

## 稀有金属高温熔炼炉水冷变压器

# Water-cooled Transformer for Rare Metal High Temperature Smelting Furnace

### ■ 产品概述(Product Introduction)

高温合金是指以铁、镍、钴为基，能在600℃以上的高温及一定应力作用下长期工作的一类金属材料；具有较高的高温强度，良好的抗氧化和抗腐蚀性能，良好的疲劳性能、断裂韧性等综合性能。高温合金可以按基体组织材料划分为铁基高温合金、镍基高温合金和钴基高温合金。

研发应用中，高温合金一般按制备工艺划分成铸造高温合金、变形高温合金和其他几类新型高温合金（粉末冶金高温合金、弥散强化高温合金ODS等），其工作温度范围-253~1320℃。高温合金是具有良好的力学性能和综合的强韧性指标，具有较高的抗氧化、抗腐蚀性能的一类合金。按其热处理工艺可分为固溶强化型合金和时效强化型合金。铸造高温合金是指可以或只能用铸造方法成型零件的一类高温合金。由于可不必兼顾其变形加工性能，合金的设计可以集中考虑优化其使用性能。如对于镍基高温合金，可通过调整成分使γ结构含量达60%或更高，从而在高达合金熔点85%的温度下，合金仍能保持优良性能。此外，相比变形高温合金，它有更广阔的应用领域。

公司研发的稀有合金高温炉专用水冷变压器整机容量2150kVA的变压器分为14个安装单元，分别布置到炉体顶面和侧面，整机安装高度达到4.5米，对抗震结构提出了很高的要求。为了保证高温炉的调温要求，水冷变压器要具备原边大范围调压功能，经过精确的电气参数设计计算和科学的结构设计，在保证产品的电气性能优良的前提下，高压线圈采用自冷箔式结构，低压线圈采用水冷铜管式结构，整体线圈为同心式分布轴向压装，既降低了器身高度，且保证高效的散热。



High-temperature alloy refers to a type of metal material based on iron, nickel, and cobalt that can work for a long time under high temperatures above 600°C and certain stress. It has high high-temperature strength, good anti-oxidation and anti-corrosion properties, and good fatigue performance and good fracture toughness. High-temperature alloys can be divided into iron-based high-temperature alloys, nickel-based high-temperature alloys and cobalt-based high-temperature alloys based on matrix structure materials.

In research and development applications, high-temperature alloys are generally divided into cast high-temperature alloys, deformed high-temperature alloys and other types of new high-temperature alloys (powder metallurgy high-temperature alloys, dispersion-strengthened high-temperature alloys ODS, etc.) according to the preparation process. Their operating temperature range is -253 ~ +1320°C. High-temperature alloys are a type of alloy with good mechanical properties, comprehensive strength and toughness indicators, and high oxidation resistance and corrosion resistance. According to its heat treatment process, it can be divided into solid solution strengthened alloy and age strengthened alloy. Cast high-temperature alloys refer to a type of high-temperature alloys that can or can only be formed by casting methods. Since there is no need to consider its deformation processing performance, the design of the alloy can focus on optimizing its performance. For example, for nickel-based high-temperature alloys, the composition can be adjusted so that the γ structure content reaches 60% or higher, so that the alloy can still maintain excellent properties at temperatures up to 85% of the melting point of the alloy. In addition, it has a wider application field than deformed high-temperature alloys.

Our company developed a special water-cooled transformer for rare alloy high-temperature furnaces. The transformer has a total capacity of 2150kVA. The transformer is divided into 14 installation units, which are respectively arranged on the top and side of the furnace body. The installation height of the whole machine reaches 4.5 meters, which puts forward high requirements for earthquake-resistant structures. In order to ensure the temperature regulation requirements of the high-temperature furnace, the water-cooled transformer must have a wide-range voltage regulation function on the primary side. Be guaranteed the excellent electrical performance, after accurate electrical parameter design calculations and scientific structural design, the high-voltage coil adopts a self-cooling foil structure, the low-voltage coil adopts a water-cooling copper tube structure, and the overall coil is concentrically distributed axially press-fitting, which not only reduces the height of the device but also ensures efficient heat dissipation.

### ■ 产品特点(Product Feature)

1. 选用进口杜邦公司N0mex-T410绝缘材料，保证绝缘和耐温特性，铜管单螺旋裸管抛光，保证散热和美观。高、低压线圈分别采用箔式层式和水冷铜管式结构，低压线圈为多单元并联式分布轴向压装，降低线圈高度、保证高效的散热。高压侧调压抽头用铜排轴向引出
2. 铁芯内置水冷换热器，强化铁芯散热能力。采用30Q120高导磁硅钢片，同时采用先进的多级步进多级叠片方式，有效降低了空载损耗、空载电流和噪声。在设计、制造过程中较好地消除了变压器大电流漏磁涡流引起局部发热问题，产品具有极高的可靠性
3. 变压器“三防漆”处理（防盐雾、防湿热、防霉菌），装饰性、耐腐蚀性、保光性、保色性、流平性和遮盖力较好，结构简化，外形美观。整流变压器配温度保护装置，用于测量、控制、保护、通讯
4. 根据水冷散热特性，合理分配水冷管路水流量，达到最佳冷却效果。水系统管路设计安全可靠，主管路采用铜管路，满足防腐要求，出水嘴采用国际标准的密封螺纹，有效防止渗漏。分支连接管路采用耐高温尼龙纤维与橡胶符合管路或聚四氟乙烯管路，保证可靠的耐高温耐压耐久性
5. 整机满足IP56等级的防护要求

1. Imported DuPont N0mex-T410 insulation material is selected to ensure insulation and temperature resistance. The single spiral bare copper tube is polished to ensure heat dissipation and beauty. The high and low voltage coils adopt foil layered and water-cooled copper tube structures respectively. The low voltage coil is multi-unit parallel distributed axial press-fitting, which reduces the height of the coil and ensures efficient heat dissipation. The pressure regulating tap on the high voltage side is led out axially with a copper bar
2. The iron core has a built-in water-cooled heat exchanger to enhance the heat dissipation capacity of the iron core. It adopts 30Q120 high magnetic permeability silicon steel sheet and advanced multi-stage stepping multi-stage lamination method to effectively reduce no-load loss, no-load current and noise. During design and manufacturing, local heating problems caused by large current leakage magnetic eddy currents in the transformer have been eliminated, and the product has extremely high reliability
3. The transformer is treated with "three-proof paint" (anti-salt spray, anti-humidity and heat, and anti-mold). It has good decorative properties, strong corrosion resistance, good gloss retention, good color retention, good leveling and hiding power, simplified structure and beautiful appearance. The rectifier transformer is equipped with a temperature protection device for measurement, control, protection and communication
4. According to the water-cooling heat dissipation characteristics, reasonably distribute the water flow in the water-cooling pipeline to achieve the best cooling effect. The water system pipeline design is safe and reliable. The main pipeline uses copper pipelines to meet anti-corrosion requirements. The water outlet uses international standard sealing threads to effectively prevent leakage. The branch connecting pipes are made of high-temperature resistant nylon fiber and rubber-compatible pipes or polytetrafluoroethylene pipes to ensure reliable temperature and pressure resistance and durability
5. The whole machine meets the protection requirements of IP56 level