

First Batch of Domestic TOP TENs List

China BAT List

BAT1: Foundry metal stress relief technology

1. Technical principle

Spectrum harmonic based stress processing technique is to perform Fourier analysis on metal workpieces, to detect harmonic frequencies within 100Hz, applies adequate energy at multiple detected harmonic frequencies to vibrate, generates multi-directional dynamic stress, superimposed with multi-dimensional distributed residual stress. It creates a plastic yielding effect, thereby reducing the peak residual stress and homogenizing the residual stress distribution as well. By applying this technology, it no longer needs heat treatment of the metal workpiece, and the residual stress

can be eliminated, thereby saving energy.

2. Main technical specifications

The Fourier spectrum analysis of the metal workpiece can detect 5 resonant frequencies and 2 spare resonant frequencies. The other vibration parameters are adjusted automatically by the vibration equipment except that the excitation force is adjusted to ensure two maximum vibration acceleration values of $30\sim70\text{m/s}^2$. The vibration frequency is below 6000rpm, with low noise. The maximum exciting force can reach 80kN.

3. Energy saving effects

Compared with traditional TSR (Thermal Stress Relief), this technology has energy saving more than 95% on average. Compared with sub-resonant VSR (Vibration

Stress Relief) technology, the application area of spectrum harmonics-based stress relief technology reaches more than 90%, while the application area of the former is only 23%.

4. Application areas

This technology can be widely used to eliminate the residual stress of metal workpieces after casting, forging, welding, cutting, etc.. It is mainly used for stress relief of small, light and thin-walled metal workpieces, and can also be used for stress relief of some large structural parts.

BAT2: Waste energy recovery technology in the metallurgical industry using a coaxial drive turbine unit

1. Technical principle

Blast furnace Power Recovery Turbine unit (BPRT) and Sintering blower residual Heat Recovery Turbine (SHRT) refers to the combination of blast furnace blower and gas turbine into one unit, and the energy recovered by the gas turbine directly drive the blast furnace blower. At the same time, the original motor-driven sintering blower and sintering residual heat power generation system are modified, and the main blower is jointly driven by the steam turbine and the electric motor. Both BPRT and SHRT eliminate power generators, power generation and distribution systems, and merge auto control, lubricating oil, and power oil systems, avoids energy losses caused by energy conversion, improves energy efficiency, reduces environmental pollution, and reduces product costs.

2. Main technical specifications

BPRT main Specifications: Blast furnace gas flow:

500,000 Nm³/h. Inlet pressure: 150kPa. Gas turbine speed: 3000rpm ~ 3600rpm. Output power: 100MW. SHRT main Specifications: sintering circular cooling system: 220m². Configures 5000kW residual heat recovery steam turbine. sintering main blower flow rate 22000m³/min. motor: 8000kW, residual energy utilization efficiency increased by 5%.

3. Energy saving effects

Compared with blower unit, the average energy saving efficiency of BPRT technique is more than 50%. compared with the original sintering main blower, the average energy saving efficiency of SHRT unit is more than 60%.

4. Application areas

This technology can be widely used in the field of joint applications of waste heat & waste pressure power recovery and mechanical driving system, which is applicable for metallurgy, coal chemical industry and other industries.

BAT3-1: Industrial Low Grade Waste Heat Recovery: Slag water waste heat recovery blast furnace

1. Technical principle

The direct heat exchange waste heat recovery technology of blast furnace slag water adopts a special slag water heat exchanger to realize the 60°C~90°C blast furnace slag water directly enters the heat exchanger, heats the heating water without filtering, which is used for heat supply, thereby reducing coal consumption and pollutant

emissions, to achieve the purpose of energy conservation and emission reduction. After cooling, the slag water continues to circulate slag flushing. For the slag flushing processes such as INBA, Jiaheng, and Minte with cooling towers, the cooling tower can be closed to further save power and water consumption. And for the slag flushing processes without cooling towers, after the slag water being cooled, the evaporation of the slag water is reduced, which can reduce the water consumption.

2. Main technical specifications

Per ton of iron output, can be equipped with a heating area of 0.4~0.6 m², energy saving 5~7.5 kg of standard coal, water saving 40.0~57.6 kg, power saving 0.3~0.4 kWh. the slag water no need to be filtered.

3. Energy saving effects

At present, the iron output is about 710 million tons in China, the slag iron ratio is 350 kg, and the waste heat resources from slag flushing are equivalent to about 15.3 million tons of standard coal. In which, iron output in the north accounts for 63.5% of the total output, and 36.5% in the south. With the increasing demand for central cooling and heating in China, there is a broad market prospect for the direct heat exchange waste heat recovery technology of blast furnace slag water. Estimated by the promotion of this technology in 50% of the applicable production capacity, it'll achieve an annual energy saving of 2.22 million tons of standard coal and 4.9 million tons of carbon dioxide emissions reduction.

4. Application areas

This technology is suitable for the recovery and utilization

of waste heat from blast furnace slag water during production processes such as ironmaking and copper smelting. It is more meaningful to be promoted especially in north China where has demands of central heating.

BAT3-2: Industrial Low Grade Waste Heat Recovery: Thermoelectric coordinated central heating technology

1. Technical principle

The thermoelectric coordinated central heating technology is to improve heating capacity, reduce heating energy consumption, realize energy conservation by recovering waste heats, including specially developed absorption heat exchange units and waste heat recovery dedicated heat pump units. In the thermal station of the cogeneration central heating system, the heat pump heat exchange unit replaces the conventional water-to-water heat exchanger, which greatly reduces the return water temperature of the primary network to about 20°C. The heating water is heated to 130°C by waste heat recovery dedicated heat pump unit of the thermal power plant (recovering waste heat from steam turbine condenser exhaust steam in power plant) and peak heaters by cascade style, and then supplied. During the operation, a heat storage device is installed in thermal station, so that the heat pump can fully utilize the valley power to maintain the required return water temperature in primary network. A heat storage tank is installed in thermal power plant to maintain heating supply capacity and stable waste heat recovery, and the on-grid power of generator units can be adjusted within the range of 60%-100%.

of the rated value,alleviating the problem of peak load regulation difficulties of the power grid in winter. The key technologies mainly include heat pump heat exchange units and heat pump waste heat recovery units of power plant as the core.

2.Main technical specifications

Compared with the conventional cogeneration system,the heating capacity is increased by 30%-50%,and the heating network transmission capacity is increased by 60%-80%,which can realize long-distance heating supply. For the new built large-scale heating network,the construction investment can be reduced by more than 30%.

3.Energy saving effects

Compared with conventional thermal power plants,the energy consumption of heating supply is greatly reduced,the energy-saving effect is nearly 50%. If this technology is promoted in central heating area of 300 million m²,it will have energy saving 1.2 million tons of standard coal annually.

4.Application areas

This technology is applicable for central heating area,to replace small and medium-sized coal boilers,is an effective way to solve the shortage of heating sources in northern cities in winter.

BAT4: Cement suspension preheating and calcining technology with high solid-gas ratio

1.Technical principle

The cement suspension preheating and calcining technology with high solid-gas ratio is to improve the internal solid material and airflow mass ratio of the system to achieve the effects of improving the thermal efficiency of the system and enhancing the thermal stability of the system,which is an original processing technique,has comprehensive benefits of energy conservation,production increasing,quality improvement,and emissions reduction,consists of suspension preheaters with high solid-gas ratio and external circulation reactor with high solid-gas ratio. The high solid-gas ratio suspension preheater adopts parallel double series airflow and cross one-way material flow to complete gas-solid heat exchange,improves the contact area between solid material and hot gas and the times of gas-solid heat exchange,which greatly improves the heat transfer efficiency and significantly reduces the gas temperature of preheater exit. The external circulation reactor with high solid-gas ratio makes unburnt or incompletely reacted coarse particulate return to the reactor many times,which greatly improves solid-gas ratio and the residence time of the material in calciner,makes the raw material reaction rate close to 100 %. This technology is jointly configured with grate coolers and process control technology,achieves a better integration effect.

2.Main technical specifications

Compared with the ordinary five-stage preheating and pre-calcining technology,the exhaust gas temperature is reduced by 20%,the exhaust gas volume is reduced by 20%,and the emissions of SO₂ and NO_x are reduced by more than 50%.

3.Energy saving effects

Compared with the ordinary five-stage heat exchange technology, the production capacity is increased by 40%. the coal consumption per ton of cement clinker is reduced by 16kg, the power consumption is reduced by 13%, and the energy saving rate is above 10%.

4. Application areas

This technology is applicable for the calcination of cement clinker and applied to heat exchange and reaction engineering of powder.

BAT5-1: Data Center Energy conservation: Data Room Smart Direct-Cooling Technology

1. Technical principle

The Data Room Smart Direct-Cooling Technology innovated applies the natural phase change circulating technology of the refrigerant to the cabinet-level cooling of the data center, which generates a pressure difference in the form of temperature difference, drives the natural phase change circulate flow of the refrigerant, realizes no power heat exchange between indoor and outdoor of data room. At the same time, according to variances of refrigerant evaporation capacity, carries out real-time monitoring through self-developed energy efficiency management software and environmental maintenance system monitoring software to control the cooling capacity of the circulated refrigerant, realizes adaptive cooling capacity adjustment and cabinet-level temperature distribution control, significantly reduces power consumption of the air-conditioning in data room.

The technology also switches between air-cooling chiller units (mechanical refrigeration) and closed cooling towers (natural cooling sources) according to the outdoor temperature, to improve the utilization efficiency of natural cooling sources and reduce the mechanical power consumption of the air-cooling system, thereby greatly reduces data center's PUE value.

2. Main technical specifications

This technology can achieve a single cabinet cooling capacity of 20 kilowatts. The power saving rate of air conditioning of data centers using this technology reaches 50%-80%, can reduce the PUE value of data centers to 1.2-1.4.

3. Energy saving effects

Use a data center as an example, with an installed capacity of 1,000 kilowatts, annual operating time of 8,760 hours, compared with conventional precision air conditioners, this technology saves power of 3.504 million kWh each year, the power saving rate is 64.5%, which is equivalent to 2,628 tons of CO₂ emissions reduction.

4. Application areas

The technology is not limited by conditions such as climate, atmospheric environment, water resources, etc., and can replace the existing traditional cooling methods of data centers. It is applicable for the energy-saving transformation of the data room that is using traditional air conditioning in data centers.

BAT5-2: Data Center Energy Conservation: high temperature resistant valve-regulated sealed battery

technology for communication

1. Technical principle

High temperature resistant valve-regulated sealed battery for communication adopts lead-tin-based multiple alloy technology with independent intellectual property rights, positive 4BS seeding technology, unique carbon material additives and other technologies, achieves a breakthrough in the applicable temperature of battery products, which makes the battery normal use temperature increased to 35°C, and can be used at the extreme temperature of 75°C. Thereby, the air conditioning temperature setting of the base station for communication is increased by 10°C compared with that of the conventional base station, and the air conditioner operating time is reduced, the power consumption and investment cost of air conditioning can be reduced.

2. Main technical specifications

The product meets the technical requirements of IEC60896-2004 and YD/T799-2010 "Valve-regulated sealed lead-acid battery for communication" and YD/T 2657-2013 "High-temperature valve-regulated sealed lead-acid battery for communication". Under the working condition of environment temperature of 35°C, the designed floating charge life is ≥ 10 years. the battery can withstand the maximum working condition of environment temperature of 75°C. under the working condition of environment temperature of 55°C, the life cycle of 80% DOD is greater than 12 big cycles, and each big cycle contains eleven 80% DOD

discharge cycles.

3. Energy saving effects

Compared with conventional base stations, for the base stations equipped with high-temperature resistant valve-regulated sealed lead-acid batteries, the annual comprehensive energy saving rate is above 26%.

4. Application areas

This technology can be widely applied in the transformation of base station batteries for communications, and also can be used in fields such as solar energy storage and wind energy storage.

BAT6: Infrared Radiant Porous Ceramics Energy Saving Combustion Technology

1. Technical principle

Infrared Radiant Porous Ceramics Energy Saving Combustion Technology adopts full pre-mixed no-flame catalytic combustion technology, precisely controls the air-fuel ratio, achieves complete combustion and improves combustion efficiency. Heat is transferred by infrared radiation, it has a high temperature of the combustion front, and short transfer distance, greatly reduces the physical heat loss during the heat transfer process. The surface of the cooker adopts a high emissivity infrared coating, so that the infrared emission wavelength band of the coating and the infrared absorption wavelength band of the heated materials are matched as much as possible, which heat absorption efficiency is further improved. This technology uses ceramics to replace traditional high-energy-consuming

metal materials such as copper, Fe-Cr-Al alloy and nickel-chromium alloy to produce cookers, which can reduce manufacturing energy consumption and save a lot of metal materials.

2. Main technical specifications

The thermal efficiency is above 70%, the average emissivity of the infrared coating reaches 0.9, and the emission level of CO and NO_x is reduced by more than 30%.

3. Energy saving effects

Compared with the atmospheric type cooker, the average energy saving is more than 20%, each household can save 48 m³ of natural gas (equivalent to 64 kg of standard coal) per year. Due to infrared energy-saving cookers replacing traditional metal materials with high infrared emissivity porous ceramics, the manufacturing energy consumption of each cooker is reduced by 0.8 kg of standard coal.

4. Application areas

This technology can be fully promoted in the field of gas cooker production, which not only helps to reduce the energy consumption in the manufacturing process of cookers, but also greatly improves the energy utilization efficiency of gas cookers.

BAT7: Efficient New-type Membrane gap Ion Membrane Electrolysis Technology

1. Technical principle

Efficient New-type Membrane gap Ion Membrane

Electrolysis Technology designs the cathode assembly of the ion membrane electrolyzer as a flexible structure, so that the ion membrane is stably attached to the anode during the operation of the electrolyzer to form a membrane gap distance, reduces the ohmic drop of the solution (IR solution), realizes energy saving and consumption reduction. In the ion-exchange membrane electrolysis process, the cell voltage is an important technical indicator that affects the power consumption of electrolyzer, includes six parts: $V_{\text{cell}} = V_0 + V_M + V_{\text{Anode}} + V_{\text{Cathode}} + IR_{\text{solution}} + IR_{\text{Metal}}$ (IR solution is ohmic drop in the solution). Among them, V_{Anode} , V_{Cathode} and IR_{solution} have greater influences on the V_{cell} voltage.

2. Main technical specifications

Take NBZ-2.7 cell type of China national Bluestar (Group) Co., Ltd. as an example. The design current density is 6.0 kA/m², operating current density is 5.5 kA/m², unit cell voltage is 2.98 V, and DC power consumption is 2035 kWh per ton of caustic soda, concentration of caustic soda is 32% (mass fraction).

3. Energy saving effects

The cell voltage decreases by about 100 mV, the power consumption per ton of caustic soda decreases by about 70 kWh, for every 1 mm reduction of electrode gap. Compared with the traditional ion-exchange membrane electrolyzers, the distance between the anode and cathode of each pair of unit cells is 2 to 3 mm, adopts the membrane gap technology can reduce the DC power consumption per ton of caustic soda by 100-170

kWh. At present, the total production capacity of this technology is 12.15 million tons per year, which saves power by 1.58 billion kWh, reduces CO₂ emissions by 1.188 million tons per year.

4. Application areas

This technology can be used to renovate existing equipment, or increase new production capacity as well.

BAT8: Energy-saving technology of two stage screw air compressor

1. Technical principle

The two-stage ultra-high-efficiency screw air compressor is an integrated technical system that has a main engine of two-stage high-efficiency compression screw as the core, consisting of the air end, driving motor, driving system, air intake system, cooling system, oil filtering system, oil and gas separation system, and auto-control system, etc. components. The two-stage compression high-efficiency screw air end adopts the Y-type screw rotor profile technology and uses the two-stage compression principle, reduces the compression ratio of each stage. Through the unique inter-stage cooling design, makes the compression process approaching to the isothermal compression process with the most energy-saving level. It carries out comprehensive innovations to the spray cooling method, the compression ratio distribution at all levels, and the oil - gas separation technology, combined with the integrated structure design of the upper and

lower parts' overlap, cooperated with the whole process auto-control technology, to achieve the ultra-high-efficiency of air compressor.

2. Main technical specifications

The product reaches the level I energy efficiency of GB19153-2009 standard. has 15% of power saving than level II energy efficiency air compressor. 30% of power saving than level III energy efficiency air compressor.

3. Energy saving effects

Compared with conventional air screw compressors, the average energy saving is more than 20%.

4. Application areas

This technology can be widely applied in industries that use compressed air, such as machinery, steel, metallurgy, mining, electronics & electricity, and chemical etc., also can be used in pneumatic conveying fields in cement and textiles etc. industries.

BAT9: High-efficiency industrial pulverized coal Boiler

1. Technical principle

High-efficiency industrial pulverized coal Boiler system technology adopts multiple techniques such as precision pulverized powder supply, air staged combustion, and full-process auto-control etc., realizes efficient operation and clean emissions of coal boilers. Through the precision powder supply system, real-time adjustment of powder feeding, to ensure that

the pulverized coal fed into the furnace is stable and matches the oxygen supplying volume. adopts low-nitrogen combustion technologies such as air stages combustion, reduces the amount of nitrogen oxides in the furnace while ensuring pulverized coal burn-out rate. through the combustion control system, realizes automatic and stable load variation, optimizes excess air coefficient, improves combustion efficiency, saves energy. By using assistant methods such as instant power on or off and system frequency variable control to improve the overall energy efficiency of the system.

2. Main technical specifications

The combustion efficiency reaches more than 98%, boiler operating thermal efficiency reaches 88% - 92%. Comprehensive multi-stage combination of pollution removal technology, achieves exhaust smoke consists of dust $\leq 30\text{mg/Nm}^3$, $\text{SO}_2 \leq 100\text{mg/Nm}^3$, and $\text{NOX} \leq 200\text{mg/Nm}^3$.

3. Energy saving effects

Compared with conventional chain boilers, the energy saving rates of 40t/h (steam boiler) and 58MW (hot water boiler) pulverized coal boilers are 18.7% and 19.8%, respectively.

4. Application areas

This technology has low requirements for coal types, can use class III bituminous coal with a particle size of 200 mesh or less ($R_{75} \leq 15\%$). It is applicable for the replacement of traditional chain furnace, grate furnace and new buildings' heating supply, industrial heating and steam supply systems.

BAT10: Heat Pump Energy conservation: Two-stage heat pump technology

1. Technical principle

The air source heat pump technology based on the two-stage Vapor Enhancement frequency variable compressor is a technology that greatly improves the heat pump capacity through the operation of a single-compressor two-stage compression with Enhanced Vapor Injection and variable displacement ratio. The basic principles are: (1) The compression process is changed from one-stage compression to two-stage compression, which reduces the pressure difference of each stage, reduces the internal leakage of the compression chamber, improves the volume efficiency. (2) The exhaust temperature is reduced by the intermediate flashing replenishes vapor, the isentropic efficiency is improved, and the flow rate of the high-pressure refrigerant is increased, both of the heating capacity in the low temperature environment and the cooling capacity in the high temperature environment are improved. (3) Adopts displacement variable technology, realizes Two two-stage compression operation modes with variable displacement and variable displacement ratio, so as to achieve a greatly increase of cooling capacity/heating capacity and energy efficiency improvement under severe working conditions and high load, and energy efficiency enhancement under light working conditions and low load.

This technology broadens the application scope of heat pump air conditioners and air source heat pump water

heaters, greatly improves the heating/cooling capacity and energy efficiency level in the environment of -25°C to 54°C. It can be widely used in high temperature and low temperature districts for cooling and heating demands.

2. Main technical specifications

Compared with conventional air source heat pump technology, this technology increases the energy efficiency by 5%-10% under the rated heating (outdoor 7°C) condition. increases the heating capacity by 50%-100% and improves energy efficiency by 5%-20% in the environment of outdoor -20°C.

3. Energy saving effects

Compared with conventional air conditioners, this

technology saves power 16.3% annually. Compared with conventional heat pump water heaters, the air-source heat pump water heaters using this technology can save power 24% annually.

4. Application areas

This technology is highly adaptable to outdoor environment temperature and can be promoted and applied in most of districts. Mainly applied for heat pump air conditioners, multi-connected air conditioners, heat pump water heaters (machines), household floor heaters and other equipment in residences, offices, hotels etc. places. ■