

Air conditioning solutions

CDTI-NEDO Joint Workshop on Energy Saving Engineering - Effective Use of Thermal Energy

Advanced heat driven cooling cycles for low-temperature waste heat recovery

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Air conditioning solutions

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1-1 Introduction --- Absorption Chillers---







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■ A basic behavior of an absorption chiller





1-3 Introduction --- Absorption Chillers---



Driving temperature and lineups of absorption chiller









Photograph of a steam-driven machine





 Specifications of direct fired series 						
Operating mode			Cooling	Heating		
Capacity ratio			100	71~89		
COP with no waste heat recovery (based on lower heating value)			1.47	0.97		
Fuel reduction with waste heat recovery			40%	55~69%		
Efficiency of waste heat transformation			0.8	1.0		
Temperature	Chilled/hot water	Inlet	15°C	55°C		
		Outlet	7°C	60°C		
condition under		Inlet	32°C	_		
nominal (full load)	Cooling water	Outlet	37°C			
condition	Waste heat hot	Inlet	90° C			
	water	Outlet	80°C			

Specifications of steam driven series

Operating mode	Cooling	Heating
COP with no waste heat recovery	1.40	
(based on steam input)		-
Steam reduction with waste heat recovery	30%	



3-1 1 to 3°C Output Absorption Chiller



- Currently Commercial Absorption Chillers
 - Normal outlet: 7°C Over 4°C is available
 - ➤ Less than 4°C → Difficult because of Freezing of the refrigerant



Steam Driven Absorption Chiller (Chilled water outlet: 7°C)

- > If lower temperature was generated, it will be useful for...
 - 1) Cold storage (Food warehouses, etc.)
 - 2) Chilled water storage (For space cooling, peak shift/cut)
 - 3) Reduction of chilled water flow rate by wider temperature difference





Cycle simulation tool was also developed for product design.

 \succ In the conditions of validation test, the machine operated with enough reliability without freezing or crystallization.



Simulation tool





- Specifications were determined according to the simulation result
- Reliability was confirmed against freezing and crystallization by the simulation tool.



External view of prototype



Specifications of the 1 to 3°C output absorption chiller (Example)

Item			Value
Cooling capacity (Q_E)			105
COP (Efficiency)			0.7
Chilled water	Inlet	°C	7.0
Chilled water	Outlet	°C	2.0
Cooling water	Inlet	°C	27.0
Cooling water	Outlet	°C	32.0
Hot water (Heat source)	Inlet	°C	90.0
	Outlet	°C	72.0
Power consumption	kW	5.7	
Electricity Efficiend		18.4	



The developed new absorption chiller can supply 1~3°C chilled water, it can be applied for cold storage, food process, or cold heat conveyance usage with large temperature difference etc.





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Nowadays, more than half of the primary energy, produced in the field of transportations, industries, and commercials, is not utilized but wasted as waste heat.

To "reduce", "recycle", and "reuse" these unutilized heat, the project "Research and development of innovative utilizing technology of unutilized heat energy" commissioned by NEDO has currently been proceeded.

Single-Effect Double-Lift (SEDL) absorption chiller, which enables to decrease utilizable temperature of waste heat (produced in industrial field, etc.) down to lower range and recover heat with approx. 200% of temperature difference than conventional model.





Prototype external view and specifications

Through the various studies, we have developed a novel product which is named "Single-Effect Double-Lift" Then, manufactured a prototype with these technologies

targeting for actual use.



External view of prototype

Model		DXS			
Cooling capacity		kW	176 ~ 4395		
Chilled water*	In	°C	13	12	
	Out	°C	8	7	
Cooling Water [*]	In	°C	31	27	
	Out	°C	36.5	33	
Hot water (Heat source)	In	°C	95	95	
	Out	°C	55	51	
COP(Based on heat input)			0.70	0.72	
Remarks			For Asia (Japan, etc.)	For Europe	



Specifications



Selection Chart of SEDL Absorption Chiller

We can choose various temperature of hot water and cooling water.





Assumed Application; District Heating Network

SEDL absorption chillers are expected to be used in district heat, solar system and distributed energy systems.



Wide temperature drop in hot water (i.e. 95 – 55 = 40 °C) reduces the hot water flow rate and pumping power of the system.



5 Conclusions ---Absorption Chillers Again---



180°C~

Driving temperature and lineups of absorption chiller

90°C

Temp.: 50°C (75°C)



Single-effect Double-lift absorption chiller

1 to 3°C Output Absorption Chiller





Hot water-driven absorption chiller Single effect



150°C



Steam-driven Direct-fired absorption chiller absorption chiller-heater

Double effect



Absorption Chiller with waste heat input





For the purpose of the waste heat recovery, we newly added following products up to our lineup.

- Absorption Chillers for Co-generation Systems; Single-double effect chillers are available that can use steam and hot water at the same time
- 2) 1 to 3°C Output Absorption Chiller;
 Using single-effect cycle, 1 to 3°C chilled water is obtained from some 90°C hot water, with the COP of 0.7 or higher
- SEDL Absorption Chiller; It picks up the heat from some 95°C hot water until it is cooled lower than 55°C

We are ready to fit our heat driven chillers to your demand!





END

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