

Copeland joins hands with Nuotong Technology to provide innovative energy solutions

Helping Yinan Linuo Pharmaceutical build lighthouse factories

Project background

Policy trends

The Chinese Department of Resource Conservation and Environmental Protection* proposes a policy to accelerate the electrification and decarbonization of building energy use by promoting clean and low-carbon heating such as heat pumps, gas, biomass and geothermal energy according to local conditions. The Action Plan for Carbon Dioxide Peaking Before 2030 proposes to promote energy conservation and efficiency in key energy-consuming equipment by raising energy efficiency standards across the board with a focus on equipment such as pumps, compressors, transformers, heat exchangers and industrial boilers. With the accelerated implementation of carbon reduction requirements for buildings and policy support such as clean heating grants, the energy supply market is moving towards green, low carbon, high energy efficiency development.



* The Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy



Project status

Project introduction

In 2023, the People's Government of Yinan County and Shandong Linuo Pharmaceutical Co., Ltd. jointly built the Yinan Linuo Pharmaceutical Digital Intelligence Manufacturing Project, with plans to build a modernized and digitalized pharmaceutical production base. The project has a planned site of 435 acres, divided into two parts: the pharmaceutical and medical equipment industries, focusing on the pharmaceutical industry, and supplemented by commercial services and technology research and development. It strives to build high-level, internationalized digital intelligence pharmaceutical lighthouse factories, a highland for pharmaceutical innovation and R&D. Selected by the World Economic Forum, the industry considers lighthouse factories to represent the leading level of smart manufacturing and digitalization in the global manufacturing sector. If successful, the project is expected to realize China's pharmaceutical industry lighthouse factories' zero breakthrough, leading China's pharmaceutical industry to rise among the ranks of global advancement.

Project environment

In 2023, the lowest temperature in Yinan County, Linyi was -14°C, the highest temperature was 38°C, and in extreme weather, the nighttime temperature in the area reached as low as -20°C.

Energy requirements

Energy solutions for office heating and cooling systems, centralized water heating systems for workshops and steam systems.

Energy supply scheme

After repeated comparisons, the project eventually selected the energy supply scheme consisting of 50 air-source heat pump heating and cooling units, air-source heat pump water heaters and superhigh temperature heat pumps from Shanghai Nuotong New Energy Technology Co., Ltd. Nuotong Technology is the industrial outcome of the scientific and technological cooperation between Shandong Linuo Paradigma Co., Ltd. and Shanghai Jiao Tong University and is a social service platform dedicated to providing advanced new energy and low-carbon technologies. The company is committed to becoming a supplier of systematic thermal energy-saving solutions with high-temperature heat pumps and steam heat pumps as core products. It is dedicated to the research and development of high-temperature thermal energy above 90°C, and it can provide low-carbon and green-distributed industrial steam equipment and comprehensive energy system solutions for our customers.





Challenges

Technical requirements (simultaneous, stable supply of hot and cold loads throughout the year with limited space and significant temperature differences)

In 2023, the lowest temperature in Yinan County, Linyi, where the Yinan Linuo Pharmaceutical Project is located, reached -14°C , the highest temperature reached 38°C and the nighttime temperature around the plant could be as low as -20°C in extreme weather. In this environment, aerial garden-style buildings for indoor living and tropical plant cultivation in the project are susceptible to air temperatures, with a significant temperature difference between day and night. Therefore, the project must equip it with a cooling and heating system to maintain a constant temperature ($\sim 26^{\circ}\text{C}$) throughout the seasons.

The project needs to ensure stable operation of the compressor throughout the year at temperatures as low as -20°C . The heating capacity of traditional heat pumps is usually much higher than the cooling capacity (the nominal cooling capacity is about 80% of the heating capacity), so in the installation range required by the project, traditional heat pumps are unable to satisfy the demand for cooling loads of up to 500 watts/square meter in the summer while meeting the heat loads.

Lighthouse factory energy saving and carbon reduction requirements

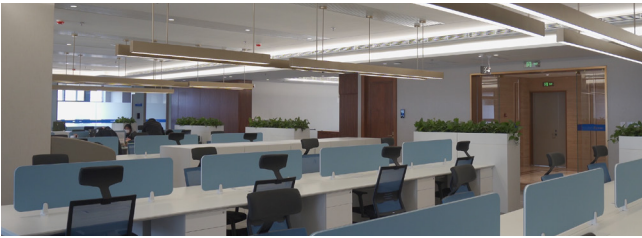
The Yinan Linuo Pharmaceutical Project was designed to create lighthouse factories. To be selected as a lighthouse factory, a company must meet the zero carbon standard and improve key performance indicators such as greenhouse gas emissions, waste reduction, water use reduction and energy efficiency. Only 153 factories were selected worldwide by the end of 2023. The competition for lighthouse factories is fierce. Therefore, the project calls for decarbonization in the use of heat sources in the production process of the pharmaceutical factory so that the energy savings and carbon reduction of the factory can reach the advanced level of the industry. If successful, the project will become the first lighthouse factory in China's pharmaceutical industry, leading China's pharmaceuticals to rise among the ranks of the world's advanced pharmaceutical companies.

Superhigh temperature requirements:

In the industry, the maximum outlet water temperature is 60°C for conventional heat pumps and 90°C for cascade heat pumps, while Yinan Linuo Pharmaceutical requires the project to be able to supply a steady supply of saturated steam at 150°C for production through heat pumps.

Solutions

In response to the project's difficulties, Nuotong Technology worked with Chongqing Pharmaceutical and the Medical Industry Design Institute to classify and manage the use of heat sources in the factory. Nuotong Technology, Chongqing Pharmaceutical and the Medical Industry Design Institute classified the heat sources of the factory into three levels, namely, conventional daily hot water, cooling and heating supply, centralized heating, and steam for production. They achieved a distributed energy supply in the entire temperature range of low-temperature (room temperature), medium temperature, high-temperature and super-high temperature.



At low-temperature (room temperature, outlet water temperature below 60°C), the project specially designed a heat and cool balanced air-source heat pump heating and cooling unit (170 kW) based on Copeland's ZW286 compressor to heat and cool the factory's operation center and aerial garden-style building.



Copeland ZW286 Compressor

At medium-temperature (outlet water temperature of 90°C), the project uses 28 air-source heat pump water heaters equipped with Copeland ZW150 compressors for centralized heating. In this project, the ZW150 is designed for a temperature of 80 degrees, which is well suited for high-temperature hot water and drying and dehumidifying heat pump systems.



Copeland ZW150 Compressor



At high-temperature and superhigh-temperature (outlet water temperature above 100°C), the project uses Copeland’s ZW650 superhigh-temperature heat pump compressor and a Nuotong Technology’s T6000 vapor compression unit to help the heating unit stably supply saturated steam at 150°C. In the project, Copeland’s ZW650 compressor produces steam at 110°C or more. With Nuotong Technology’s T6000 vapor compression unit, the temperature of the saturated steam raised to 150°C and achieved the supply of 2 tons of 150°C saturated steam per hour.

- The ZW650 compressor is Copeland’s superhigh-temperature heat pump solution for industrial users. Its outstanding advantage is that it raises the maximum condensing temperature to 135°C, which significantly expands the compressor’s operating range, making it suitable for a wide range of industrial applications above 100°C. It can satisfy the demand of a wide range of industrial heat sources, including high-temperature hot air, hot water and steam.
- The ZW650 compressor is equipped with Copeland’s EVI scroll heating technology, which improves the heating capacity by 25% and the heating efficiency by 10%. It ensures the system has excellent performance and high reliability, which is quite an efficient, reliable and environmentally friendly solution in the field of superhigh-temperature industrial heat pump applications at this stage.

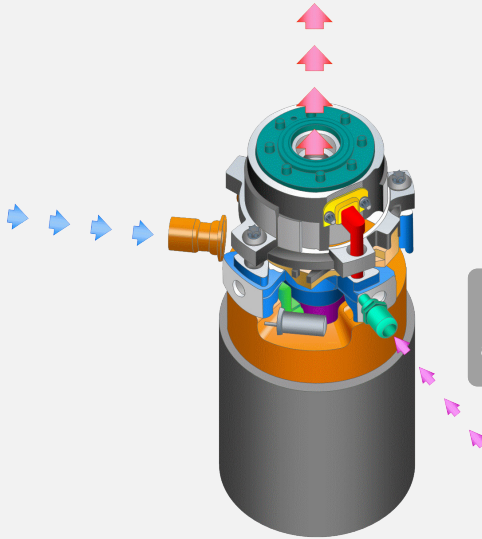
Copeland 120°C Superhigh Temperature Heat Pump integrated solution equipped with Copeland ZW650 Compressor



Copeland ZW650 compressor rated performance

Condensing temperature (°C)	120
Evaporating temperature (°C)	50
Suction superheat (K)	5
Subcooling (K)	10
Surrounding temperature (°C)	35
Heating capacity (kW)	67,4
Input power (kW)	21.2
HCOP (W/W)	3.2

EVI (Enhanced Vapor Injection) Scroll Heating Technology



Create a second suction port in the scroll, increase refrigerant flow through the second suction circuit and increase the enthalpy difference of the main circulating refrigerant.

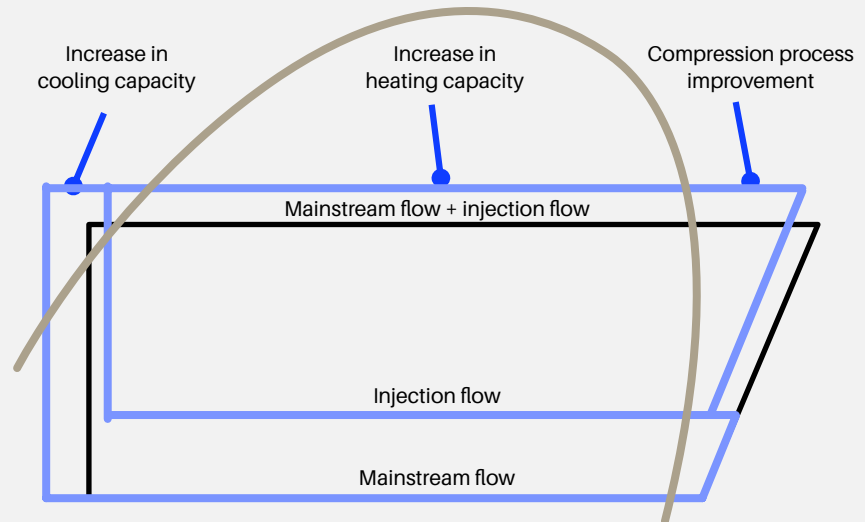
Medium-pressure refrigerant for additional injection

20% more refrigerant circulation

2 compressions with 1 compressor

Improve cooling and heating efficiency

— EVI Modular Refrigerant Circulation
— Conventional Modular Refrigerant Circulation



Paired with the Copeland ZW650 compressor, the twin-screw vapor compressor T6000, developed, designed and manufactured by Noutong Technology, is used to raise the saturation temperature of steam. The advantages of the T6000 are as follows:

- **High-temperature heating:** The T6000's pressure ratio reaches 10, which means that it can compress up to 1 kgf of steam to 10 kgf, and compress 100
- **Pure steam:** The T6000 is an oil-free compressor with a stainless-steel design, patented seals and isolation to ensure the purity of incoming and outgoing steam.
- **Wide range of applications:** The T6000 can be used in multiple scenarios such as steam pressurization and industrial gas compression.
- **High-economic benefits:** The T6000 pressurization cost is low, and it can supply 1 ton of 140°C steam for as low as 40 RMB.

Results

Meeting stringent technical requirements

Nuotong Technology, together with Copeland's ZW286 compressor, specially designed a heat and cool balanced heat pump to provide a customized solution for the aerial garden building in Yinan Linuo Pharmaceutical. Through the Copeland ZW286 compressor, equipped with Enhanced Vapor Injection (EVI) technology, the heat pump heating is strong, the minimum evaporating temperature is -35°C and the condensing temperature is 50°C . This means that at the lowest ambient temperature of -30°C , the outlet water temperature can reach 45°C , making it easy to ensure that building heating can cope with cold and wet weather.

In addition, the Copeland ZW286 compressor uses R410-A. Its high-pressure and high-density allow the refrigerant tube diameter to be significantly reduced, and the compressor size and displacement are also greatly reduced. At the same time, its excellent thermal conductivity, low-pressure loss and high-compression efficiency can improve system efficiency. According to Nuotong Technology's calculations, the cooling capacity and heating capacity of the customized heat pump solution equipped with the Copeland ZW286 compressor reaches more than 160 kW, a cooling capacity that is 20% higher than that of conventional heat pumps, which successfully solves the cooling and heating needs of factories with large temperature differences in a limited range of space.

Stable and efficient energy supply over the entire temperature range

The Copeland ZW series scroll compressors for heat pumps help heat pumps break through the traditional 80°C heating limit and raise the outlet water temperature to over 130°C . While improving the heat pump's heating efficiency, it meets Yinan Linuo Pharmaceutical's need for energy supply in the full temperature range from low-temperature (room temperature), medium-temperature, high-temperature and super high-temperature.

At low-temperature, Nuotong Technology's energy supply units equipped with Copeland ZW286 compressors help the pharmaceutical factory's operation center and sunroom to maintain an overall



temperature of 26°C throughout the year, successfully meeting the constant temperature demand under large temperature differences. At medium-temperature, equipped with Copeland ZW150 Compressors, Nuotong Technology's energy supply units stably supply 75°C hot water to the centralized water heating system for workshops. At superhigh-temperature Copeland's ZW650 heat pump compressor works together with Nuotong Technology's T6000 vapor compressor to meet the superhigh-temperature requirements of the Yinan Linuo Pharmaceutical's steam system, achieving a stable supply of 2 tons of 150°C saturated steam per hour.

Significant energy and carbon savings

Energy supply units equipped with Copeland ZW series scroll compressors for heat pumps helped the project achieve significant energy and carbon savings in the management of the factory's heat source, meeting the customer's need in creating lighthouse factories and zero-carbon factories:

- Distributed energy supply reduces pipeline resistance losses along the steam transportation process, reducing pipeline resistance losses from 10% to less than 2%.
- Distributed energy supply realizes corresponding temperature needs and gradient utilization, gives full play to the advantages of heat pumps and reduces heat energy wastage. The operating costs can be reduced by up to 50% as compared to the original centralized steam supply.
- The Enhanced Vapor Injection (EVI) function equipped with Copeland ZW series compressors not only increases the heating capacity of the system, but also improves the energy efficiency of the heat pump system through economizer heat transfer, thus making the project's energy saving more efficient.

Feedback from Nuotong Technology

- **Technology:** Copeland enjoys a technological advantage within the scroll compressor industry in China, especially at high-temperatures. The Copeland ZW650 compressor is two to three years ahead of the industry, and there is no proven product to compete with it.

Product

- **Stable and reliable:** As the core of heat pumps, the Copeland ZW series scroll compressors for heat pumps have stood up to the test in this operation. Copeland's ZW650 compressor has zero failure and never broken down in Nuotong Technology's three years of experience with it. This high-level of "zero error" performance has been highly praised by Nuotong Technology and customers as an ideal solution for super-high temperature heat pump applications.
- **Completed solutions:** Copeland has solutions covering the full temperature range of low (room temperature) - medium - high - superhigh temperatures in its heating products, which can fully satisfy customers' overall thermal management application needs.

Services

- Copeland's integrated solutions can provide product and technical support and product promotion resources support throughout the development cycle, thus helping customers significantly save development cycle and R&D costs and prompting the rapid market application of the product. Each of Copeland's solutions has undergone rigorous testing and validation to ensure the durability and reliability of the operation. With the support of the system integration team, Copeland provides customers with one-stop purchasing services to help solve application needs in different scenarios.

Yinan Linuo Pharmaceutical customer feedback

Yinan Linuo Pharmaceutical is very satisfied with the overall operation of the project. The products and solutions of the project satisfy the pharmaceutical factory's needs for building a lighthouse factory and zero-carbon factory, as well as their production energy needs. In addition, the customer is also very satisfied with the project's overall economic benefits and the realization of low-carbon environmental protection and energy supply goals. In the future, Yinan Linuo Pharmaceutical will apply for a lighthouse factory according to the requirements, and we look forward to the birth of the first lighthouse factory in China's pharmaceutical field.



Contacts

Asia Pacific

Tel: (852)28663108
Fax: (852)25206227

Shanghai

Tel: (86-21) 33387333
Fax: (86-21) 33387330

Guangzhou

Tel: (86-20) 85955188

Qingdao

Fax: (86-532) 81637267

Taiwan

Tel: (8862) 81617688
Fax: (8862) 81617614