Comparative study

Temper vs Propylene Glycol

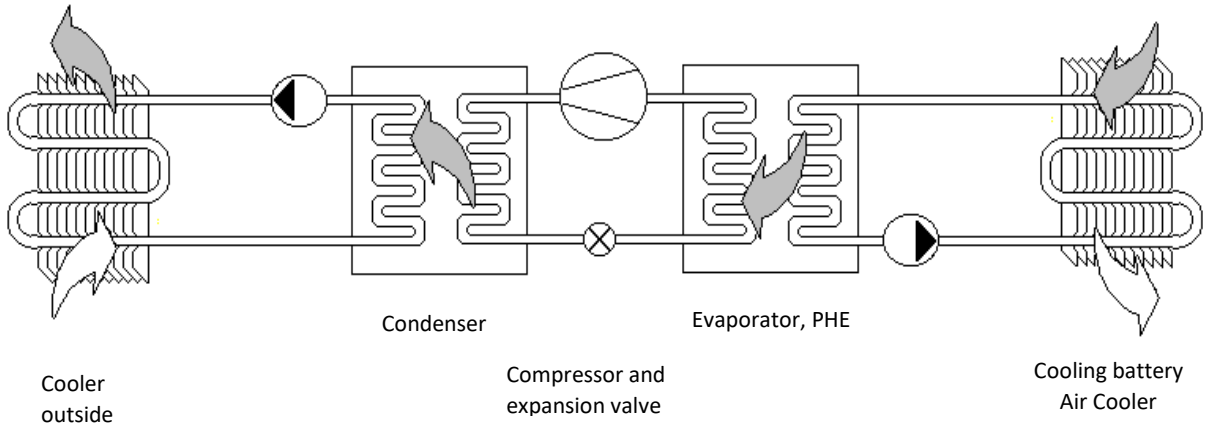
Introduction

Why cooling and freezing?

Cooling and freezing are requested in many areas, like climate testing, sport arenas, air condition, and chemical process cooling **but perhaps the most known: cooling in foodstuff production, where often both cooling and freezing is needed?**

In a secondary refrigeration system with a heat transfer fluid (HTF) as the energy transfer medium, three main components can be identified. Namely **plate heat exchangers (PHE)** between refrigerant and heat transfer fluid, **cooling battery** during transfer from heat transfer fluid to the air in the refrigerated area and the **pumps** for the circulation of the HTF.

Heat transfer coefficient together with the heat transfer surface and the temperature difference defines the total heat transfer. If you have good heat transfer coefficient you may reduce the heat transfer surface and keeping the same total heat load.



Temper's specific heat is lower than MPG or 1.3-Propanediol. However, its higher density leads to very similar values of volumetric flow. Together with the good thermal properties of Temper it results in smaller size and lower price of most of the system components, especially those that represent the highest cost in an installation, and consequently lower energy consumption.

Chemical degradation of glycols is an aspect that needs to be considered, a phenomenon that does not occur with Temper (100% chemically stable fluid and without degradation of the mixture). Glycol alcohols (MPG, MEG) and those derived from plant sources degrade slowly when subject to high temperatures (> +30℃) and with the presence of oxygen and/or metals. This degradation generates acids and other products harmful to the installation, apart from making the lose its antifreeze properties.

Temper vs glycol medium temperature comparative study

Typical conditions in low temperature applications (e.g. cabinets or rooms):

Cooling Power: 200kW
Fluid Inlet Temperature: -8°C
Fluid Outlet Temperature: -4°C
Service Temperature: 0°C

GENERAL THERMAL PROPERTIES							
Temperature °C	**Fluid**	**Freezing point °C**	**Density kg/m³**	**Specific heat, kJ/kg.K**	**Thermal conduc-tivity W/m.K**	**Dynamic viscosity mPa.s**	**Kinematic viscosity, mm²/s**
-10	Temper® -15	-15	1.121,0	3,374	0,484	4,63	4,13
	MPG 35%	-17	1.044,3	3,702	0,391	16,96	16,24
-5	Temper® -15	-15	1.120,0	3,388	0,491	3,87	3,45
	MPG 35%	-17	1.042,6	3,717	0,397	12,6	12,09
0	Temper® -15	-15	1.119,0	3,4	0,498	3,11	2,78
	MPG 35%	-17	1.040,9	3,732	0,403	9,55	9,17

COMPONENTS

ECO MODINE AIR COOLER			25kW	70 kPa max.	
Fluid	**Model**	**Price**	**Capacity kW**	**Flow l/h**	**Exchange surface**
Temper®-15	ICE 43A06 W12	€7.688	24,78	5.986	97
MPG 35%	ICE 52B06 W16	€9.313 (+19%)	25,95	5.885	140 (+31%)

To obtain the required performances in case of choosing MPG or 1,3-Propanediol as secondary fluid (an air cooler of 25 kW with a maximum pressure drops of 70 kPa), we would need a 31% larger equipment. This would result in a cost increase of 19% compared to Temper-15.

SWEP PLATE HEAT EXCHANGER			100 kW			
Fluid	**Model**	**Price**	**Capacity kW**	**Flow l/h**	**Pressure drop kPa**	**Exchange surface**
Temper®-15	P250ASx206	€3.712	100	24.150	13,60	26,50
MPG 35%	P250ASx250	€4.350 (+15%)	100	23.290	16,20 (+17%)	32,20 (+18%)

In the case of choosing an MPG or 1,3-Propanediol as a secondary fluid, a larger heat exchanger with more plates 250 for Glycol and 206 for Temper) is needed and an 18 % higher exchange surface. Furthermore, the pressure drop will increase with 17% in the case of MPG or 1,3-Propanediol, compared with Temper.

Temper vs glycol low temperature comparative study

Typical conditions in low temperature applications (e.g. cabinets or rooms):

Cooling Power: 200 kW
Fluid Inlet Temperature: -28°C
Fluid Outlet Temperature: -24°C
Service Temperature: -20°C

GENERAL THERMAL PROPERTIES							
Temperature °C	Fluid	Freezing point °C	Density kg/m³	Specific heat, kJ/kg.K	Thermal conduc-tivity W/m.K	Dynamic viscosity mPa.s	Kinematic viscosity, mm²/s
-35	Temper® -40	-40	1.226,0	2,851	0,405	34,62	28,24
	MPG 55%	-41	1.069,1	3,21	0,307	312	291,8
-30	Temper® -40	-40	1.225,0	2,875	0,41	23,96	19,56
	MPG 55%	-41	1.067,6	3,231	0,311	199,3	186,7
-25	Temper® -40	-40	1.223,0	2,897	0,416	17,13	14
	MPG 55%	-41	1.066,0	3,252	0,315	130,7	122,6

Components

GÜNTNER AIR COOLER			25 kW		70 kPa max.	
Fluid	Model	Price	Capacity kW	Flow l/h	Pressure drop kPa	Exchange surface
Temper®-40	GGHN 080.2F/27-AHS50/4P.E	€12.128	24,30	6.180	41	325,60
MPG 55%	GGHN 080.2H/27-AHS50/8P.E	€14.303 (+18%)	25,30	6.350	68 (+65%)	434,20 (+33%)

To obtain the required performances in case of choosing MPG or 1,3-Propanediol as secondary fluid (an air cooler of 25kW, with a maximum load loss of 70 kPa), we would need a 33% larger equipment. This would result in a price increase of 18% compared to the Temper-40.

Bearing in mind that in a normal installation the air cooler represents a significant percentage. Large savings will be made by choosing the Temper fluid instead of the MPG or 1,3-Propanediol.

SWEP PLATE HEAT EXCHANGER			100 kW			
Fluid	**Model**	**Price**	**Capacity kW**	**Flow l/h**	**Pressure drop kPa**	**Exchange surface**
Temper®-40	P250ASx212	€3.795	100	25.430	28,90	27,30
MPG 55%	P250ASx284	€4.800 (+21%)	100	26.610	30,10	36,60 (+34%)

In case of choosing an MPG or 1,3-Propanediol as a secondary fluid, a large heat exchanger with more plates (284 for glycol and 212 for Temper-40) is needed with a 34% higher exchange surface.

Conclusion

The result of this comparison shows for the medium temp application a reduction of air cooler surface area with 31 % for Temper compared with MPG. In the PHE area reduction is 18 %. In the PHE the pressure drop is also 17 % lower.

For the low temp application, a reduction of air cooler area with 33 % is shown for Temper compared with MPG. In the air cooler the pressure drop is also 65 % lower. In the PHE area reduction is 34 %.

Considerations when choosing HTF

Health and environmental hazards, fire hazards, energy efficiency – thermal properties, corrosion protection, installation - restrictions in material, lifespan, costs, or rather life cycle costs. **Temper** fulfils all this requirement.

Temper Technology would like to thank Federico Martinez at HTF Iberian Partners for the calculations.