HVAC Scale Prevention and Removal Engineering

Galaxy Technology Development Co., Ltd.
General Manager: Kevin Cheng

During the cooling process of circulating water, continuous heat exchange and evaporation cycles cause the concentration of dissolved salts to gradually increase. Once the concentration exceeds the solubility limit, precipitation occurs, resulting in scale formation.

Common scale components in cooling water systems include calcium carbonate, calcium phosphate, and magnesium silicate. These deposits are dense in structure and significantly reduce heat transfer efficiency. When the scale thickness reaches 0.6 mm, the heat transfer coefficient can decrease by approximately 20%.

In addition, scale can corrode metal equipment and pipelines, cause blockages, shorten equipment lifespan, and increase maintenance costs. In severe cases, it may even lead to system shutdowns, affecting normal production operations.

According to the 2012 Energy Technology White Paper published by the Bureau of Energy, Ministry of Economic Affairs, inadequate scale management in cooling water systems for refrigeration equipment directly increases energy consumption. The main contributing factors are as follows:

Scale accumulation on condenser copper tubes raises the refrigerant temperature. For every 1°C increase, power consumption rises by approximately 3%.
Scale formation reduces the inner diameter of condenser pipes, leading to insufficient cooling water flow. If the flow drops below 85%, power consumption increases by about 3%.
Scale buildup in cooling towers increases heat dissipation temperature. For every 1°C increase, energy consumption rises by approximately 2%.

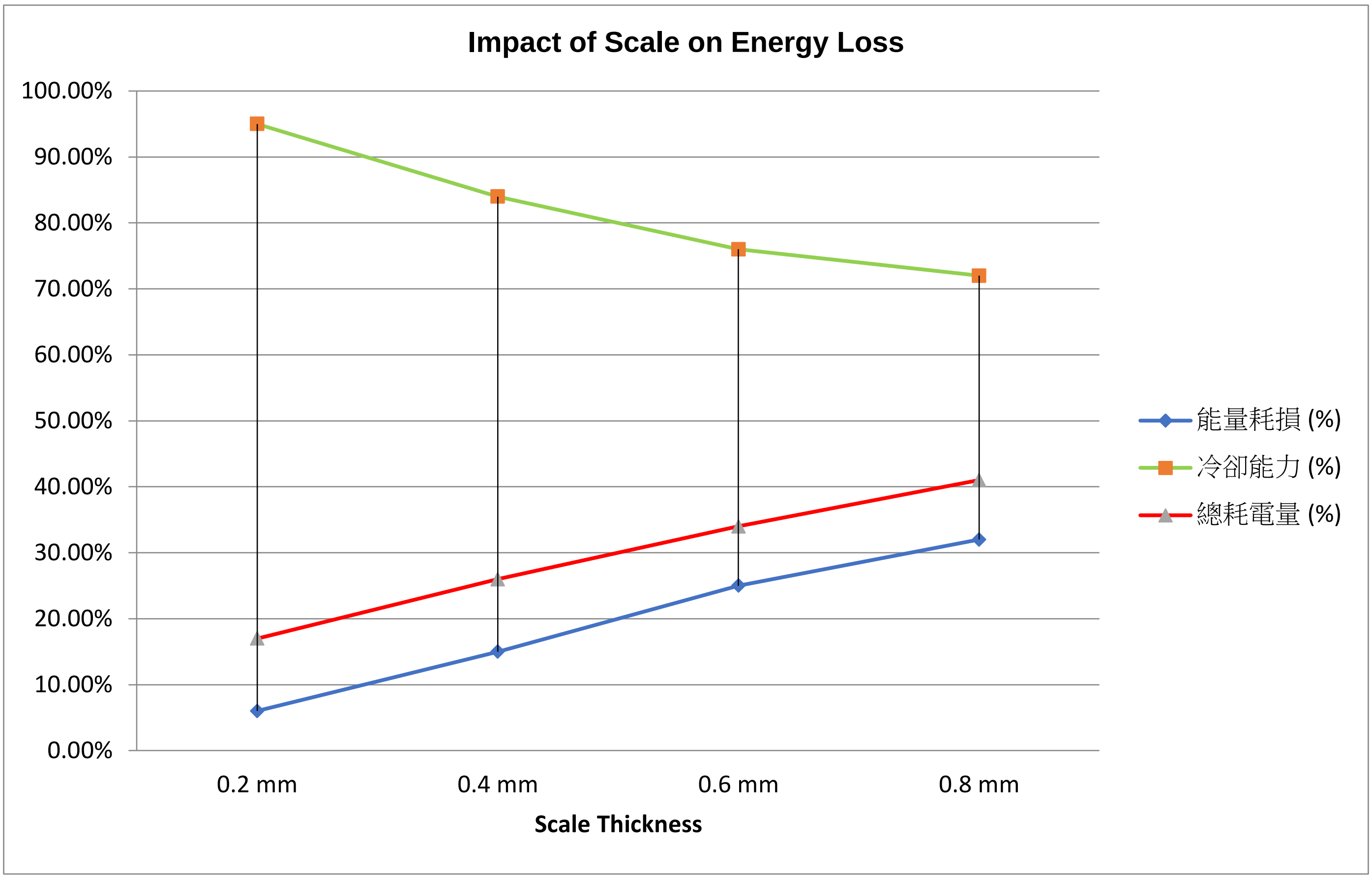
According to analysis by the Energy Technology Service Center of the Industrial Technology Research Institute, the impact of scale on heat transfer efficiency and power consumption is as follows:

Energy Loss Table

Source：財團法人中國技術社能源技術服務中心

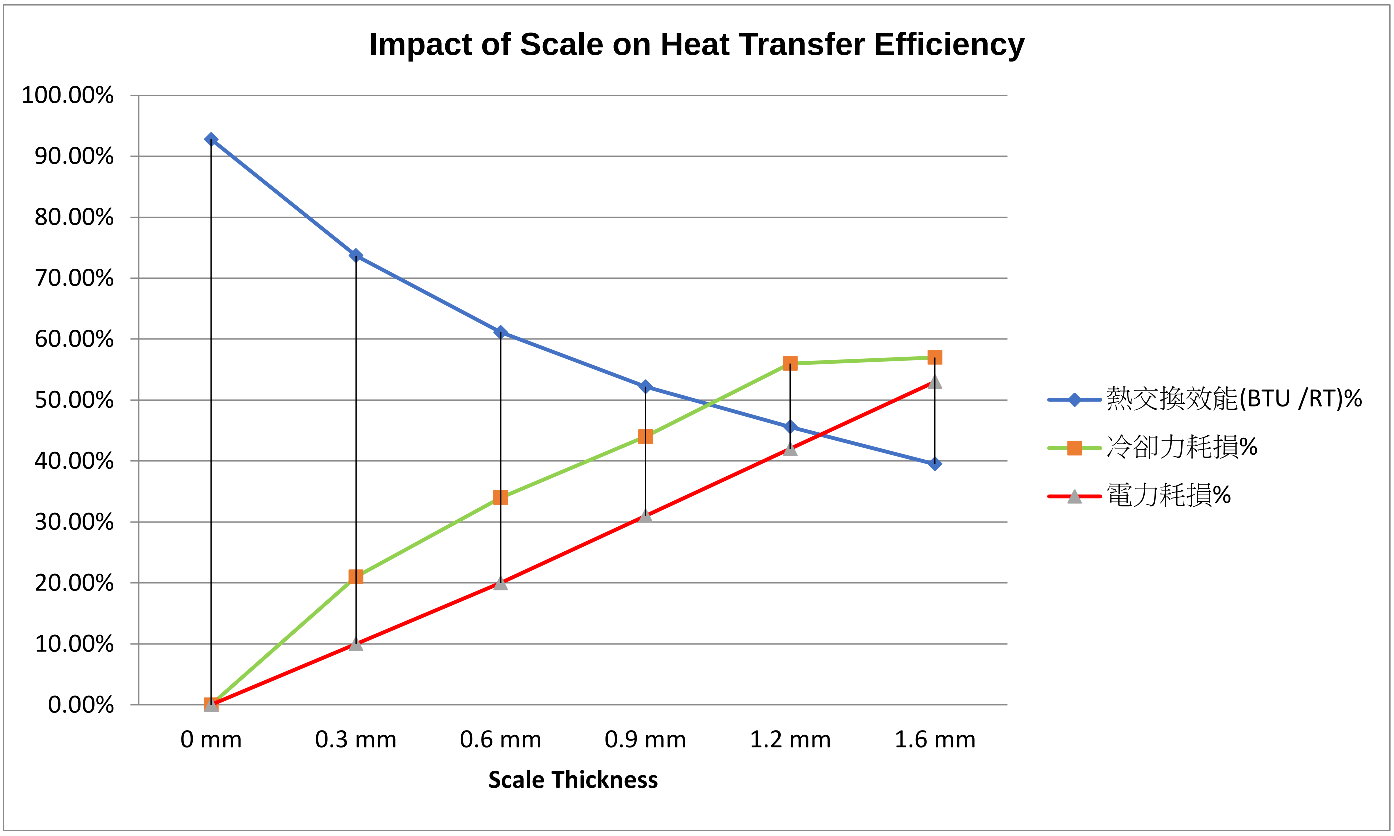
Scale Thickness（mm）	Energy Loss（%）	Cooling Capacity（%）	Total Power Consumption（%）
0.2 mm	+ 6%	95%	+ 7~17%
0.4 mm	+ 15%	84%	+ 16~26%

0.6 mm	+ 25%	76%	+ 26~34%
0.8 mm	+ 32%	72%	+ 31~41%



Regarding the impact of scale on heat transfer efficiency, Phillip Kotz Clean System has also conducted an analysis of performance effects. ：

Impact of Scale on Heat Transfer Efficiency Source: Phillip Kotz Clean System Approach to Air Conditioning Heating Piping Air Conditioning Journal			
Scale Thickness (mm)	Heat Transfer Efficiency (BTU /RT)	Cooling Capacity Loss	Power Consumption Loss
0 mm	92.77	0	0
0.3 mm	73.68	21%	10%
0.6 mm	61.12	34%	20%
0.9 mm	52.20	44%	31%
1.2 mm	45.60	56%	42%
1.6 mm	39.52	57%	53%



Scale has been recognized as one of the primary factors contributing to energy consumption. At present, there are two main approaches for scale removal:

1) Chemical Treatment Method

Chemical treatment for scale removal requires the installation of additional water treatment systems, chemical dosing equipment, and cleaning systems.

In this approach, makeup water is treated via ion exchange to remove hardness and salts. Scale inhibitors and corrosion inhibitors are then added into the circulating water. Regular system cleaning and backwashing are required, resulting in significant chemical and labor costs.

However, improper dosing can cause further issues:

- Excessive chemical dosing may corrode pipelines and equipment
- Insufficient dosing cannot effectively remove scale

In addition, chemical-laden wastewater discharged from the system may cause environmental pollution, which is not sustainable in the long term.

Chemical treatment can only slow down scale formation. It cannot fully remove existing deposits, nor can it prevent further scale growth. Therefore, chemical-based scale control is ultimately considered an outdated solution.

2) Physical Electrolysis Method

The physical electrolysis method uses high-frequency electrolysis to soften water and dissolve scale-forming substances such as calcium carbonate, calcium phosphate, and magnesium silicate. Calcium and other metal ions are removed through adsorption and electrochemical reactions without the use of chemicals. This restores water quality to acceptable standards.
This method does not corrode pipelines or equipment, and does not produce secondary environmental pollution through discharge.

The physical electrolysis method is therefore an environmentally friendly scale removal technology that supports:

- Energy saving
- Water conservation
- Carbon reduction

It fully aligns with ESG principles:

- Environmental (E)
- Social (S)
- Governance (G)
- SRD Technology Introduction

Galaxy Technology Development Co., Ltd. introduces an advanced physical electrolysis-based scale removal system, the SRD (Scale Removal Device), specifically designed for automatic scale removal in HVAC systems.
Scale formation in cooling tower piping significantly reduces the efficiency of chillers, heat exchangers, and related equipment. As scale accumulates, power consumption increases, leading to higher carbon emissions.

SRD Operating Principle

The SRD treats circulating cooling water through an electrolysis reaction chamber, converting dissolved minerals into solid calcium carbonate. The formed scale is automatically captured and collected in a storage tank.
Operators only need to periodically remove the crystallized calcium carbonate from the collection tank. The system is simple to operate.

Key advantages include:

- No chemical additives required
- No need for water discharge or system water replacement
- Significant water, energy, and carbon savings

SRD not only suppresses new scale formation but also removes existing deposits and completely prevents further growth.
This provides a sustainable solution for future generations and fully supports carbon neutrality goals by 2050 and ESG management principles.

Return on Investment

The cost of one SRD unit can typically be recovered within approximately 1.5 years.
After payback, the system eliminates the need for additional air-conditioning cleaning and maintenance costs, saving approximately millions in chemical and maintenance expenses annually.
The system can continue delivering cost savings for up to 15 years.

SRD Implementation Categories

SRD installation is divided into two major applications:

1) New HVAC Systems (Prevention Engineering)

For newly installed HVAC systems, SRD effectively prevents scale formation from the beginning.
Prevention is more effective than removal, allowing the system to maintain its original efficiency over time.
No chemical dosing systems or cleaning equipment are required, eliminating annual chemical costs entirely.

2) Existing HVAC Systems (Scale Removal Engineering)

For existing HVAC systems, SRD can be retrofitted to:

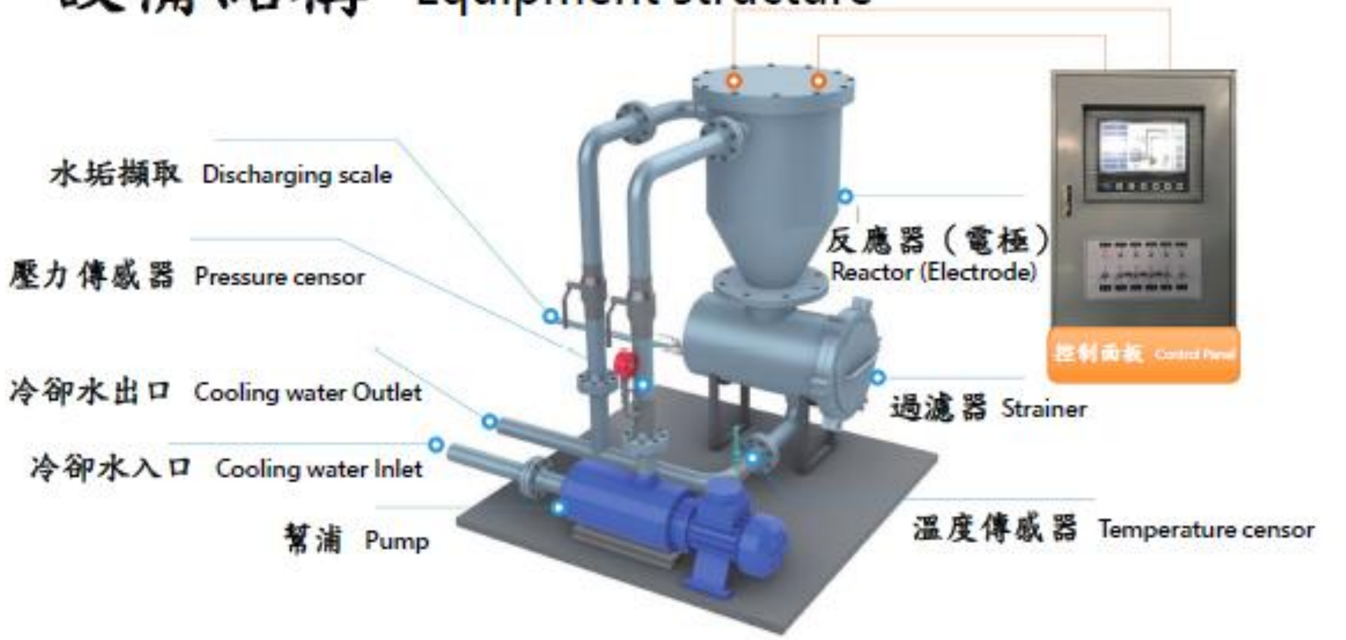
- Prevent new scale formation
- Remove existing scale in pipelines, cooling towers, and all accessible water pathways
- Restore and maintain system efficiency

Conclusion

Regardless of whether the system is newly built or already in operation, scale formation is unavoidable.
Prevention is always better than treatment. For new systems, SRD is the optimal solution. For existing systems, SRD effectively resolves scale problems and significantly reduces operating costs.
SRD is not only a technical solution, but also a financial tool that reduces expenses and improves

system performance.
We offer system evaluation services to assess your HVAC equipment and estimate SRD investment payback period and annual savings.
SRD is a high-efficiency system that delivers rapid ROI and continuous annual savings, eliminating the burden of expensive scale removal operations.

設備結構 Equipment structure



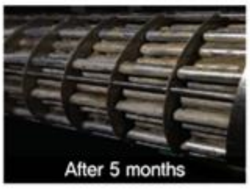
主要功能 Major function

規格 Specification

型號 Model	SRD-300A	SRD-500A	SRD-1000A
目標設施 Target Facility	Cooling tower 100~300RT	Cooling tower 400~600RT	Cooling tower 700~1200RT
處理能力 Treating capacity	7m³/hr	10m³/hr	20m³/hr
吸力/壓力高度 Suction/Pressure height	8M/13M (MAX)	8M/13M (MAX)	8M/19M (MAX)
輸入功率 Input power	Single phase AC220V / 60Hz	Single phase AC220V / 60Hz	Single phase AC220V / 60Hz
消耗功率 Power consumption	1.8~2.7kW (MAX)	1.8~2.7kW (MAX)	2.8~3.6kW (MAX)
電極壽命 Lifespan of electrode	3years(5A, 24hr/365d)	3years(5A, 24hr/365d)	3years(5A, 24hr/365d)
管徑 Pipe Diameter	Water inlet – 40A, Water outlet – 40A Drainage – 40A	Water inlet – 40A, Water outlet – 40A Drainage – 40A	Water inlet – 50A, Water outlet – 50A Drainage – 40A
尺寸 Dimension	W:960 / L:1150 / H:1250	W:940 / L:1500 / H:1250	W:940 / L:1640 / H:1440
重量 Weight	310kg	380kg	440kg

eSPC運行後熱交換器(內冷卻器)的水垢狀態
Scale status of the heat exchanger (inter cooler) after eSPC operation

顯示在未進行設備清潔的情況下清除表面水垢和附著物的狀態
shown the status of being removed scale and slime on the surface without equipment cleaning



eSPC運行後冷卻塔上層水垢狀態
Scale status of the upper tank in the cooling tower after eSPC operation

顯示去除表面水垢和附著物的狀態
shown the status of being removed scale and slime on the surface

eSPC運行後冷卻塔鰭片的水垢狀態
Scale status of the filler in the cooling tower after eSPC operation

顯示去除表面水垢和粘附著物狀態
shown the status of being removed scale and slime on the surface