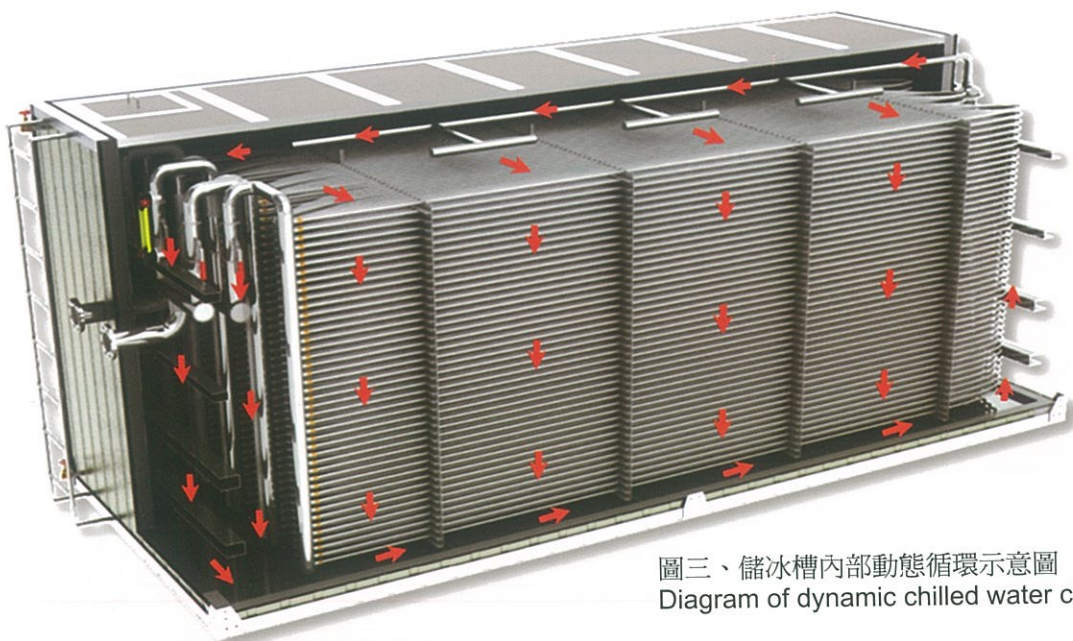
一般儲冰槽在盤管內側循環低溫鹵水將管外靜止儲水結冰於管壁，靜止儲水與鹵水熱交換之主要熱阻抗為傳導與對流熱阻抗，外部靜止水之自然對流熱阻抗較大，所以儲冰效率較不佳。而在溶冰階段，鹵水管與結冰間管壁冰迅速溶冰成水後逐漸形成靜止水層，成為熱阻抗也會使溶冰效率減緩，甚至在溶冰末期雖有剩餘冰量，卻因漂浮於上層而無法完全釋冷。

動態儲冰槽主要是利用間續攪拌以提升外部儲水儲冰或融冰之熱傳效率。儲冰槽內盤管間以隔板隔成數空間室，再配以一小型循環水泵將水導流而上下循環於各隔板間室，如此可以利用最小的動力泵構成一動態冰水循環水流，儲冰與融冰時可以提高對流傳熱，而提高儲冰速度與效率。

The dynamic ice storage tank is assembled by multi-loop and multilayer PE coils which surround inside of the tank. The tank is full filled with clean water outside the PE tubes, and the glycol is circulated through the PE tubes. The compressor is operated during non-peak hours cooling a glycol-solution to sub-freezing temperatures which is then circulated through the PE coils to extract the thermal energy of water by charge pumps. Finally, the water will be frozen into ice in phase change process and store a lot of latent heat. During the on-peak hours in daytime, the glycol inside the tank is circulated by discharge pumps through the plate heat exchanger of secondary side for heat exchanging with warmer return water. The cooling demand is satisfied by melting the stored ice during on-peak hours for the purposes to reduce running hours of compressor, and transfer power usage from on-peak hours to off-peak hours. Therefore not only can lower the peak power usage, reducing electricity contract capacity but also enjoy off-peak preferential price to save the costs.

In general the low temperature glycol is circulated inside the coils in conventional ice storage tank and freezes the still water into ice on the exterior surface of coils. The main heat resistance between still water and glycol includes conduction and convection resistance. The external still water has larger free conduction heat resistance so the ice build efficiency is not good. During the ice melt phase, a still melted ice layer is formed between the glycol tube and ice cylinder as a heat resistance to lower the ice melt efficiency. Even there is some residual ice in the end of ice melt phase, the cooling capacity is unable to fully discharge because the floating ice occupies the up layer of water.

Dynamic ice storage system with periodical agitating device is used to improve heat exchange efficiency of ice build or ice melt period. The tank is divided into several chambers by baffles and coupled with a small circulation pump to guide and circulate water through each chambers. Therefore the chilled water can be pumped into dynamic circulating flow by minimum horsepower. The heat convection rate will increase during ice build and ice melt period and raise the efficiency of ice storage system.



圖三、儲冰槽內部動態循環示意圖
Diagram of dynamic chilled water circulating

動態儲冰槽之優點 Benefits of Dynamic Recirculation Ice Storage Tank

本儲冰槽為鹵水循環式，採用耐腐蝕、耐低溫之合成聚乙烯(Polyethylene, PE)儲冰盤管，可採用內、外融冰設計。搭配內部水循環泵控制，將有效動態提升融冰速率及融冰率，確保快速供冷與完全融冰，故稱為動態儲冰槽，主要特點說明如下：

一、最佳的融冰速率與融冰率

槽內緊密排列以增加盤管面積，熱傳面積達 $1.5 \text{ m}^2/\text{RT-HR}$ ，同時配置循環攪拌泵以提升槽內冰水之對流熱傳，可有效提升整體儲融冰效率及融冰率，適合較大溫差或快速融冰設計；搭配水路分配與槽體機構設計，可有效防止萬年冰產生。

二、最節省的安裝空間

長方形且可共壁大槽體結構設計，儲冰槽可於現場有限區域組裝，比一般儲冰槽節省15~40%之安裝空間，有效減少機房空間尺寸及預留動線。

三、最具彈性的系統設計

模組化盤管回路設計，可彈性調整儲槽尺寸，而且可選擇配置內融冰或外融冰盤管設計，以因應各種不同系統要求

四、最耐用的槽體結構

儲冰槽內部採不銹鋼槽體與結構件，槽體以氬鐳組裝完成。槽體角鐵與周圍設置防地震固定，長期使用穩定可靠，最符合經濟效益。

五、最少的儲冰熱損失

儲冰槽四周保溫層厚度達100mm，R值高於18以上；可共壁設計減少外面積，有效降低儲冰槽熱損失，也避免槽體結露。

六、最低的配管與吊運成本

採較大容量可現場組裝設計，減少儲冰槽槽數，節省外部相關配管、儀表與吊運費用，也減少將來洩漏機率。

七、最快速的現場維修

儲冰槽內預留維修空間，同時採用具有防蝕、耐壓與防洩之特有接頭，可現場快速進行維護，減少維護成本且有利於未來進行汰舊換新工程。

The ice storage tank with glycol circulation is consisted of corrosion resistance and low temperature resistance coils made by synthesis polyethylene (PE), and either internal melt or external melt system is optional. Ice storage tank combined with internal circulation pump can improve ice melting rate and percentage to ensure rapid cooling and completely melting. So it is called dynamic ice storage tank, the main features are as follows:

1. Best ice melting rate and percentage

Ice storage coils are arranged closely within the tank to increase surface area with the heat conduction area reaching $1.5\text{m}^2/\text{RT-HR}$. Internal circulation pump is used to improve ice build/melt rate and melting percentage for larger temperature differences or rapid melting design. In addition, the distribution water flow and mechanical designs of tank is efficient to prevent perpetual ice.

2. Most space saving

Rectangular type and shared wall design of tank allows to assemble ice storage tank in limited area for saving 15~40% of the installation space than conventional ice storage tank. The dimensions of machine room are also reduced, and the circulation is reserved.

3. Most flexible system

The size of ice storage tank is adjustable for coolant circuit designed by modular coils, and either internal melt or external melt coils is optional for each kind of system requirements.

4. Most durable tank structure

The ice storage tank and structural parts are made by stainless steel. The tank body is constructed by argon welding. The angles and body of tank are earthquake-resistant fixed for long-term use and efficiency purposes.

5. Minimum thermal storage loss

The insulation of ice storage tank is 100 mm thick with R value above 18. Shared wall design of tank can reduce the exterior surfaces for decreasing heat loss and preventing dew condensation.

6. Lowest costs of piping and lifting

The use of larger capacity tank which is assembled in site can minimize the number of tanks, saving piping, instrument and lifting costs, and reduces leakage probability in the future.

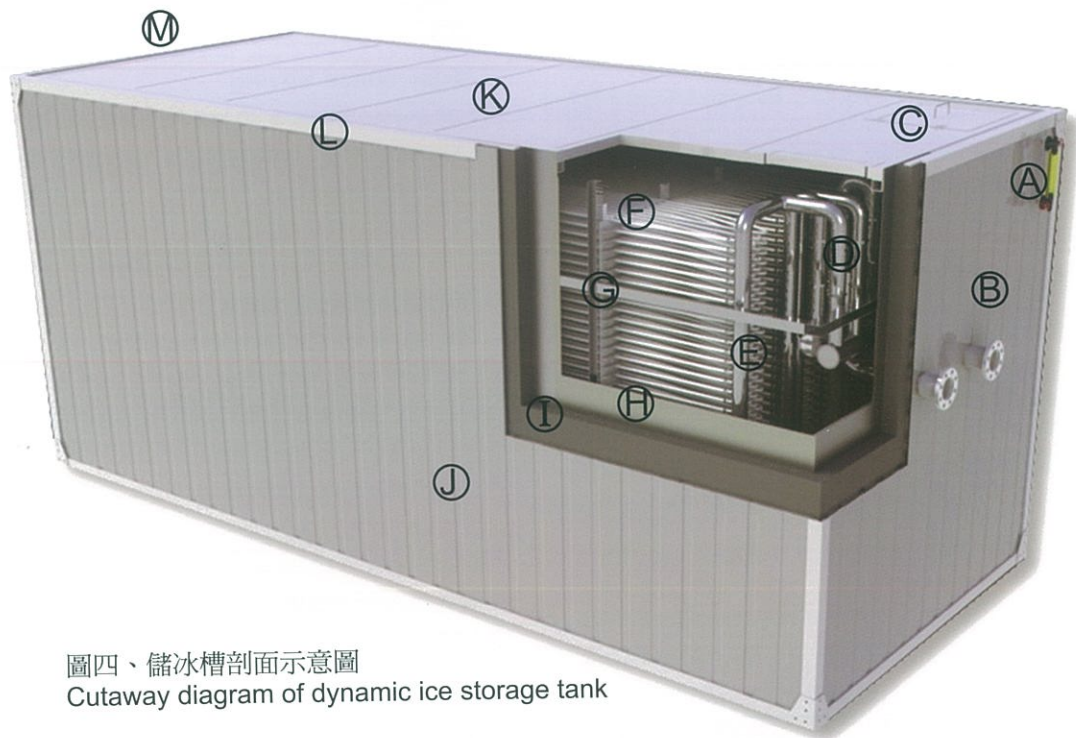
7. Fastest maintenance service

There is a maintenance space reserved inside the ice storage tank. A particular joint that designed for corrosion-resistant, pressure-resistant and anti-leakage can be repaired quickly in site to cut down maintenance costs and to proceed new for old project in future.

動態儲冰槽構造及說明 Structure and Description of Dynamic Recirculation Ice Storage Tank

儲冰槽內部以PE材質隔板與多迴路盤管組合而成，為主要儲冰區域。內槽採SUS304不銹鋼板氬銲而成；內部結構補強角鐵、拉桿及鹵水分配頭等皆為耐腐蝕SUS304材質。四周槽壁內層為80mm聚乙烯(Polyethylene)保溫材；外層為20mm PU發泡(Expanded Polyurethane)保溫庫板，保溫板總熱阻抗係數大於R-18。底部保溫為75mm PS(Polystyrene)，頂部為50mm PU發泡保溫庫板。儲冰槽剖視圖如下說明：

The inside part of ice storage tank is assembled by PE baffles, multiloop and multi-layer PE coils. The tank body is made by SUS304 stainless steel and constructed by argon welding. All inner reinforced angles, tie rods and glycol distribution heads are also made by corrosion-resistant SUS304. The inner insulation layer is 80mm thick polystyrene and outer layer is 20mm thick PU (expanded polyurethane) on the tank sides. The total thermal resistance coefficient of the insulation is above R-18. A 75mm thick PS (Polystyrene) insulation is placed on the bottom of the tank and the cover is 50mm thick PU (expanded polyurethane). The cut-away view of dynamic ice storage tank is as follows:



圖四、儲冰槽剖面示意圖
Cutaway diagram of dynamic ice storage tank

說明(Description)：

- A、冰量或液位指示計(ice quantities or liquid level indicator)
- B、JIS 10K法蘭接口(JIS 10K flange joint)
- C、人孔蓋(manhole cover)
- D、不鏽鋼分佈管(SUS304 stainless steel tube for distributing)
- E、機械接頭構造(mechanical joint structure)
- F、PE管排及隔板(PE tube arrangement and baffles)
- G、不鏽鋼補強構件(SUS304 stainless steel reinforced structures)

- H、不鏽鋼內槽(SUS304 stainless steel inner shell)
- I、雙層PE保溫板(double PE insulated plate)
- J、PU庫板(PU foam metal panel)
- K、保溫蓋板(insulated cover plate)
- L、熱浸鍍鋅角鐵(Hot Galvanized Angle Steel)
- M、內循環水泵(Water Circulating Pump)

標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目(items) / 機型(model)		單位	DYN-460	DYN-570	DYN-680	DYN-790	DYN-500	DYN-620
能力 (capacity)	全熱(total heat) (final outlet temp. = 12 °C)	RT-HR	460	570	680	790	500	620
		kW-HR	1,619	2,006	2,394	2,781	1,760	2,182
	全熱(total heat) (final outlet temp. = 5 °C)	RT-HR	410	510	615	715	450	555
		kW-HR	1,443	1,795	2,165	2,517	1,584	1,954
	潛熱(latent heat)	RT-HR	380	470	565	660	415	510
kW-HR		1,338	1,654	1,989	2,323	1,461	1,795	
外型尺寸 (dimension)	長(length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬(width)	mm	2,360	2,860	3,360	3,870	2,360	2,860
	高(height)	mm	2,200	2,200	2,200	2,200	2,400	2,400
材質 (material)	內槽體(inner shell)	NA	SUS 304不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管(manifold)	NA	SUS 304不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件(inner parts)	NA	SUS 304不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板(partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管(ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭(fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板(top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層(inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層(outer side)	NA	18mm PU發泡保溫板 (18mm PU formed plate)					
	槽底(bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻抗R值	NA	18.4 (approx 18.4 ft ² ·°F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量(brine volume)	liter	1,330	1,660	2,000	2,330	1,450	1,820
	槽內水量(water volume)	m ³	20.6	25.4	30.1	34.9	22.5	27.7
	水位上升(rated level rising)	mm	103	105	106	107	113	115
接管 (connection)	出入口(inlet/outlet)	inch	3B	4B	4B	4B	3B	4B
	法蘭等級(flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重(shipping weight)	kg	2,100	2,600	3,200	3,700	2,300	2,900
	運轉重量(operating weight)	kg	24,100	29,700	35,300	41,000	26,300	32,400
再循環水泵(water circulating pump)	HP	1/2	1	1	1	1/2	1	
操作壓力(operating pressure)	bar	max. 8.8 (125 psi)						
測試壓力(inspect pressure)	bar	10 (150 psi)						
操作溫度範圍(operating temp. range)	°C	-15 ~ 50 (5°F ~ 120°F)						
儲冰容量顯示計(ice capacity indicator)	NA	0 ~ 100% 刻度 (scale)						

備註：

- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
- (4) 儲冰容量計算依據ANSI/AHRI Standard 901-2014。
- (5) 以上規格若有變更恕不另行通知。

remarks：

- (1) The standard outlet of connection is side type, but could be customized as top type.
- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
- (4) Net usable ice storage capacity is calculated according to ANSI/AHRI Standard 901-2014.
- (5) Specifications are subject to change without notice.

標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目 (items) / 機型 (model)		單位	DYN-750	DYN-870	DYN-560	DYN-690	DYN-830	DYN-970
能力 (capacity)	全熱 (total heat) (final outlet temp. = 12 °C)	RT-HR	750	870	560	690	830	970
		kW-HR	2,640	3,062	1,971	2,429	2,922	3,414
	全熱 (total heat) (final outlet temp. = 5 °C)	RT-HR	675	780	500	620	745	870
		kW-HR	2,376	2,746	1,760	2,182	2,622	3,062
	潛熱 (latent heat)	RT-HR	620	720	460	570	685	800
		kW-HR	2,182	2,534	1,619	2,006	2,411	2,816
外型尺寸 (dimension)	長 (length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬 (width)	mm	3,360	3,870	2,360	2,860	3,360	3,870
	高 (height)	mm	2,400	2,400	2,600	2,600	2,600	2,600
材質 (material)	內槽體 (inner shell)	NA	SUS 304 不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管 (manifold)	NA	SUS 304 不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件 (inner parts)	NA	SUS 304 不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板 (partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管 (ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭 (fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板 (top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層 (inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層 (outer side)	NA	18mm PU發泡保溫板 (18mm PU formed plate)					
	槽底 (bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻R值	NA	18.4 (approx 18.4 ft ² ·°F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量 (brine volume)	liter	2,180	2,540	1,600	2,010	2,410	2,810
	槽內水量 (water volume)	m ³	32.9	38.1	24.9	30.6	36.3	42.1
	水位上升 (rated level rising)	mm	116	117	125	127	128	129
接管 (connection)	出入口 (inlet/outlet)	inch	4B	4B	4B	4B	4B	5B
	法蘭等級 (flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重 (shipping weight)	kg	3,500	4,000	2,500	3,200	3,800	4,500
	運轉重量 (operating weight)	kg	38,600	44,800	29,100	35,800	42,600	49,500
再循環水泵 (water circulating pump)	HP	1	1	1	1	1	1	
操作壓力 (operating pressure)	bar	max. 8.8 (125 psi)						
測試壓力 (inspect pressure)	bar	10 (150 psi)						
操作溫度範圍 (operating temp. range)	°C	-15 ~ 50 (5°F ~ 120°F)						
儲冰容量顯示計 (ice capacity indicator)	NA	0 ~ 100% 刻度 (scale)						

備註：

- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
- (4) 儲冰容量計算依據ANSI/AHRI Standard 901-2014。
- (5) 以上規格若有變更恕不另行通知。

remarks :

- (1) The standard outlet of connection is side type, but could be customized as top type.
- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
- (4) Net usable ice storage capacity is calculated according to ANSI/AHRI Standard 901-2014.
- (5) Specifications are subject to change without notice.

標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目(items) / 機型(model)		單位	DYN-600	DYN-760	DYN-910	DYN-1050	DYN-660	DYN-820
能力 (capacity)	全熱(total heat) (final outlet temp. = 12 °C)	RT-HR	600	760	910	1050	660	820
		kW-HR	2,112	2,675	3,203	3,696	2,323	2,886
	全熱(total heat) (final outlet temp. = 5 °C)	RT-HR	545	680	815	945	590	740
		kW-HR	1,918	2,394	2,869	3,326	2,077	2,605
	潛熱(latent heat)	RT-HR	500	625	750	870	540	680
kW-HR		1,760	2,200	2,640	3,062	1,901	2,394	
外型尺寸 (dimension)	長(length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬(width)	mm	2,360	2,860	3,360	3,870	2,360	2,860
	高(height)	mm	2,800	2,800	2,800	2,800	3,000	3,000
材質 (material)	內槽體(inner shell)	NA	SUS 304不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管(manifold)	NA	SUS 304不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件(inner parts)	NA	SUS 304不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板(partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管(ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭(fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板(top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層(inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層(outer side)	NA	20mm PU發泡保溫板 (20mm PU formed plate)					
	槽底(bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻抗R值	NA	18.4 (approx 18.4 ft ² ·°F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量(brine volume)	liter	1,760	2,200	2,630	3,070	1,910	2,390
	槽內水量(water volume)	m ³	27.2	33.5	39.8	46.1	29.6	36.4
	水位上升(rated level rising)	mm	137	139	141	141	149	152
接管 (connection)	出入口(inlet/outlet)	inch	4B	4B	5B	5B	4B	4B
	法蘭等級(flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重(shipping weight)	kg	2,800	3,500	4,200	4,900	3,000	3,800
	運轉重量(operating weight)	kg	31,900	39,300	46,700	54,200	34,600	42,700
再循環水泵(water circulating pump)	HP	1	1	1	1	1	1	
操作壓力(operating pressure)	bar	max. 8.8 (125 psi)						
測試壓力(inspect pressure)	bar	10 (150 psi)						
操作溫度範圍(operating temp. range)	°C	-15 ~ 50 (5°F ~120°F)						
儲冰容量顯示計(ice capacity indicator)	NA	0 ~ 100% 刻度 (scale)						

備註：

- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
- (4) 儲冰容量計算依據ANSI/AHRI Standard 901-2014。
- (5) 以上規格若有變更恕不另行通知。

remarks :

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- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
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標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目(items) / 機型(model)		單位	DYN-980	DYN-1150	DYN-690	DYN-860	DYN-1030	DYN-1200
能力 (capacity)	全熱(total heat) (final outlet temp. = 12 °C)	RT-HR	980	1150	690	860	1030	1200
		kW-HR	3,450	4,048	2,429	3,027	3,626	4,224
	全熱(total heat) (final outlet temp. = 5 °C)	RT-HR	880	1,030	620	770	925	1,080
		kW-HR	3,098	3,626	2,182	2,710	3,256	3,802
	潛熱(latent heat)	RT-HR	810	950	570	710	850	995
kW-HR		2,851	3,344	2,006	2,499	2,992	3,502	
外型尺寸 (dimension)	長(length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬(width)	mm	3,360	3,870	2,360	2,860	3,360	3,870
	高(height)	mm	3,000	3,000	3,200	3,200	3,200	3,200
材質 (material)	內槽體(inner shell)	NA	SUS 304不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管(manifold)	NA	SUS 304不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件(inner parts)	NA	SUS 304不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板(partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管(ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭(fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板(top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層(inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層(outer side)	NA	20mm PU發泡保溫板 (20mm PU formed plate)					
	槽底(bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻抗R值	NA	18.4 (approx 18.4 ft ² ·F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量(brine volume)	liter	2,860	3,340	2,000	2,500	3,000	3,500
	槽內水量(water volume)	m ³	43.2	50.1	31.0	38.2	45.3	52.6
	水位上升(rated level rising)	mm	153	154	157	159	161	161
接管 (connection)	出入口(inlet/outlet)	inch	5B	5B	4B	5B	5B	5B
	法蘭等級(flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重(shipping weight)	kg	4,600	5,300	3,200	4,000	4,800	5,600
	運轉重量(operating weight)	kg	50,700	58,900	36,300	44,700	53,100	61,700
再循環水泵(water circulating pump)	HP	1	1	1	1	1	1	
操作壓力(operating pressure)	bar	max. 8.8 (125 psi)						
測試壓力(inspect pressure)	bar	10 (150 psi)						
操作溫度範圍(operating temp. range)	°C	-15 ~ 50 (5°F ~120°F)						
儲冰容量顯示計(ice capacity indicator)	NA	0 ~ 100% 刻度 (scale)						

備註：

- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
- (4) 儲冰容量計算依據ANSI/AHRI Standard 901-2014。
- (5) 以上規格若有變更恕不另行通知。

remarks :

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- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
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標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目(items) / 機型(model)		單位	DYN-740	DYN-930	DYN-1110	DYN-1300	DYN-795	DYN-1000
能力 (capacity)	全熱(total heat) (final outlet temp. = 12 °C)	RT-HR	740	930	1110	1300	795	1000
		kW-HR	2,605	3,274	3,907	4,576	2,798	3,520
	全熱(total heat) (final outlet temp. = 5 °C)	RT-HR	665	830	1,000	1,170	715	900
		kW-HR	2,341	2,922	3,520	4,118	2,517	3,168
	潛熱(latent heat)	RT-HR	610	765	920	1,075	655	830
kW-HR		2,147	2,693	3,238	3,784	2,306	2,922	
外型尺寸 (dimension)	長(length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬(width)	mm	2,360	2,860	3,360	3,870	2,360	2,860
	高(height)	mm	3,400	3,400	3,400	3,400	3,600	3,600
材質 (material)	內槽體(inner shell)	NA	SUS 304不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管(manifold)	NA	SUS 304不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件(inner parts)	NA	SUS 304不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板(partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管(ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭(fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板(top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層(inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層(outer side)	NA	20mm PU發泡保溫板 (20mm PU formed plate)					
	槽底(bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻抗R值	NA	18.4 (approx 18.4 ft ² ·°F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量(brine volume)	liter	2,150	2,690	3,230	3,760	2,300	2,880
	槽內水量(water volume)	m ³	33.4	41.1	48.7	56.6	35.8	44.0
	水位上升(rated level rising)	mm	169	171	173	174	181	185
接管 (connection)	出入口(inlet/outlet)	inch	5B	5B	5B	5B	5B	5B
	法蘭等級(flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重(shipping weight)	kg	3,400	4,300	5,100	6,000	3,700	4,600
	運轉重量(operating weight)	kg	39,000	48,100	57,200	66,400	41,800	51,600
再循環水泵(water circulating pump)		HP	1	1	1	2	1	1
操作壓力(operating pressure)		bar	max. 8.8 (125 psi)					
測試壓力(inspect pressure)		bar	10 (150 psi)					
操作溫度範圍(operating temp. range)		°C	-15 ~ 50 (5°F ~120°F)					
儲冰容量顯示計(ice capacity indicator)		NA	0 ~ 100% 刻度 (scale)					

備註：

- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
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remarks :

- (1) The standard outlet of connection is side type, but could be customized as top type.
- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
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標準型儲冰槽規格表 Specifications Table of Standard Ice Storage Tank

項目(items) / 機型(model)		單位	DYN-1190	DYDYN-1390	DYN-1060	DYN-1270	DYN-1130	DYN-1350
能力 (capacity)	全熱(total heat) (final outlet temp. = 12 °C)	RT-HR	1190	1390	1060	1270	1130	1350
		kW-HR	4,189	4,893	3,731	4,470	3,978	4,752
	全熱(total heat) (final outlet temp. = 5 °C)	RT-HR	1,070	1,250	950	1,140	1,010	1,210
		kW-HR	3,766	4,400	3,344	4,013	3,555	4,259
	潛熱(latent heat)	RT-HR	985	1,150	875	1,050	930	1,115
		kW-HR	3,467	4,048	3,080	3,696	3,274	3,925
外型尺寸 (dimension)	長(length)	mm	6,000	6,000	6,000	6,000	6,000	6,000
	寬(width)	mm	3,360	3,870	2,860	3,360	2,860	3,360
	高(height)	mm	3,600	3,600	3,800	3,800	4,000	4,000
材質 (material)	內槽體(inner shell)	NA	SUS 304不銹鋼板 (SUS 304 stainless steel plate)					
	分佈管(manifold)	NA	SUS 304不銹鋼管 (SUS 304 stainless steel tube)					
	內部結構件(inner parts)	NA	SUS 304不銹鋼角鐵、棒 (SUS 304 stainless steel angle & rod)					
	隔板(partition)	NA	高密度PE材質 (high density polyethylene, HDPE)					
	結冰盤管(ice coil)	NA	16mm PE管 (16 mm Polyethylene tube)					
	緊固接頭(fast joint)	NA	銅鍍鎳材質 (nickel-plating cooper)					
保溫 (insulation)	上蓋板(top cover plate)	NA	50mm PU發泡保溫板 (50mm PU formed plate)					
	槽壁內層(inner side)	NA	80mm PE板 (80mm PE formed plate)					
	槽壁外層(outer side)	NA	20mm PU發泡保溫板 (20mm PU formed plate)					
	槽底(bottom)	NA	75mm 高密度PS保溫板 (75mm high density PS formed plate)					
	槽壁熱阻抗R值	NA	18.4 (approx 18.4 ft ² ·°F·hr / BTU)					
容量與水位 (volume & level)	管內鹵水量(brine volume)	liter	3,450	4,030	3,070	3,680	3,260	3,910
	槽內水量(water volume)	m ³	52.2	60.6	46.9	55.6	49.8	59.1
	水位上升(rated level rising)	mm	185	186	196	198	208	210
接管 (connection)	出入口(inlet/outlet)	inch	5B	5B	5B	5B	5B	5B
	法蘭等級(flange grade)	NA	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K	JIS 10K
重量 (weight)	淨重(shipping weight)	kg	5,500	6,400	4,900	5,900	5,200	6,200
	運轉重量(operating weight)	kg	61,200	71,100	54,900	65,300	58,300	69,300
再循環水泵(water circulating pump)	HP		2	2	1	2	2	2
操作壓力(operating pressure)	bar		max. 8.8 (125 psi)					
測試壓力(inspect pressure)	bar		10 (150 psi)					
操作溫度範圍(operating temp. range)	°C		-15 ~ 50 (5°F ~ 120°F)					
儲冰容量顯示計(ice capacity indicator)	NA		0 ~ 100% 刻度 (scale)					

備註：

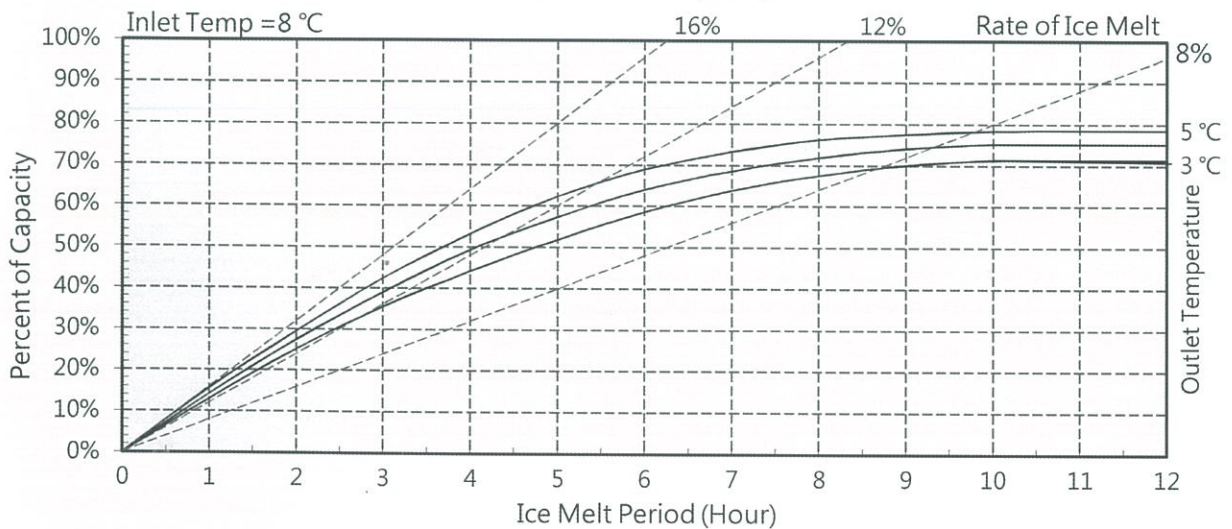
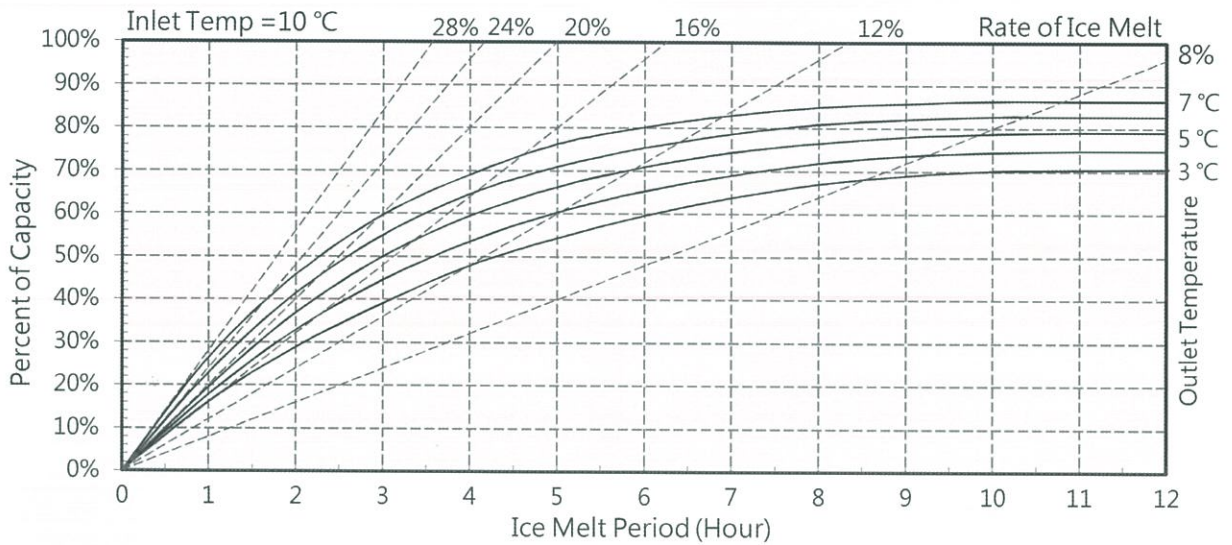
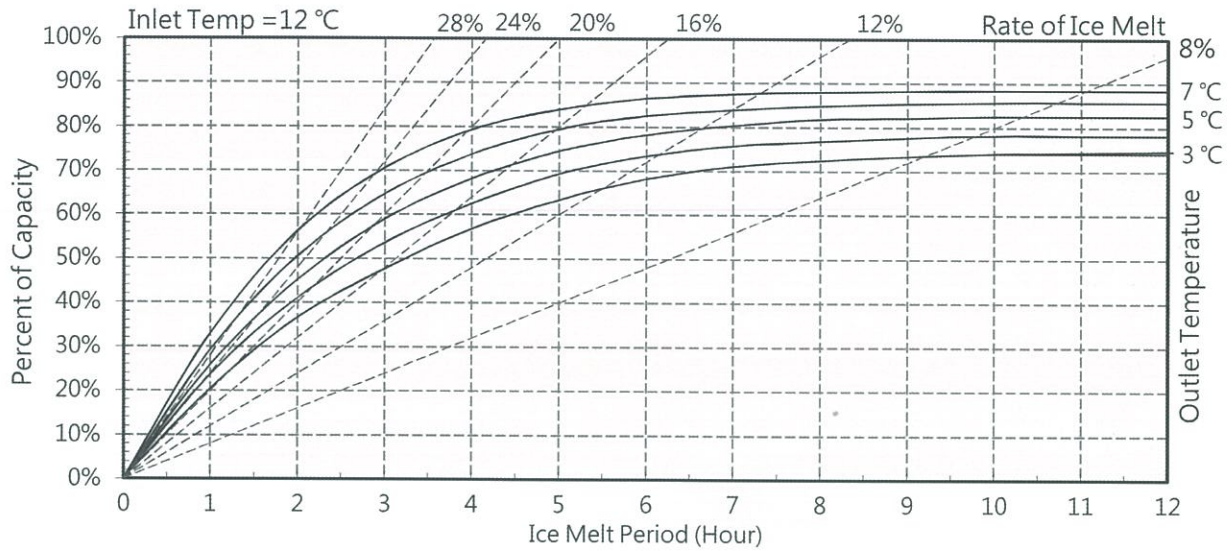
- (1) 標準型接口管為側出，但可依客戶需求改為上出。
- (2) 以上儲冰槽為標準規格，歡迎訂製其他規格儲冰槽或配合現場製作。
- (3) 循環冰水泵採3PH/60Hz/220V或380V通用型馬達，如採用其他電源請於訂購前告知。
- (4) 儲冰容量計算依據ANSI/AHRI Standard 901-2014。
- (5) 以上規格若有變更恕不另行通知。

remarks :

- (1) The standard outlet of connection is side type, but could be customized as top type.
- (2) Besides the above standards, customized specifications and local fabrication are all welcome.
- (3) The circulating chilled water pump with 3PH/60Hz/220V or 380V motor, please notify in advance if special power source required.
- (4) Net usable ice storage capacity is calculated according to ANSI/AHRI Standard 901-2014.
- (5) Specifications are subject to change without notice.

標準型儲冰槽融冰速率

Discharge Rate of Standard Ice Storage Tank



備註：採用冰水循環泵攪拌可提升2~5%之融冰率。

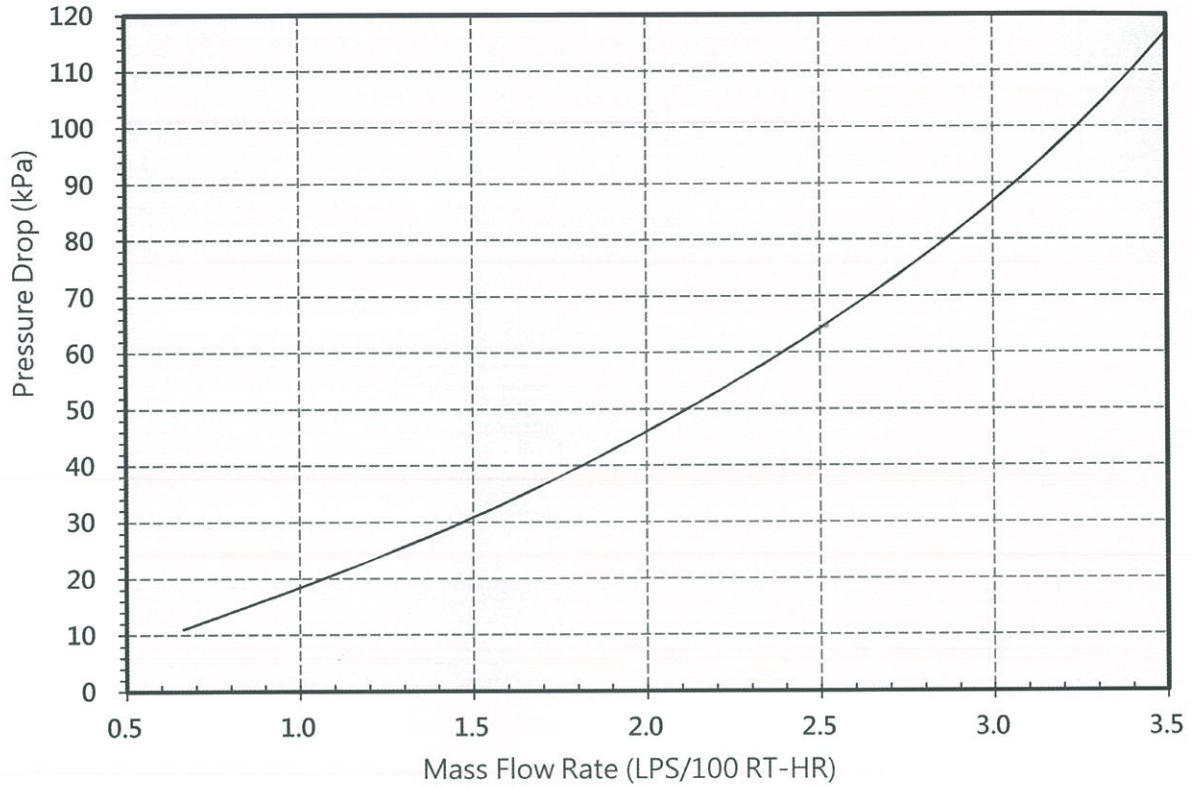
Note : Using the chilled water circulating pump can improve the rate of 2 to 5%.

標準型儲冰槽壓降曲線

Pressure Drop Curve of Standard Ice Storage Tank

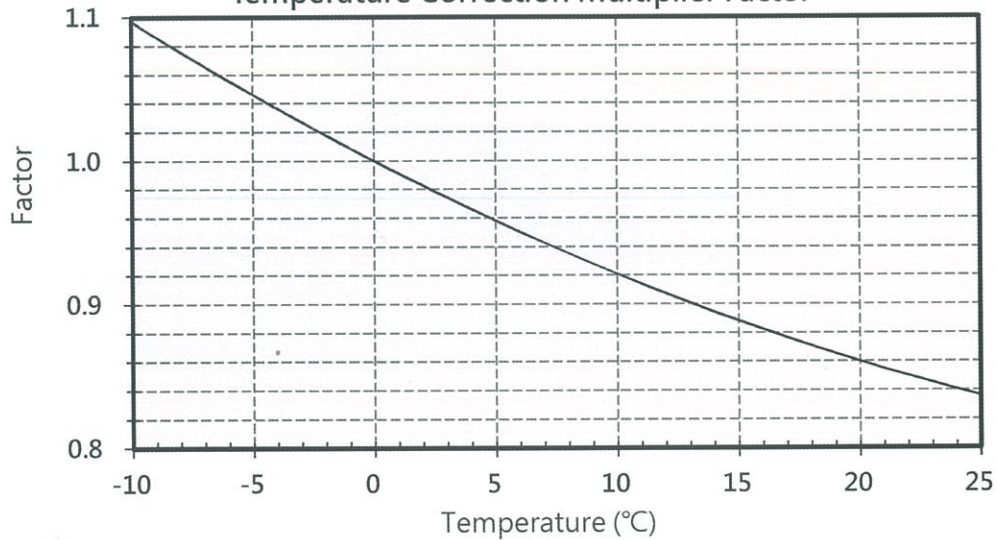
壓降曲線

Pressure Drop Curve



溫度修正係數

Temperature Correction Multiplier Factor



1 kPa = 101.972 mmAq = 0.145037 PSI

1 LPS = 3.6 CMH = 2.1189 CFH = 15.85 GPM

儲冰槽應用 Ice Storage Tank Application



室內儲冰槽
Indoor Ice Storage Tank



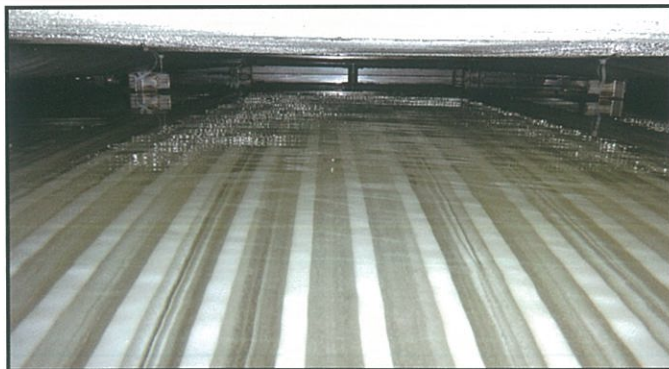
戶外儲冰槽
Outdoor Ice Storage Tank



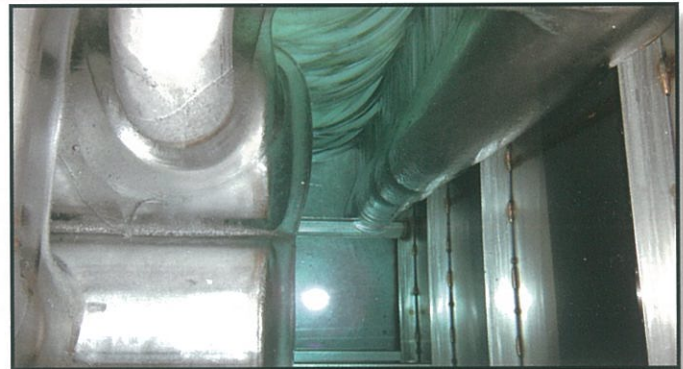
儲冰槽更新
Renewed Ice Storage Tanks



儲冰槽更新
Renewed Ice Storage Tanks



結冰PE盤管
PE Tube Bank with Ice



結冰不銹鋼集管頭
Stainless head with Ice



儲冰槽內融冰
Ice Melting in the Ice Storage tank



融冰冰水循環
Ice Melting with Chilled water Circulating

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