



# Glacier Coolant

Glacier Group

**She**

**Integrating all the advantages into one**

**Encountering by chance**

**Makes you unable to miss it**

**Once possessed**

**It's hard to give up anymore**

**Glacier coolant**

**Makes the refrigeration process perfect and unparalleled**

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## One. Company Profile

Chaoyang Guangda Chemical Co., Ltd., located in the High-tech Industrial Park of Chaoyang City, Liaoning Province, is a national high-tech enterprise specializing in the production of secondary refrigerants. It primarily



develops and manufactures the LM series of glacier coolants, which are applied to low-temperature secondary refrigeration systems. The business covers the whole country.

The company boasts a secondary refrigerant research and development center, a provincial-level experimental research laboratory, and a high-quality R&D team. Additionally, it maintains extensive and in-depth technical collaborations with institutions such as the Hong Kong University of Science and Technology, Lanzhou University of Technology, and Dalian University of Technology. The company possesses over 20 invention patents.

In 2001, LM Glacier Coolant won the Liaoning Provincial Science and Technology Award. In 2002, LM Glacier Coolant was rated as the “Trusted Brand by Users” by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China. In 2004, it was awarded the title of “National Quality Supervision Continuously Qualified and Reassuring Brand Backbone Enterprise”. In 2005, LM Glacier Coolant was jointly recognized as a national key new product by the Ministry of Science and Technology, the Ministry of Commerce, the General Administration of Quality Supervision, Inspection and Quarantine, and the State Environmental Protection Administration. In 2006, it won the best innovative product award at the Liaoning Provincial Enterprise Technology Innovation Achievement

Exhibition. In 2007, the company obtained ISO 9001 quality system certification. In 2021, it was identified as a specialized, high-end and innovation-driven small and medium-sized enterprise (SME) by the National Ministry of Industry and Information Technology.

Relying on excellent product quality, reasonable product prices, and reliable after-sales service, the company has established a stable supply and demand relationship with its customers. Based on customer needs, the company has increased its efforts in new product development year by year.



# 国家重点新产品 证书

项目名称：环保型高效防腐戴剂

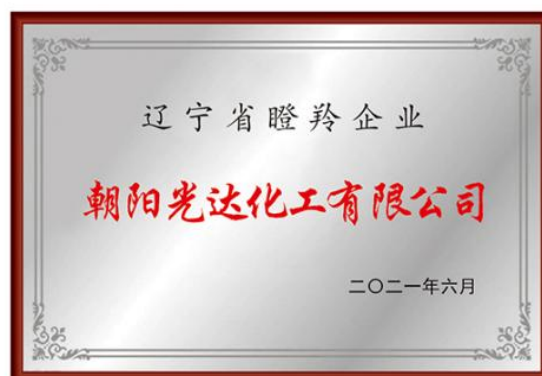
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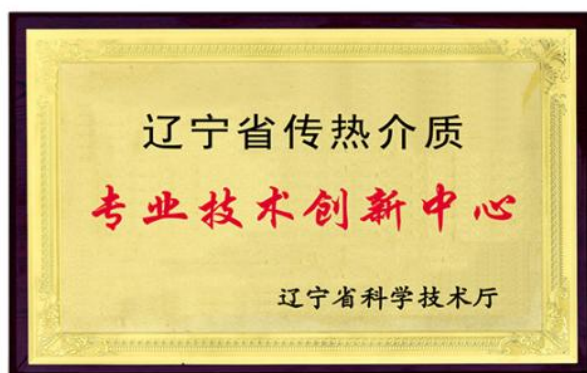
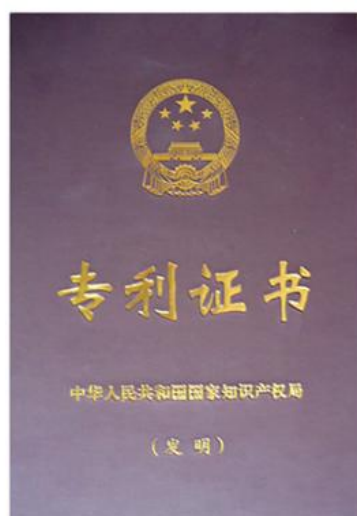
承担单位：朝阳市光达化工厂

发证时间：2005 年 6 月

有效 期：三年

批准机关：





## Three. Inspection Report from Authoritative Institutions



## 载冷剂腐蚀性能评价

## 检测报告

委托单位: 朝阳光达化工有限公司

产品名称: 冰河冷媒(载冷剂)

检验类别: 委托

中国科学院金属研究所  
金属腐蚀与防护国家重点实验室  
二〇〇八年七月七日

中国科学院金属研究所

## 检验报告

|               |                                                                                                                                                                                                                                                                                                                                                                    |      |              |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------|
| 客户单位          | 朝阳光达化工有限公司                                                                                                                                                                                                                                                                                                                                                         | 委托人  | 陈锦良          |
| 样品牌号          | 冰河冷媒 LM-1                                                                                                                                                                                                                                                                                                                                                          | 联系电话 | 0421-7210956 |
| 生产日期          | 2008.6.26                                                                                                                                                                                                                                                                                                                                                          | 形状规格 | 液态           |
| 生产编号          | 108062601                                                                                                                                                                                                                                                                                                                                                          | 来样状态 | 液态           |
| 来样数量          | 3                                                                                                                                                                                                                                                                                                                                                                  | 来样日期 | 2008-06-28   |
| 来样情况<br>及委托内容 | 来样情况:<br>来样为朝阳光达化工有限公司生产的 LM-1 冰河冷媒、LM-4 冰河冷媒载冷剂和分<br>析纯乙二醇。试验用 A3 钢和紫铜(尺寸均为 10×10×40)。<br>委托内容:<br>配制成质量百分比为 25% 的水溶液, 评价对 A3 钢和紫铜的腐蚀性能。                                                                                                                                                                                                                          |      |              |
| 检测结论          | 1、检测过程:<br>根据委托检测要求按 GB/T 19291-2003《金属和合金的腐蚀 腐蚀试验一般原<br>则》评价载冷剂对 A3 钢和紫铜的腐蚀性能。<br>2、检测条件:<br>在常温下测试载冷剂对 A3 钢和紫铜的腐蚀性能, 测试时间 168h (7 天)。<br>3、检测仪器:<br>检测仪器: Sartorius 电子天平(最小分度值 0.01 毫克)。<br>4、检测结果:<br>见附录。<br>5、检测结论:<br>试验 168h 后, A3 钢在乙二醇溶液中腐蚀严重, 表面变黑, 而在 LM-1 和 LM-4 溶<br>液中仍保持光亮, 基本无腐蚀。<br>紫铜在乙二醇溶液中的腐蚀失重最多, 发生了局部腐蚀, 而在 LM-1 和 LM-4 溶<br>液中保持光亮, 基本无腐蚀。 |      |              |
| 编写            | 王成                                                                                                                                                                                                                                                                                                                                                                 | 批准:  |              |
| 校对            | 梁丹                                                                                                                                                                                                                                                                                                                                                                 |      |              |
| 日期            | 08年 7月 7日                                                                                                                                                                                                                                                                                                                                                          |      |              |

沈阳产品质量监督检验院  
Shenyang Product Quality Supervision And Inspection Institute  
检验报告  
Inspection Report

报告编号: Report No. SY. 2016501W3BX00755 共 2 页 第 1 页 201607513

|                            |                                      |                            |                       |
|----------------------------|--------------------------------------|----------------------------|-----------------------|
| 样品名称<br>Product            | LM-4 型冰河冷媒                           |                            |                       |
| 规格型号/等级<br>Model           | LM-4****                             | 样品名称<br>Brand              | 冰河                    |
| 样品批号<br>Batch No.          | ****                                 | 生产日期<br>Producing Date     | 2016.4.30             |
| 样品状态<br>Sample Description | 液体                                   | 执行标准<br>Executing Standard | Q/CGD001-2015         |
| 委托单位<br>Client             | 朝阳光达化工有限公司                           |                            |                       |
| 生产单位<br>Manufacturer       | 朝阳光达化工有限公司                           |                            |                       |
| 采样日期<br>Sampling Date      | 2016/05/16                           | 样品数量<br>Sampling Quantity  | 1000ml                |
| 采样人员<br>Sampling Person    | 陈锦良                                  | 检验期间<br>Inspect Duration   | 2016/05/16—2016/05/30 |
| 交付方式<br>Delivery Mode      | 特快专递                                 | 生产者确认情况<br>affirmance      | 已确认                   |
| 检验依据<br>Test Standard      | Q/CGD001-2015                        |                            |                       |
| 检验项目<br>Test Item          | pH 值、水溶性、有效成分、凝固点、防锈性、外观等共 6 项       |                            |                       |
| 检验结论<br>Test Conclusion    | 该样品按 Q/CGD001-2015 标准检验, 所检项目符合标准要求。 |                            |                       |
| 备注<br>Memo                 | ****                                 |                            |                       |

批准: 张凯 审核: 于桂良 主检: 任晓颖  
Ratifier: 张凯 Corrector: 于桂良 Chief Testing Person: 任晓颖

CMA 量认(京)字(950229)号 No. L0321

样品受理编号: 2003DL-Q0050

第 2 页 / 共 2 页

## 急性经口毒性试验报告

- 1 材料和方法:
- 1.1 样品 名称: LM-3 型冰河冷媒  
来源: 朝阳市光达化工有限公司  
性状: 无色液体 推荐量: /  
前处理方法: 原液直接使用。
- 1.2 实验动物: 清洁级昆明种小鼠 40 只, 雌雄各半, 体重 18-21g。  
由军事医学科学院实验动物中心提供, 动物合格证号: 京动许字 99001。  
饲养环境: 室温为(20-24)℃, 相对湿度为(47-55)%RH, 群笼饲养, 5 只/笼。  
饲料来源: 北京市朝阳区九江口饲料厂; 饲料合格证号: 京动许字(2000)第 007 号。  
动物实验室合格证号: SYXK(京)2002-0022。
- 1.3 试验方法: (霍里氏法)  
实验动物投药 3d, 选健康成年小鼠 40 只, 雌雄各半, 剂量设计雌性为 4640、10000、21500、46400mg/kgBW, 雄性为 4640、10000、21500、46400mg/kgBW, 经口灌胃给予受试物。灌胃前动物禁食过夜, 自由饮水。灌胃后给予正常饮食, 观察二周, 记录中毒体征及死亡情况。
- 2 结果:
- 表 对小鼠体重的影响及急性毒性情况
- | 性别 | 剂量(mg/kg) | 动物数(N) | 初始体重(g)  | 终体重(g)   | 死亡动物数(N) | 死亡率(%) |
|----|-----------|--------|----------|----------|----------|--------|
| 雌  | 4640      | 5      | 20.0±0.6 | 40.0±2.6 | 0        | 0      |
| 雌  | 10000     | 5      | 19.6±1.0 | 37.3±0.8 | 1        | 20     |
| 雌  | 21500     | 5      | 19.4±1.0 | -----    | 5        | 100    |
| 雌  | 46400     | 5      | 20.0±0.6 | -----    | 5        | 100    |
| 雄  | 4640      | 5      | 20.0±1.1 | 29.8±1.2 | 0        | 0      |
| 雄  | 10000     | 5      | 19.6±1.0 | 28.3±1.2 | 2        | 40     |
| 雄  | 21500     | 5      | 19.6±0.5 | -----    | 5        | 100    |
| 雄  | 46400     | 5      | 19.2±0.7 | -----    | 5        | 100    |
- 在观察期内, 4640mg/kgBW 组动物未见异常反应; 10000mg/kgBW 组动物出现嗜睡, 24h 后雌性动物有 2 只死亡, 雄性动物 1 只死亡, 其余存活动物恢复健康; 21500、46400mg/kgBW 组动物于一次灌胃后 4h 内全部死亡。
- 雌性小鼠经口 LD<sub>50</sub>10800mg/kgBW(95%可信限 7410-15700mg/kgBW);  
雄性小鼠经口 LD<sub>50</sub>12600mg/kgBW(95%可信限 9260-17100mg/kgBW)。
- 3 结论:  
根据《食品安全性毒理学评价程序和方法》15194.3 中急性毒性分级标准判定, LM-3 型冰河冷媒属实际无毒。



签发日期: 2016年 12月 16日

#### Four. Introduction of LM Series Glacier Coolant

Glacier coolant combines many advantages such as energy conservation, environmental protection, anti-corrosion, low usage, strong cooling capacity, and unparalleled rust resistance.

The LM series glacier coolants are exclusively developed by our company and have obtained a Chinese invention patent. In the field of secondary refrigerant development, production, and application, we have achieved a domestic leading level, with some products reaching the international advanced level.

The project passed the scientific and technological achievement appraisal in 2000. In 2001, it successively won the Liaoning Provincial Science and Technology Award and the Excellent New Product Gold Award. In 2002, it was rated as a trustworthy brand by the General Administration of Quality Supervision, Inspection and Quarantine of China. It was published in People's Daily on June 11, 2002. In 2005, it was jointly recognized as a national key new product by the Ministry of Science and Technology, the Ministry of Commerce, the General Administration of Quality Supervision, Inspection and Quarantine of China, and the State Environmental Protection Administration.

Glacier coolant, as the latest generation of secondary refrigerants, has excellent anti-corrosion and rust prevention properties, cooling and heat transfer properties, safety and environmental protection. It is suitable for various types of new and old cooling systems. You can replace the old secondary refrigerant or directly design the relevant cooling system through our tailor-made approach. By using glacier coolant, the problems such as severe corrosion of equipment by other cooling media can be thoroughly solved. Various hazards caused by cooling system problems can be effectively avoided, and the service life of refrigeration systems can be doubled.

Currently, the LM series of glacier coolants have been widely applied in various fields

such as chemical industry, pharmaceutical industry, food industry, aerospace, and automobiles. The company boasts over 4,000 long-term partners, including Daqing Petrochemical, Jilin Petrochemical, Changchun FAW, SAC Group, Northeast Pharmaceutical, Jiuzhou Pharmaceutical, Tsinghua Tongfang, Xi'an Aerospace Power Plant, and Dalian Institute of Chemical Physics.



## Five. Introduction for Different Models of Glacier Coolant

### 1. LM-1 Glacier Coolant

#### Composition and Properties:

LM-1 glacier coolant consists of modified monohydric alcohol, and the main additives include corrosion inhibitors, mold inhibitors, solubilizers, etc. It is a light-colored liquid. At 20°C, the density, viscosity, specific heat and thermal conductivity of the stock solution are 0.850~0.860 g/cm<sup>3</sup>, 1.25 mPa·s (cP), 0.603 cal/g·°C and 0.26 W/m·K, respectively. The boiling point of the stock solution is higher than 60°C, the freezing point is lower than -100°C, and the flash point is 16°C. Other relevant parameters are shown in Table 1.

**Table 1 Physical parameters of different concentrations of LM-1 glacier coolant (reference values)**

| Concentration%                   | wt  | 30              | 35              | 40               | 45               | 50               | 55               | 60               | 65               | 70               |
|----------------------------------|-----|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                                  | vol | 36              | 41              | 47               | 52               | 57               | 62               | 67               | 72               | 77               |
| Parameters                       |     |                 |                 |                  |                  |                  |                  |                  |                  |                  |
| Freezing point °C                |     | -25.5           | -31.5           | -38.5            | -46.0            | -53.0            | -60.0            | -66.5            | -73.0            | -80.0            |
| Boiling point °C                 |     | 82              | 81              | 79               | 77               | 76               | 75               | 74               | 73               | 72               |
| Density g/cm <sup>3</sup> (20°C) |     | 0.954           | 0.946           | 0.937            | 0.929            | 0.920            | 0.906            | 0.892            | 0.881            | 0.870            |
| Viscosity cP                     |     | 7.19<br>(-15°C) | 9.48<br>(-20°C) | 15.38<br>(-30°C) | 19.36<br>(-35°C) | 23.43<br>(-40°C) | 37.46<br>(-50°C) | 39.72<br>(-55°C) | 44.01<br>(-60°C) | 65.99<br>(-70°C) |

#### Application Areas:

LM-1 glacier coolant has the advantages of low operating temperature, low viscosity, large specific heat, high thermal conductivity, and strong cold-carrying capacity. It has excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. Under different concentration conditions, it can be used as a secondary

refrigerant in the temperature range of  $-100^{\circ}\text{C}$ ~normal temperature.

### Use and Usage:

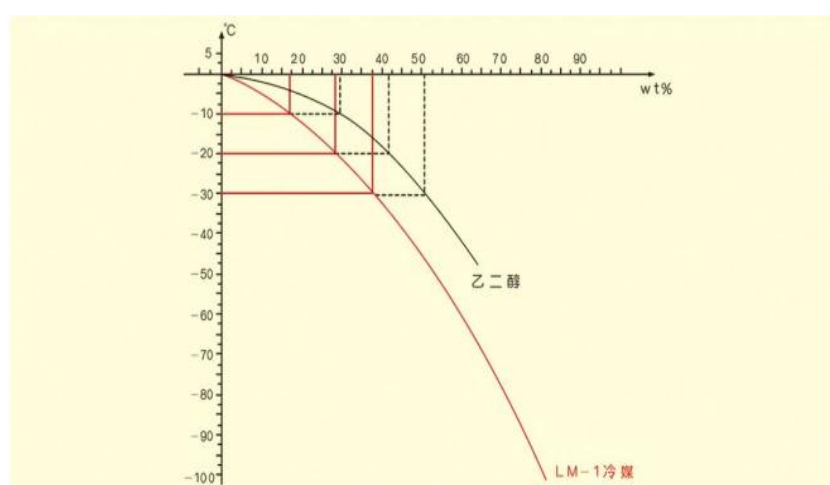
It should be diluted with water to the appropriate concentration for use according to the process temperature requirements. LM-1 series products can also be customized with different concentration standards for more stable and reliable performance. If mixed with other alcohol-based secondary refrigerants, an appropriate amount of LMZ synergist should be added.

### Packaging Specifications:

167 kg iron drums, more than 10 tons of bulk cargo special tanker shipment.

### Safety Tips:

This product is classified as a hazardous chemical, see the Material Safety Data Sheet for details.



**Figure 1 Concentration vs freezing point curves of LM-1 glacier coolant and ethylene glycol**

## 2. LM-1L Glacier Coolant

### Composition and Properties:

The physical properties of LM-1L glacier coolant are similar to those of LM-1, and the

packaging specifications and safety precautions are the same as those of LM-1. It has excellent anti-corrosion performance for aluminum and other metals, mainly used in refrigeration systems containing carbon steel, stainless steel, copper and aluminum.

### 3. LM-3 Series Glacier Coolants

#### Composition and Properties:

LM-3 series glacier coolants consist of modified monohydric alcohol, and the main additives include corrosion inhibitors, mold inhibitors, solubilizers, etc. They are light-colored liquids. At 20°C, the density, viscosity, specific heat and thermal conductivity of the stock solution are 0.820~0.830 g/cm<sup>3</sup>, 1.68 mPa·s (cP), 0.612 cal/g·°C and 0.20 W/m·K, respectively. The boiling point of the stock solution is higher than 70°C, the freezing point is lower than -100°C, and the flash point is 17°C. Other relevant parameters are shown in Table 2.

**Table 2 Physical parameters of different concentrations of LM-3 series glacier coolants (reference values)**

| Concentration%                   | wt  | 10            | 20            | 30               | 40               | 50               | 60               | 70               |
|----------------------------------|-----|---------------|---------------|------------------|------------------|------------------|------------------|------------------|
|                                  | vol | 12.3          | 24.0          | 35.5             | 46.0             | 56.0             | 65.5             | 74.7             |
| Freezing point °C                |     | -4            | -10           | -18              | -26              | -34              | -42              | -55              |
| Boiling point °C                 |     | 91.3          | 87.0          | 84.6             | 83.1             | 81.9             | 81.0             | 80.2             |
| Density g/cm <sup>3</sup> (20°C) |     | 0.982         | 0.968         | 0.954            | 0.936            | 0.914            | 0.890            | 0.868            |
| Viscosity cP                     |     | 2.38<br>(5°C) | 5.34<br>(0°C) | 11.82<br>(-10°C) | 17.46<br>(-15°C) | 18.57<br>(-20°C) | 29.30<br>(-30°C) | 37.04<br>(-40°C) |

#### Use and Usage:

This series of products has the advantages of low operating temperature, low viscosity, large specific heat, high thermal conductivity, and strong cold-carrying capacity. They have excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. Under different concentration conditions, they can be used as secondary refrigerants in the temperature range of -80°C~normal temperature. It should be diluted with water to the appropriate concentration for use according to the process temperature requirements. This series of products includes:

LM-3 glacier coolant is actually non-toxic, and is mainly used as a secondary refrigerant in the food industry.

LM-3A glacier coolant is mainly used as a general industrial secondary refrigerant.

LM-3AL glacier coolant is mainly used for refrigeration systems containing aluminum.

**Packaging Specifications:**

167 kg iron drums, more than 10 tons of bulk cargo special tanker shipment.

**Safety Tips:**

This series of products is classified as hazardous chemicals, see the Material Safety Data Sheets for details.

#### **4. LM-4 Series Glacier Coolants**

**Composition and Properties:**

LM-4 series glacier coolants are composed of modified diols, and the main additives include anti-corrosion agent, anti-mold agent, solubilizer, water stabilizer, etc. They are light-colored liquids. They are safe, low-toxic and odorless. They are non-flammable and not easily volatile. At 20°C, the density, viscosity, specific heat and thermal conductivity of the stock solution are 1.105~1.125 g/cm<sup>3</sup>, 13.92 mPa·s (cP), 0.619 cal/g·°C

and 0.26 W/m·K, respectively. The boiling point of the stock solution is higher than 140°C, the freezing point is lower than -50°C, and the flash point is higher than 120°C.

Other relevant parameters are shown in Table 3.

**Table 3 Physical parameters of different concentrations of LM-4 series glacier coolants (reference values)**

| Parameters<br>Concentration wt% | Density g/cm <sup>3</sup> (20°C) | Freezing point °C | Boiling point °C | Viscosity cP  |
|---------------------------------|----------------------------------|-------------------|------------------|---------------|
| 20                              | 1.024                            | -8.0              | 101              | 2.45(5°C)     |
| 25                              | 1.032                            | -11.0             | 102              | 3.25 (0°C)    |
| 30                              | 1.038                            | -15.0             | 103              | 5.49 (-5°C)   |
| 35                              | 1.048                            | -19.0             | 104              | 7.93 (-10°C)  |
| 40                              | 1.058                            | -23.0             | 106              | 12.37 (-15°C) |
| 45                              | 1.062                            | -29.0             | 107              | 18.94 (-20°C) |
| 50                              | 1.066                            | -35.0             | 107              | 32.90 (-25°C) |
| 55                              | 1.072                            | -42.0             | 108              | 53.57 (-30°C) |
| 60                              | 1.078                            | -49.0             | 109              | 63.63 (-30°C) |
| 70                              | 1.089                            | <-45.0            | 116              | 51.96 (-20°C) |
| 80                              | 1.101                            | <-45.0            | 123              | 70.20 (-20°C) |
| 90                              | 1.113                            | -29.5             | 140              | 65.03 (-10°C) |

#### Use and Usage:

LM-4 series glacier coolants have the advantages of low toxicity, non-flammability, large specific heat, safety and stability, and strong cooling capacity. They have excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. They can be used in a wide range of temperatures under different concentration conditions and are widely used in various refrigeration systems. It should be diluted with water to the appropriate concentration for use according to the process temperature

requirements. If mixed with other alcohol-based secondary refrigerants, an appropriate amount of LMZ synergist should be added. Other relevant parameters are shown in Table 4. This series of products includes:

LM-4-BP glacier coolant adopts pure organic additives (without inorganic salt), which is more suitable for the pharmaceutical industry. This product is environmentally friendly and can be used in the temperature range of  $-35^{\circ}\text{C}\sim 130^{\circ}\text{C}$ .

LM-4D-YE glacier coolant adopts non-ionic additives to replace inorganic salt components in order to reduce the conductivity and enhance the resistance to electrochemical corrosion. This product is environmentally friendly, and has excellent anti-corrosion performance for aluminum, stainless steel, carbon steel and copper, etc. The operating temperature range is  $-35^{\circ}\text{C}\sim 130^{\circ}\text{C}$ . Before using this product, it is recommended to clean the system and then add LM-4D-YE Glacier Coolant. It should be diluted with pure water to the appropriate concentration for use according to the process temperature requirements. It is strictly forbidden to mix with other secondary refrigerants. After normal use, test the pH value every 3 months. If the pH value is lower than the specified value, contact us for adjustment.

LM-4D glacier coolant adopts multi-functional organic non-ionic additives, eliminating inorganic salts such as nitrogen, phosphorus and silicon to further improve electrochemical antioxidant capability, inhibit the trend of ionization of liquids, and achieve extremely low conductivity. The conductivity is less than  $1\text{ }\mu\text{S/cm}$  for the stock solution at  $20^{\circ}\text{C}$  and less than  $5\text{ }\mu\text{S/cm}$  for the 50% dilution. It is environmentally friendly and has excellent anti-corrosion properties for stainless steel, copper, brass, aluminum alloy and other metals. This product can be used as fuel cell coolant in the temperature range of  $-35^{\circ}\text{C}\sim 100^{\circ}\text{C}$ . The system should be cleaned before use. It should

be diluted with ultrapure water to the appropriate concentration for use according to the process temperature requirements. It is strictly forbidden to mix with other secondary refrigerants. After normal use, the conductivity value and pH value should be tested every 3 months. If the conductivity is higher than the specified value or the pH is lower than the specified value, you should contact us for adjustment.

**Table 4 Comparison table of the models and properties of LM-4 series  
glacier coolants**

| Product<br>Model | Functional characteristics                                  | Temperature<br>range °C | Adaptive metals                                    |
|------------------|-------------------------------------------------------------|-------------------------|----------------------------------------------------|
| LM-4             | Commonly used type                                          | -35~50                  | Stainless steel, carbon steel, copper              |
| LM-415L          | Used in data centers                                        | 0~80                    | Stainless steel, carbon steel, copper,<br>aluminum |
| LM-420           | Used in data centers                                        | -3~80                   | Stainless steel, carbon steel, copper              |
| LM-440           | Customisable                                                | -18~50                  | Stainless steel, carbon steel, copper              |
| LM-450           | Customisable                                                | -30~50                  | Stainless steel, carbon steel, copper              |
| LM-455           | Customisable                                                | -35~50                  | Stainless steel, carbon steel, copper              |
| LM-4L            | Anti-corrosion for aluminum                                 | -35~50                  | Stainless steel, carbon steel, copper,<br>aluminum |
| LM-4G            | High temperature resistance                                 | -35~150                 | Stainless steel, carbon steel, copper              |
| LM-450G          | Custom high-temperature resistant                           | -30~100                 | Stainless steel, carbon steel, copper              |
| LM-455G          | Custom high-temperature resistant                           | -35~100                 | Stainless steel, carbon steel, copper              |
| LM-4GL           | High temperature resistance, anti-corrosion<br>for aluminum | -35~150                 | Stainless steel, carbon steel, copper,<br>aluminum |

|            |                                                                        |         |                                                 |
|------------|------------------------------------------------------------------------|---------|-------------------------------------------------|
| LM-4-BP    | No inorganic salt, high temperature resistance                         | -35~130 | Stainless steel, carbon steel, copper           |
| LM-4Q      | Standard type                                                          | -30~25  | Stainless steel, carbon steel, copper           |
| LM-4D-YE   | No inorganic salt, high temperature resistance, low conductivity       | -35~130 | Stainless steel, carbon steel, copper, aluminum |
| LM-420D-YE | Used in data centers                                                   | -3~80   | Stainless steel, carbon steel, copper, aluminum |
| LM-425D-YE | Used in data centers                                                   | -6~80   | Stainless steel, carbon steel, copper, aluminum |
| LM-4D      | No inorganic salt, high temperature resistance, ultra-low conductivity | -35~100 | Stainless steel, carbon steel, copper, aluminum |

### Packing Specification:

25 kg plastic drum, 200 kg iron drum, 1100 kg ton drum, more than 10 tons of bulk cargo special tanker shipment.

## 5. LM-4A Series Glacier Coolants

### Composition and Properties:

LM-4A series glacier coolants consist of modified diols, and the main additives include anti-corrosion agent, anti-mold agent, solubilizer and water stabilizer. They are light-colored liquids with no odor. They are non-flammable and not easily volatile. At 20°C, the density, viscosity, specific heat and thermal conductivity of the stock solution are 1.035~1.045 g/cm<sup>3</sup>, 27.00 mPa·s (cP), 0.644 cal/g·°C and 0.21 W/m·K, respectively. The boiling point of the stock solution is higher than 126°C, the freezing point is lower than -50°C, and the flash point is higher than 100°C. Other relevant parameters are shown in Table 5.

**Table 5 Physical parameters of different concentrations of**

**LM-4A series glacier coolants (reference values)**

| Concentration<br>wt%             | 20             | 25             | 30              | 35                | 40                | 45                | 50                 | 55                 |
|----------------------------------|----------------|----------------|-----------------|-------------------|-------------------|-------------------|--------------------|--------------------|
| Parameters                       |                |                |                 |                   |                   |                   |                    |                    |
| Density g/cm <sup>3</sup> (20°C) | 1.016          | 1.019          | 1.022           | 1.026             | 1.029             | 1.032             | 1.035              | 1.036              |
| Freezing point °C                | -7             | -10            | -13             | -16               | -21               | -26.5             | -33                | -41                |
| Boiling point °C                 | 101            | 101            | 102             | 103               | 104               | 105               | 106                | 106                |
| Viscosity cP                     | 3.26<br>(5 °C) | 5.03<br>(0 °C) | 9.04<br>(-5 °C) | 17.10<br>(-10 °C) | 28.60<br>(-15 °C) | 54.90<br>(-20 °C) | 101.70<br>(-25 °C) | 243.00<br>(-30 °C) |

**Use and Usage:**

LM-4A series glacier coolants have the advantages of environmental friendliness, high specific heat, and high cold-carrying capacity. They have excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. They can be used as secondary refrigerants in a wide range of temperatures under different concentration conditions. It should be diluted with pure water to the appropriate concentration for use according to the process temperature requirements. Other relevant parameters are shown in Table 6.

**Table 6 Comparison table of the models and properties of LM-4A series  
glacier coolants**

| Model                             | LM-4A                            | LM-4AB                            | LM-4ABL                           | LM-4ABG                           | LM-4ABGL                          |
|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Functionality                     |                                  |                                   |                                   |                                   |                                   |
| Temperature range °C              | -20~50                           | -20~50                            | -20~50                            | -20~100                           | -20~100                           |
| Toxicity                          | Actually non-toxic               | -                                 | Customizable                      | Customizable                      | Customizable                      |
| Whether hazardous material or not | No                               | No                                | No                                | No                                | No                                |
| Adaptive metals                   | Stainless steel,<br>carbon steel | Stainless steel,<br>carbon steel, | Stainless steel,<br>carbon steel, | Stainless steel,<br>carbon steel, | Stainless steel,<br>carbon steel, |

|  |  |        |                     |        |                     |
|--|--|--------|---------------------|--------|---------------------|
|  |  | copper | copper,<br>aluminum | copper | copper,<br>aluminum |
|--|--|--------|---------------------|--------|---------------------|

### Packing Specification:

25 kg plastic drum, 200 kg iron drum, 1100 kg ton drum, more than 10 tons of bulk cargo special tanker shipment.

## 6. LM-4B Glacier Coolant

### Composition and Properties:

LM-4B Glacier Coolant is composed of modified ternary alcohols, and the main additives include anti-corrosion agents, mold inhibitors, solubilizers, and water stabilizers. It is a light-colored or colorless liquid with no odor. It is non-flammable, not easily volatile and actually non-toxic. When prepared to appropriate concentrations, the boiling point is above 100°C and the freezing point is below -25°C.

### Use and Usage:

LM-4B Glacier Coolant has the advantages of large specific heat, non-toxicity, low viscosity at low temperatures, wide temperature range, and strong cold-carrying capacity. It has excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. Under different concentration conditions, it can be used as a food secondary refrigerant in the temperature range of -20°C~95°C. It should be diluted with water to the appropriate concentration for use according to the process temperature requirements. Other relevant parameters are shown in Table 7.

**Table 7 Physical parameters of different concentrations of LM-4B Glacier Coolant (reference value)**

| Parameters | Freezing | Boiling | Viscosity cP | Thermal | Specific heat | Density g/cm <sup>3</sup> |
|------------|----------|---------|--------------|---------|---------------|---------------------------|
|------------|----------|---------|--------------|---------|---------------|---------------------------|

| Concentration wt% | point °C | point °C |               | conductivity<br>W/m·K | cal/g·°C      |               |
|-------------------|----------|----------|---------------|-----------------------|---------------|---------------|
| 40                | -17.5    | 102      | 12.96 (-10°C) | 0.424 (-10°C)         | 3.190 (-10°C) | 1.110 (-10°C) |
| 50                | -25.0    | 106      | 45.39 (-20°C) | 0.387 (-20°C)         | 2.611 (-20°C) | 1.140 (-20°C) |

## 7. LM-5 Glacier Coolant

### Composition and Properties:

LM-5 glacier coolant consists of modified mixed alcohols, and the main additives include corrosion inhibitors, mold inhibitors, solubilizers, and water stabilizers. It is a light-colored liquid. At 20°C, the density, viscosity, specific heat and thermal conductivity of the stock solution are 0.920~0.980 g/cm<sup>3</sup>, 1.71 mPa·s (cP), 0.670 cal/g·°C and 0.23 W/m·K, respectively. The boiling point of the stock solution is higher than 60°C, the freezing point is lower than -60°C, and the flash point is 20°C.

### Use and Usage:

LM-5 glacier coolant has a high cooling capacity and moderate viscosity. It has excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. Under different concentration conditions, it can be used as an industrial secondary refrigerant in the temperature range of -50°C~normal temperature. This product can be used alone or mixed with alcohols. When mixed with other alcohols, an appropriate amount of LMZ synergist should be added.

### Safety Tips:

This product is classified as a hazardous chemical, see the Material Safety Data Sheet for details.

## 8. LM-6 Series Glacier Coolants

### Composition and Properties:

LM-6 series glacier coolants consist of modified hydrocarbons. They are light-colored liquids. They are insoluble in water, chemically stable, of low viscosity and combustible. Other relevant parameters are shown in Table 8.

**Table 8 Physical parameters of LM-6 series glacier coolants (reference values)**

| Parameters<br>Model | Freezing<br>point °C | Boiling<br>point °C | Flash<br>point °C | Viscosity<br>cP<br>(20°C) | Density<br>g/cm <sup>3</sup><br>(20°C) | Specific<br>heat<br>cal/g·°C<br>(20°C) | Thermal<br>conductivity<br>W/m·K<br>(20°C) | Temperature<br>range °C  |
|---------------------|----------------------|---------------------|-------------------|---------------------------|----------------------------------------|----------------------------------------|--------------------------------------------|--------------------------|
| LM-6                | -142                 | >70                 | -25               | 0.50                      | 0.750                                  | 0.430                                  | 0.120                                      | -130~30                  |
| LM-6A               | -111                 | >120                | 16                | 0.80                      | 0.771                                  | 0.431                                  | 0.118                                      | -100~room<br>temperature |
| LM-6B               | -153                 | >60                 | -32               | 0.29                      | 0.642                                  | 0.532                                  | 0.111                                      | -145~-100                |

### Use and Usage:

LM-6 series glacier coolants are ultra-low temperature secondary refrigerants, with the advantages of wide temperature range, low viscosity, stable chemical properties, and strong cold-carrying capacity. They have excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. Select the appropriate model and use it as an industrial secondary refrigerant in the temperature range of -140°C~30°C. Systems using this series of products should be closed with nitrogen to prevent moisture from entering. Before use, it is necessary to blow-dry the system with inert gas or dry hot air, and then inject the product directly. They are forbidden to be mixed with other secondary refrigerants.

### Safety Tips:

This series of products are classified as hazardous chemicals, see the Material Safety

Data Sheets for details.

## **9. LM-7 Glacier Coolant**

### **Composition and Properties:**

LM-7 glacier coolant consists of modified alkanes. It is a light-colored liquid and insoluble in water. At 20°C, its density, viscosity, specific heat and thermal conductivity are 0.830~0.870 g/cm<sup>3</sup>, 1.10 mPa·s (cP), 0.407 cal/g·°C and 0.13 W/m·K, respectively.

Its boiling point, freezing point and flash point are higher than 180°C, lower than -80°C, and higher than 57°C, respectively.

### **Use and Usage:**

LM-7 glacier coolant is a low-temperature secondary refrigerant with the advantages of wide operating temperature, low viscosity, stable chemical properties, and strong refrigerant-carrying capacity. It has excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals. It can be used as an industrial secondary refrigerant in the temperature range of -70°C~150°C. Systems using this product should be closed with nitrogen to prevent moisture from entering. Before use, it is necessary to blow-dry the system with inert gas or dry hot air, and then inject the product directly. It is forbidden to be mixed with other secondary refrigerants.

### **Safety Tips:**

This product is classified as a hazardous chemical, see the Material Safety Data Sheet for details.

## **10. LM-8 series Glacier Coolants**

### **Composition and Properties:**



LM-8 series glacier coolants consist of modified organic acid salts, and the main additives include corrosion inhibitors, mold inhibitors, solubilizers, stabilizers, etc. They are light-colored liquids with boiling points higher than 105°C. They are not easily volatile and non-combustible with no flash point. They are also of low toxicity. Other relevant parameters are shown in Table 9.

**Table 9 Physical parameters of LM-8 series glacier coolants (reference values)**

| Parameters<br>Model | Freezing point<br>°C | Viscosity<br>cP<br>(20°C) | Density<br>g/cm <sup>3</sup><br>(20°C) | Specific heat<br>cal/g·°C<br>(20°C) | Thermal conductivity<br>W/m·K<br>(20°C) | Temperature range<br>°C | Adaptive metals                                 |
|---------------------|----------------------|---------------------------|----------------------------------------|-------------------------------------|-----------------------------------------|-------------------------|-------------------------------------------------|
| LM-8                | -60                  | 3.78                      | 1.360                                  | 0.585                               | 0.464                                   | -50~50                  | Stainless steel, carbon steel, copper           |
| LM-8L               | -60                  | 3.78                      | 1.360                                  | 0.585                               | 0.464                                   | -50~50                  | Stainless steel, carbon steel, copper, aluminum |
| LM-8G               | -60                  | 3.78                      | 1.360                                  | 0.585                               | 0.464                                   | -50~100                 | Stainless steel, carbon steel, copper           |
| LM-8GL              | -60                  | 3.78                      | 1.360                                  | 0.585                               | 0.464                                   | -50~100                 | Stainless steel, carbon steel, copper, aluminum |
| LM-850              | -50                  | 3.46                      | 1.337                                  | 0.585                               | 0.477                                   | -40~50                  | Stainless steel, carbon steel, copper           |
| LM-850L             | -50                  | 3.46                      | 1.337                                  | 0.585                               | 0.477                                   | -40~50                  | Stainless steel, carbon steel, copper, aluminum |
| LM-850G             | -50                  | 3.46                      | 1.337                                  | 0.585                               | 0.477                                   | -40~100                 | Stainless steel, carbon steel, copper           |

|          |     |      |       |       |       |         |                                                       |
|----------|-----|------|-------|-------|-------|---------|-------------------------------------------------------|
| LM-850GL | -50 | 3.46 | 1.337 | 0.585 | 0.477 | -40~100 | Stainless steel, carbon<br>steel, copper,<br>aluminum |
| LM-845   | -45 | 3.31 | 1.318 | 0.634 | 0.482 | -35~100 | Stainless steel, carbon<br>steel, copper              |
| LM-840   | -40 | 2.97 | 1.293 | 0.643 | 0.490 | -30~50  | Stainless steel, carbon<br>steel, copper              |

### **Packing Specification:**

30 kg plastic drum, 1400 kg ton drum, more than 10 tons of bulk cargo special tanker shipment.

## **11. LM-8A Glacier Coolant**

### **Composition and Properties:**

LM-8A glacier coolant consists of a modified inorganic acid salt solution, and the main additives include anti-corrosion agents, anti-mold agents, solubilizers and water stabilizers. It is a light-colored liquid. At 20°C, the density, viscosity, specific heat and thermal conductivity are 1.260~1.275 g/cm<sup>3</sup>, 3.60 mPa·s (cP), 0.670 cal/g·°C and 0.48 W/m·K, respectively. Its boiling point and freezing point are 110°C and -50°C, respectively. It is not easily volatile and non-combustible with no flash point. It is also of low toxicity.

### **Use and Usage:**

LM-8A glacier coolant has the advantages of safety, low toxicity, non-combustibility, large specific heat, high thermal conductivity, and strong cold-carrying capacity. It has anti-corrosion properties on carbon steel, stainless steel, copper and other metals. It can be used as an industrial secondary refrigerant in the temperature range of -40°C~normal temperature. Before use, it is necessary to clean the circulatory system, and then directly

add the stock solution of LM-8A glacier coolant. During use, it is necessary to regularly replenish the appropriate amount of LMH corrosion inhibitor of brine, and it is forbidden to mix it with other secondary refrigerants.

### Packing Specification:

30 kg plastic drum, 250 kg iron drum, 1300 kg ton drum, more than 10 tons of bulk cargo special tanker shipment.

## 12. LM-9 series Glacier Coolants

### Composition and Properties:

LM-9 series glacier coolants consist of modified multifunctional organic compounds. They are light-colored liquids which are insoluble in water and combustible. They have the advantages of low viscosity, low volatility, good anti-corrosion properties and stable chemical properties. Other relevant parameters are shown in Table 10.

**Table 10 Physical parameters of LM-9 series glacier coolants (reference values)**

| Parameters<br>Model | Freezing<br>point °C | Boiling<br>point °C | Flash<br>point °C | Viscosity<br>cP<br>(20°C) | Density<br>g/cm <sup>3</sup><br>(20°C) | Specific<br>heat<br>cal/g·°C<br>(20°C) | Thermal<br>conductivity<br>W/m·K<br>(20°C) | Adaptive<br>metals                          | Temperature<br>range °C |
|---------------------|----------------------|---------------------|-------------------|---------------------------|----------------------------------------|----------------------------------------|--------------------------------------------|---------------------------------------------|-------------------------|
| LM-9B               | -54                  | 285                 | 135               | 6.66                      | 1.035                                  | 0.378                                  | 0.133                                      | Stainless<br>steel                          | -25~270                 |
| LM-9D               | -90                  | 175                 | 62                | 1.18                      | 0.901                                  | 0.448                                  | 0.135                                      | Stainless<br>steel, carbon<br>steel, copper | -75~150                 |
| LM-9E               | -55                  | 253                 | 114               | 2.35                      | 0.881                                  | 0.488                                  | 0.142                                      | Stainless<br>steel, carbon<br>steel, copper | -50~240                 |

### Use and Usage:

LM-9 series glacier coolants are wide temperature range bi-directional secondary refrigerants. Select the appropriate model according to the process temperature range of the refrigeration system. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering. For operation at lower temperatures only, a nitrogen containment system is recommended.

### 13. LM-11 Series Glacier Coolants

#### Composition and Properties:

LM-11 series glacier coolants consist of modified premium alkanes. They are colorless liquids which are insoluble in water. They have the advantages of low toxicity, low viscosity and chemical stability. They are also combustible. Other relevant parameters are shown in Table 11.

**Table 11 Physical parameters of LM-11 series glacier coolants (reference values)**

| Parameter<br>s<br>Model | Freezing<br>point °C | Boiling<br>point °C | Flash<br>point °C | Viscosity<br>(20°C) | Density<br>g/cm <sup>3</sup><br>(20°C) | Specific<br>heat<br>cal/g·<br>°C<br>(20°C) | Thermal<br>conductivity<br>W/m·K<br>(20°C) | Temperature<br>range °C |
|-------------------------|----------------------|---------------------|-------------------|---------------------|----------------------------------------|--------------------------------------------|--------------------------------------------|-------------------------|
| LM-11                   | -85                  | 192                 | 60                | 1.66                | 0.761                                  | 0.496                                      | 0.117                                      | -70~90                  |
| LM-11A                  | -50                  | 225                 | 94                | 3.79                | 0.780                                  | 0.487                                      | 0.106                                      | -35~100                 |
| LM-11C                  | -70                  | 243                 | 105               | 2.65                | 0.770                                  | 0.533                                      | 0.130                                      | -55~100                 |
| LM-11D                  | -85                  | 218                 | 83                | 1.96                | 0.751                                  | 0.518                                      | 0.125                                      | -70~100                 |
| LM-11E                  | -95                  | 189                 | 62                | 1.38                | 0.740                                  | 0.485                                      | 0.120                                      | -85~90                  |
| LM-11F                  | -110                 | 162                 | 41                | 1.04                | 0.731                                  | 0.455                                      | 0.118                                      | -100~90                 |

**Use and Usage:**

As a bidirectional heat transfer medium, LM-11 series glacier coolants have excellent anti-corrosion properties on carbon steel, stainless steel, copper and other metals. They are mainly used in the refrigeration systems for wide temperature ranges in which water is strictly prohibited. Select the appropriate model according to the system process temperature range. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering. For operation at lower temperatures only, a nitrogen containment system is recommended.

**Safety Tips:**

LM-11, LM-11A, LM-11F glacier coolants in this series of products are hazardous chemicals, see the Material Safety Data Sheets for details.

**14. LM-14 Series Glacier Coolants****Composition and Properties:**

LM-14 series products consist of modified perfluorinated compounds. They are non-flammable with no flash point. They are environmentally friendly with an ozone depletion potential (ODP) of 0, and the global warming potential (GWP) is very small. These products have excellent electrical insulation properties, ideal chemical inertness, excellent thermal conductivity and good fluidity. They have excellent anti-corrosion performance on carbon steel, stainless steel, copper and other metals, and have wide applicability. Other relevant parameters are shown in Table 12.

**Table 12 Physical parameters of LM-14 series glacier coolants (reference values)**

| Parameters | Freezing | Boiling  | Viscosity | Density           | Specific | Thermal      | Temperature |
|------------|----------|----------|-----------|-------------------|----------|--------------|-------------|
| Model      | point °C | point °C | cP        | g/cm <sup>3</sup> | heat     | conductivity | range °C    |

|        |       |     | (20°C) | (20°C) | cal/g·°C<br>(20°C) | W/m·K (20°C) |         |
|--------|-------|-----|--------|--------|--------------------|--------------|---------|
| LM-14A | <-120 | 50  | 1.03   | 1.611  | 0.267              | 0.060        | -110~40 |
| LM-14B | <-120 | 60  | 1.05   | 1.721  | 0.165              | 0.059        | -110~65 |
| LM-14C | <-120 | 75  | 2.53   | 1.735  | 0.223              | 0.060        | -110~50 |
| LM-14D | <-95  | 90  | 1.84   | 1.791  | 0.243              | 0.067        | -80~80  |
| LM-14E | <-95  | 109 | 4.01   | 1.830  | 0.241              | 0.060        | -55~100 |
| LM-14F | <-95  | 115 | 2.99   | 1.831  | 0.240              | 0.063        | -50~105 |
| LM-14G | <-80  | 150 | 6.32   | 1.814  | 0.235              | 0.065        | -25~135 |

### Application Areas:

They can be applied to a variety of temperature control cooling systems such as data centers, high-speed train power supply inverters, hydrogen energy batteries or lithium battery-powered vehicles, semiconductor manufacturing equipment cooling, electronic cleaning, antistatic agents, fire protection, fluorine material solvents, wind power generators, nuclear power, extra-high-voltage power grids, and military radar systems.

### Use and Usage:

Select the appropriate model according to the system process temperature range. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering. It is strictly prohibited to mix with other secondary refrigerants.

## 15. LM-15 Series Glacier Coolants

### Composition and Properties:

LM-15 series glacier coolants consist of modified polysiloxane. They are colorless or light-colored liquids and insoluble in water. They have the advantages of physiological inertness, good chemical stability, low freezing point, long service life, etc. They have almost no adverse effects on a large number of materials such as metals. They can be

used in the indirect refrigeration systems such as pharmaceutical and chemical industries, new energy and other fields. Other relevant parameters are shown in Table 13.

**Table 13 Physical parameters of LM-15 series glacier coolants (reference values)**

| Parameters<br>Model | Density<br>g/cm <sup>3</sup> (20°C) | Viscosity<br>cP (20°C) | Specific heat<br>cal/g·°C (20°C) | Thermal<br>conductivity<br>W/m·K (20°C) | Flash<br>point °C | Temperature<br>range °C |
|---------------------|-------------------------------------|------------------------|----------------------------------|-----------------------------------------|-------------------|-------------------------|
| LM-15A              | 0.919                               | 5.63                   | 0.418                            | 0.126                                   | 80                | -70~180                 |
| LM-15B              | 0.942                               | 10.40                  | 0.407                            | 0.136                                   | 148               | -50~200                 |
| LM-15C              | 0.953                               | 21.71                  | 0.420                            | 0.145                                   | 170               | -30~200                 |

#### Use and Usage:

LM-15 series glacier coolants are wide temperature range bi-directional secondary refrigerants. They are suitable for various refrigeration heat transfer systems such as water-sensitive anhydrous systems. Select the appropriate model according to the system process temperature range. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering. It is strictly prohibited to mix with other secondary refrigerants.

## 16. LM-16 Series Glacier Coolant

#### Composition and Properties:

LM-16 series glacier coolants consist of modified hydrocarbons. They are colorless or light-colored liquids and insoluble in water. Their flash points are higher than 120°C. They have good thermal stability, and are safe and reliable. They have the advantages of homogeneous heating, accurate temperature control, good heat transfer, easy

transportation and operation. Other relevant parameters are shown in Table 14.

**Table 14 Physical parameters of LM-16 series glacier coolants (reference values)**

| Parameters<br>Model | Density<br>g/cm <sup>3</sup> (20°C) | Viscosity cP<br>(20°C) | Specific heat<br>cal/g·°C (20°C) | Thermal conductivity<br>W/m·K (20°C) | Temperature<br>range °C |
|---------------------|-------------------------------------|------------------------|----------------------------------|--------------------------------------|-------------------------|
| LM-16A              | 0.88~0.92                           | 85.39                  | 0.478                            | 0.143                                | 20~280                  |
| LM-16B              | 0.99~1.03                           | 36.28                  | 0.411                            | 0.123                                | 10~320                  |
| LM-16C              | 0.98~1.01                           | 5.75                   | 0.389                            | 0.131                                | -30~340                 |

### Use and Usage:

LM-16 series products are mainly used as heat transfer medium in high-temperature environments, and are applied in the fields of pharmaceutical industry, chemical industry, new energy of light and heat, and oil and gas. Select the appropriate model according to the system process temperature range. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering.

## 17. LM-17 Series Glacier Coolants

### Composition and Properties:

LM-17 series glacier coolants consist of modified hydrocarbons. They are colorless or light-colored liquids and insoluble in water. They are all combustible with flash points higher than 100°C. Other relevant parameters are shown in Table 15.

**Table 15 Physical parameters of LM-17 series glacier coolants (reference values)**

| Parameters<br>Model | Pour<br>point °C | Density<br>g/cm <sup>3</sup><br>(20°C) | Viscosity<br>cP<br>(20°C) | Specific heat<br>cal/g·°C<br>(20°C) | Thermal<br>conductivity<br>W/m·K (20°C) | Flash<br>point °C | Breakdown<br>voltage kV |
|---------------------|------------------|----------------------------------------|---------------------------|-------------------------------------|-----------------------------------------|-------------------|-------------------------|
| LM-17A              | ≤-50             | 0.889                                  | 21.13                     | 0.429                               | 0.112                                   | 136               | 65.6                    |
| LM-17B              | ≤-47             | 0.884                                  | 14.97                     | 0.424                               | 0.109                                   | 138.5             | 74.5                    |

|        |      |       |      |       |       |     |      |
|--------|------|-------|------|-------|-------|-----|------|
| LM-17C | ≤-40 | 0.848 | 3.42 | 0.427 | 0.112 | 107 | 84.3 |
|--------|------|-------|------|-------|-------|-----|------|

The products in this series have high breakdown voltage, high DC resistivity, low gas production rate under low heat, which can provide good insulating properties. They also have excellent thermal and oxidative stability, which can prevent the formation of acid and sludge during use. They have good resistance to yellowing and do not contain corrosive sulfur, which will not corrode the electronic components or the cooling system. They have good stability and reliable performance as well.

#### **Use and Usage:**

LM-17 series products are suitable for data center server cooling systems as an immersion coolant. Select the appropriate model according to the system process temperature range. Before use, it is necessary to clean the system and blow-dry with dry air, then add the products directly. Keep the system closed during use to prevent moisture from entering.

### **18. LMH Corrosion Inhibitor of Brine**

#### **Composition and Properties:**

LMH corrosion inhibitor of brine is mainly composed of film-forming agents, stabilizers, antioxidants, corrosion inhibitors and other components which do not contain harmful substances such as chromium salts. It is a light-colored liquid which is non-flammable, non-volatile, non-corrosive and has no special odor. The pH value is 7~11 and the density is 1.020~1.080 g/cm<sup>3</sup>. This product can form three layers of protective film on the metal surface which effectively slow down the pitting corrosion damage of chlorine ions on metal equipment.

#### **Application Areas:**

LMH corrosion inhibitor of brine is specially used in indirect refrigeration systems

where calcium chloride and sodium chloride solution are used as the secondary refrigerants, and it can also be used in other environments where brine is in contact with metal, such as brine drilling fluid. It can effectively resist the corrosion of brine on carbon steel, stainless steel, copper and other metals, prolonging the service life of the systems and reducing the losses caused by equipment corrosion, system leakage and downtime for maintenance.

**Use and Usage:**

For the first time of use, the dosage is about 1% of the total amount of brine. Weigh the product and add it directly to the brine system, and keep the system in a circulating working condition. The pH value and anti-corrosion performance of the brine in the system should be tested every three months during use. The pH value should be adjusted and LMH should be replenished appropriately according to the requirements of the technical standards (generally about 0.5%).

**Packing and Storage:**

25 kg plastic drum, train or car transportation, more than 10 tons of special tanker transportation.

**Safety Tips:**

This product is classified as a hazardous chemical, see the Material Safety Data Sheet for details.

**19. LMT Series Corrosion and Scale Inhibitors**

LMT series corrosion and scale inhibitors are composed of rust inhibitor, corrosion inhibitor, scale inhibitor, bactericide and algacide. They are light yellow liquids and non-combustible. These products are widely used in the circulating cooling water systems in chemical, pharmaceutical and other industries. They can effectively prevent

metal corrosion and the formation of scale in the circulating water ensuring the safe and long-term operation of the circulating cooling water systems. They can be directly added to the circulating water systems during use, with dosages of approximately 1% of the water capacities of the systems. Proportion replenishment should be done regularly according to the amount of water replenishment in later stage. Other relevant parameters are shown in Table 16.

**Table 16 Index table of LMT series corrosion and scale inhibitors**

| Parameters<br>Model | Appearance           | Solubility     | pH   | Performance | Additive<br>quantity | Packaging      |
|---------------------|----------------------|----------------|------|-------------|----------------------|----------------|
| LMT                 | Light-colored liquid | Non-stratified | >7.0 | Good        | 1%                   | 25/200 kg drum |
| LMT-1               | Light-colored liquid | Non-stratified | >7.0 | Excellent   | 0.5%~1%              | 25/200 kg drum |

#### **Safety Tips:**

The LMT corrosion and scale inhibitor is a hazardous chemical, see the Material Safety Data Sheet for details.

## **20. LMZ Series Secondary Refrigerant Synergists**

### **Composition and Properties:**

LMZ series secondary refrigerant synergists are supplementary substitutes for LM series glacier coolant products with the function of preventing the serious corrosion of metals by secondary refrigerant substitutes in the form of concentrated additives, and enhancing the effectiveness of secondary refrigerant substitutes. For manufacturers who have already used a large number of alcohol-based secondary refrigerant substitutes, or for whom it is inconvenient to add Glacier Coolant directly due to

transportation constraints, they can choose these products which can be added directly to the alcohol-based aqueous cooling medium at a dosage of 0.5%~2%. Other relevant parameters are shown in Table 17.

**Table 17 Index table of LMZ series secondary refrigerant synergists**

| Parameters<br>Model | Appearance           | Additive quantity | Packaging      | Main ingredients   |
|---------------------|----------------------|-------------------|----------------|--------------------|
| LMZ                 | Solid particles      | 0.5%~1%           | 25 kg bag      | Inorganic          |
| LMZ-1               | Light-colored liquid | 1%~2%             | 25/200 kg drum | Inorganic          |
| LMZ-2               | Light-colored liquid | 1%                | 25/200 kg drum | Inorganic, Organic |
| LMZ-4               | Light-colored liquid | 2%                | 25/200 kg drum | Organic            |

#### **Comparative Tests for anti-corrosion performances:**

1 g of LMZ secondary refrigerant synergist was weighed and added into a 100 mL conical flask with 25% ethylene glycol solution; then one brightly polished carbon steel test piece and one copper test piece were added. At the same time, 100 mL of 25% ethylene glycol solution was added into another conical flask, and the same test pieces were added for comparative observation. The corrosion condition can be observed the next day to determine the anti-corrosion performance of LMZ secondary refrigerant synergist. Keep these two conical flasks safe; the corrosion condition of the metal specimen can be observed for a long time.

#### **Safety Tips:**

LMZ, LMZ-1 and LMZ-2 secondary refrigerant synergists in this series of products are hazardous chemicals, please refer to the Material Safety Data Sheet for details.

## **21. LM-XL Glacier Phase Change Materials for Cold Storage**

### **Composition and Properties:**

LM-XL series products are composed of main energy storage agents, phase change adjusting agents, anti-subcooling agents, anti-phase separation agents and inducing agents. These products realize the storage and release of cold energy through liquid-solid-liquid phase change, with high energy storage density and suitable specific heat and thermal conductivity. They are non-volatile, safe and reliable, and can be used repeatedly. Other relevant parameters are shown in Table 18.

### Application Areas:

This series of products can control the phase change of multiple temperature nodes between -24°C and -2°C, so as to realize the storage of cold capacity in different low-temperature conditions. The products have a wide range of application prospects in the field of cold storage, ice and snow sites, central air conditioning using low valley power peak cooling storage, as well as in the field of pharmaceuticals, food refrigerated transportation and other fields.

**Table 18 Typical physical parameters of LM-XL series products (reference values)**

| Model    | Phase transition temperature °C |         | Latent heat<br>kJ/kg | Density g/cm <sup>3</sup><br>(20°C) | Thermal<br>conductivity<br>W/m·K (20°C) | Specific heat<br>cal/g·°C (20°C) |
|----------|---------------------------------|---------|----------------------|-------------------------------------|-----------------------------------------|----------------------------------|
|          | Freezing                        | Melting |                      |                                     |                                         |                                  |
| LM-XL-2  | -2                              | -2      | 317.4                | 1.06±0.02                           | 0.603                                   | 0.884                            |
| LM-XL-5  | -3.5                            | -5.5    | 324.9                | 1.07±0.02                           | 0.585                                   | 0.837                            |
| LM-XL-10 | -11                             | -10.5   | 310.7                | 1.11±0.02                           | 0.566                                   | 0.807                            |
| LM-XL-15 | -16                             | -15.5   | 317.3                | 1.04±0.02                           | 0.567                                   | 0.870                            |
| LM-XL-18 | -18                             | -18     | 307.1                | 1.07±0.02                           | 0.559                                   | 0.844                            |
| LM-XL-21 | -23                             | -21.5   | 322.7                | 1.13±0.02                           | 0.584                                   | 0.890                            |
| LM-XL-24 | -26                             | -24     | 298.1                | 1.17±0.02                           | 0.560                                   | 0.781                            |

## 22. LM-XR Glacier Phase Change Materials for Heat Storage

### Composition and Properties:

LM-XR series products are composed of main energy storage agents, phase change adjusting agents, anti-subcooling agents, anti-phase separation agents and inducing agents. These products realize the storage and release of heat energy through solid-liquid-solid phase change, with high energy storage density and suitable specific heat and thermal conductivity. They are non-volatile, safe and reliable, and can be used repeatedly. Other relevant parameters are shown in Table 19.

### Application Areas:

This series of products can control the phase change of multiple temperature nodes between 7°C and 55°C, so as to realize the storage of thermal energy in different low-temperature conditions. They have a wide range of applications in the fields of industrial waste heat recovery, solar energy storage, air-conditioning cooling systems, phase change energy storage building, temperature control of electronic components, textile phase change microcapsules, and insulation of vegetable greenhouses.

**Table 19 Typical physical parameters of LM-XR series products (reference values)**

| Model    | Phase transition temperature °C |         | Latent heat<br>kJ/kg | Density g/cm <sup>3</sup><br>(20°C) | Thermal<br>conductivity W/m·K<br>(25°C) | Specific heat<br>cal/g·°C (25°C) |
|----------|---------------------------------|---------|----------------------|-------------------------------------|-----------------------------------------|----------------------------------|
|          | Freezing                        | Melting |                      |                                     |                                         |                                  |
| LM-XR-7  | 7                               | 7       | 154.0                | 1.40±0.10                           | 0.609                                   | 0.802                            |
| LM-XR-36 | 36                              | 36      | 294.1                | 0.75±0.05                           | 0.913                                   | 0.504                            |
| LM-XR-53 | 53                              | 52      | 268.9                | 0.80±0.05                           | 0.474                                   | 0.400                            |
| LM-XR-55 | 55.5                            | 55.5    | 206.4                | 0.80±0.05                           | 0.401                                   | 0.496                            |

## Six. Qualitative Comparative Experiment of Anti-corrosion Performances of Different Secondary Refrigerants

Corrosion of carbon steel pieces by different secondary refrigerants in one day



Figure 1 Water

The water is turbid, and the carbon steel test piece is corroded



Figure 2 30% Brine

The solution is turbid, and the carbon steel test piece has turned to black gray



Figure 3 50% Ethylene glycol

The solution is become turbid, and 90% of the carbon steel test piece is corroded



Figure 4 30% LM-4 Glacier Coolant

The solution is colorless and transparent, and there is no obvious change on the surface of the carbon steel test piece

Corrosion of carbon steel pieces by different secondary refrigerants in a year



Figure 5 50% Ethylene glycol

The carbon steel test piece is severely corroded, and the rust accumulates and deposits on the bottom



Figure 6 30% LM-1 Glacier Coolant

There is no obvious change on the surface of the carbon steel test piece, and the solution is transparent

## Seven. Quantitative Comparative Experiment of Anti-corrosion Performances of Different Secondary Refrigerants

### 1. Detection of the corrosion performances of A3 steel in different secondary refrigerants (Test by the Institute of Metals, Chinese Academy of Sciences)

The results of the corrosion properties of ethylene glycol, LM-1 and LM-4 glacier coolants on A3 (Q235) steel are shown in Figure 1 and Table 20. The weight loss of A3 (Q235) steel in ethylene glycol solution increased linearly with the increase of immersion time, and the corrosion of A3 (Q235) steel in LM-1 and LM-4 glacier coolants was slight. The macroscopic morphologies after corrosion for 168h are shown in Figure 2. A3 (Q235) steel corroded severely in the ethylene glycol solution and the surface has blackening, while in the LM-1 and LM-4 solutions remained bright.

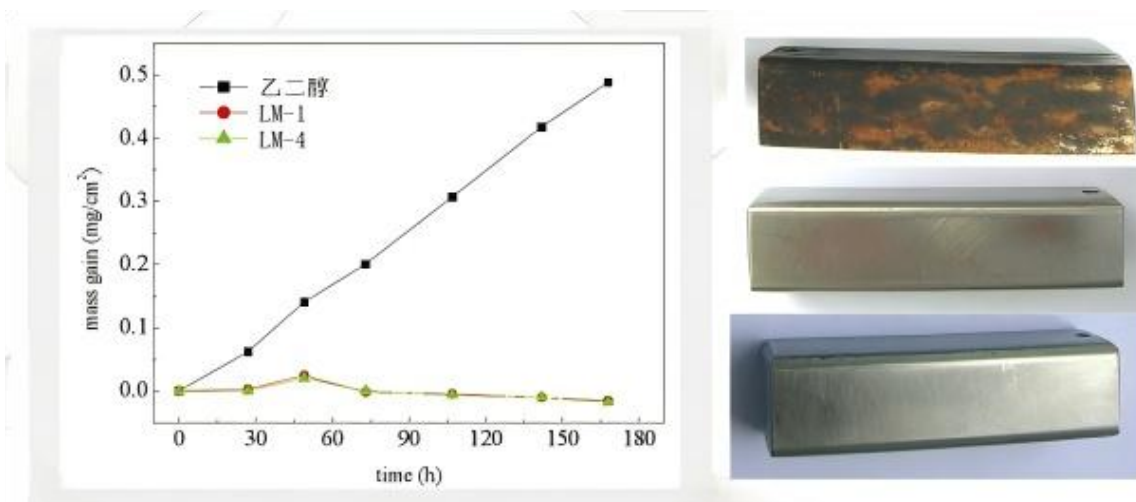


Figure 1. Weight losses of A3 (Q235) steels in different secondary refrigerants

Figure 2. The macroscopic morphologies of A3 (Q235) steels after immersion in ethylene glycol, LM-1 and LM-4 solutions for 168 hours is shown from top to bottom

**Table 20 Weight losses of A3 steels in different secondary refrigerants (mg/cm<sup>2</sup>)**

| <b>Samples<br/>Time (h)</b> | <b>Ethylene glycol</b> | <b>LM-1 Glacier Coolant</b> | <b>LM-4 Glacier Coolant</b> |
|-----------------------------|------------------------|-----------------------------|-----------------------------|
| 0                           | 0                      | 0                           | 0                           |
| 27                          | 0.06222                | 0.00278                     | 0.00017                     |
| 49                          | 0.14056                | 0.02444                     | 0.02000                     |
| 73                          | 0.20056                | -0.00167                    | 0                           |
| 107                         | 0.30667                | -0.00483                    | -0.00683                    |
| 142                         | 0.41778                | -0.01017                    | -0.01037                    |
| 168                         | 0.48778                | 0.01556                     | 0.01833                     |

## 2. Comparison of corrosion results of metals in different secondary refrigerants over three years

| <b>Time</b> | <b>Test solution<br/>Test piece</b>  | <b>25% LM-1 Glacier<br/>Coolant</b> | <b>25% Alcohol</b> | <b>Tap-water</b> |
|-------------|--------------------------------------|-------------------------------------|--------------------|------------------|
| 0 Day       | Initial weight of steel piece (g)    | 9.9512                              | 9.9466             | 9.8545           |
|             | Initial weight of copper piece (g)   | 8.01356                             | 8.2562             | 8.1342           |
|             | Initial weight of aluminum piece (g) | 8.5142                              | 8.1314             | 8.1251           |
| 1 Day       | Weight loss of steel piece (g)       | 0                                   | 0.0024             | 0.0025           |
|             | Weight loss of copper piece (g)      | 0                                   | 0                  | 0                |
|             | Weight loss of aluminum piece (g)    | 0                                   | 0                  | 0                |
| 1 Month     | Weight loss of steel piece (g)       | 0                                   | 0.0654             | 0.0701           |
|             | Weight loss of copper piece (g)      | 0                                   | 0.0315             | 0.0362           |
|             | Weight loss of aluminum piece (g)    | 0                                   | 0.0081             | 0.0103           |
| 1 Year      | Weight loss of steel piece (g)       | 0                                   | 0.8012             | 0.8412           |

|                                 |                                      |        |        |        |
|---------------------------------|--------------------------------------|--------|--------|--------|
|                                 | Weight loss of copper piece (g)      | 0      | 0.3522 | 0.3924 |
|                                 | Weight loss of aluminum piece<br>(g) | 0      | 0.1021 | 0.1251 |
| 3 Years                         | Weight loss of steel piece (g)       | 0.0002 | 2.5004 | 2.5269 |
|                                 | Weight loss of copper piece (g)      | 0      | 1.1202 | 1.2018 |
|                                 | Weight loss of aluminum piece<br>(g) | 0      | 0.4561 | 0.5155 |
| Corrosion rate of steel piece % |                                      | 0.0007 | 8.38   | 8.55   |

The tests were conducted using 25% LM-1 glacier coolant, 25% alcohol and tap water in which A3 (Q235) carbon steel, copper and aluminum test pieces with a thickness of 4 mm were immersed. After 3 years of observation at room temperature (1997.2.20-2000.2.20), the weight loss of each piece was measured periodically to examine the corrosivity to metals of different solutions. The results are listed in the table above. By calculation, the corrosion rates of different solutions on various metals can be determined.

Equation for the corrosion rate:

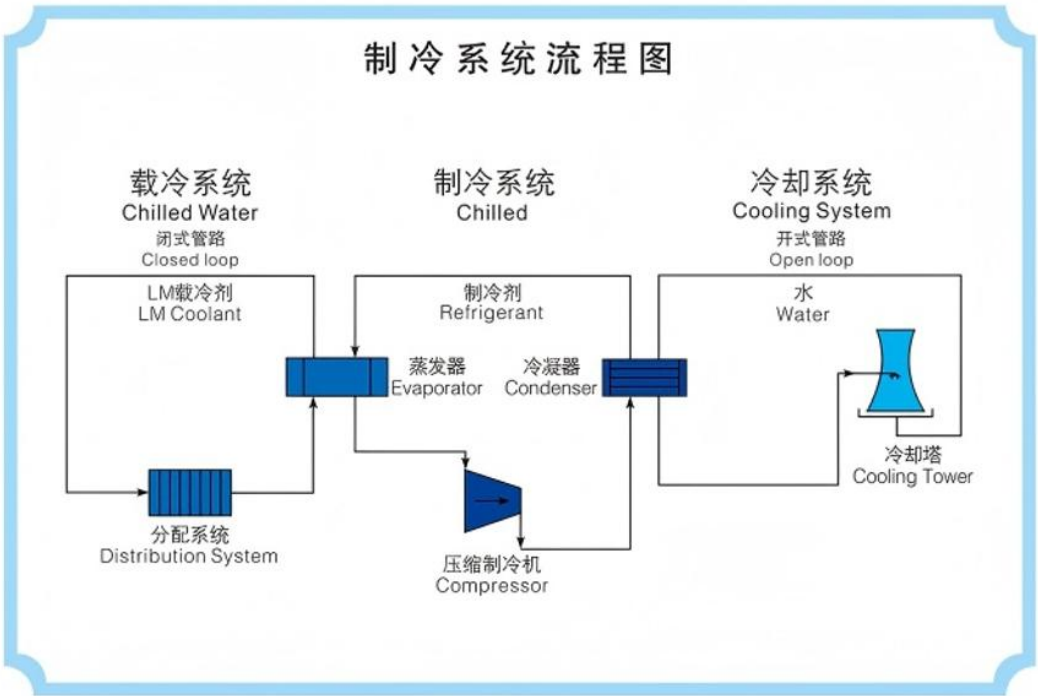
$$(\text{Metal weight loss}/\text{Initial weight}/\text{time}) \times 100\% = \text{Corrosion rate percentage}$$

For example, the corrosion rate of A3 (Q235) steel in 25% alcohol per year is as follows:  $(2.5004/9.9466/3 \text{ years}) \times 100\% = 8.38\%$ .

**Eight. Comparison of physical properties of several kinds of secondary refrigerants at the same freezing point (operating temperature -10°C)**

| Secondary refrigerant<br>Parameters | Calcium chloride | Ethylene glycol | Alcohol          | LM-1 Glacier Coolant | LM-4 Glacier Coolant |
|-------------------------------------|------------------|-----------------|------------------|----------------------|----------------------|
| Concentration wt%                   | 21               | 38              | 38               | 25                   | 35                   |
| Freezing point °C                   | -20              | -20             | -20              | -20                  | -20                  |
| Density g/cm <sup>3</sup> (20°C)    | 1.20             | 1.05            | 0.97             | 0.96                 | 1.05                 |
| Specific heat cal/g·°C              | 0.721            | 0.825           | 0.90             | 0.950                | 0.837                |
| Thermal conductivity W/m·K          | 0.527            | 0.391           | 0.36             | 0.435                | 0.429                |
| Viscosity cP                        | 5.07             | 7.63            | 12.82            | 5.54                 | 6.73                 |
| Corrosivity                         | Severe corrosive | Corrosive       | Severe corrosive | Non-corrosive        | Non-corrosive        |

**Flowchart of Refrigeration System**



### **Nine. Reasons for Selecting Glacier Coolant**

1. High specific heat capacity: A high specific heat capacity provides greater cooling capacity, which reduces the required flow rate of the heat-transfer fluid, saves pump energy, and lowers consumption.
  2. Low viscosity: Low viscosity facilitates pumping, thereby reducing energy consumption.
  3. High thermal conductivity: High thermal conductivity decreases the heat-exchange surface area required.
  4. Low corrosiveness: Minimizes corrosion of equipment, piping, and accessories, extends the service life and reduces maintenance costs. Corrosion can impair heat-exchange efficiency.
  5. Excellent chemical stability: Allows long-term recycling, reduces the amount of make-up fluid.
  6. After-sales service: After the delivery of Glacier Coolant, our company tracks product performance, provides regular service, and dispatches personnel for on-site visits and sampling. We test the fluid and promptly report results to customers. Regional offices ensure rapid on-site support if issues arise during use.
  7. Strong R&D capabilities: We have a high-level professional team and our R&D center is a provincial-level engineering technology center. A provincial-level liquid heat-transfer medium laboratory and testing center has been established.
  8. Transport assurance: We have a qualified professional transportation company to ensure dedicated vehicles for our products, prevent product contamination caused by mixed transportation, ensure product quality during transportation, and deliver goods safely and on time.
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## Ten. Safety Precautions

LM-1, LM-2, LM-3, LM-5, LM-6, LM-6A, LM-6B, LM-7, LM-11 and LM-11F Glacier Coolants are all combustible and explosive hazardous materials. When storing and using them, keep away from sources of fire, prevent static electricity, prevent leakage, and maintain ventilation.

If LM-1, LM-3, or LM-5 leaks, evacuate personnel immediately, open doors and windows, and dilute with water. In case of fire, extinguish with foam or other suitable agents. If LM-6, LM-6A, LM-6B, LM-9D, LM-9E, LM-7, LM-11, LM-11A, LM-11B, LM-11C, LM-11D, LM-15 series, LM-16 series, or LM-17 series leaks, promptly evacuate personnel, open doors and windows, and rinse with detergent-containing water. If these products catch fire, evacuate at once and extinguish with foam, dry chemical, carbon dioxide, or soil.

All LM series Glacier Coolants and their performance enhancers are harmful if ingested and should not be inhaled in large quantities. Storage and use areas must be well-ventilated, and the products must not be used for any purpose other than as heat-transfer fluids.

The data and performance figures in this product brochure are for reference only; the contract and related technical agreements shall prevail. Detailed requirements, safety precautions, and handling instructions during storage and use are provided in the product's enterprise standards, Material Safety Data Sheet, and safety labels.

# Glacier Coolant

## A secondary refrigerant that does not corrode equipment

### Glacier Group

Glacier Coolant Tech (Beijing) Co., Ltd.

Glacier Coolant Tech (Chaoyang) Co., Ltd.

Chaoyang Guangda Chemical Co., Ltd.

Liaoning Glacier Heat Transfer Medium Testing Co., Ltd.

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