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Energy saving directives for heat treatment

热处理节能技术导则

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1 Scope

This standard specifies the main energy-saving routes and measures to be adopted in heat treatment production, so as to avoid waste of energy and to ensure that energy is used sensibly.

This document is a guiding technical document for standardization of the People's Republic of China, approved by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 17 May 2002 and implemented on 1 December 2002.

2 Referenced standards

The provisions contained in the following standards constitute, through reference in this standard, provisions of this standard. At the time of publication the editions shown were valid. All standards are subject to revision, and the parties using this standard should investigate the possibility of applying the most recent editions.

GB/T 7232-1999, Terminology of heat treatment of metals

GB/T 17358-1998, Norms for electricity consumption in heat treatment production and methods for its calculation and determination

JB/T 50162-1999, Energy consumption grades of box-type and bogie-hearth resistance furnaces for heat treatment

JB/T 50163-1999, Energy consumption grades of pit-type resistance furnaces for heat treatment

JB/T 50164-1999, Energy consumption grades of salt bath furnaces for heat treatment

3 Definitions

Besides the definitions given in GB/T 7232, the following definitions apply in this standard.

3.1 thermal efficiency for heating equipment - the percentage ratio of the useful heat needed to heat the workpiece to the total heat consumed, when the heating equipment works at full load at a given temperature.

3.2 load rate of heating equipment - the degree to which the charge of the equipment occupies its rated output; it is usually expressed as the percentage ratio of the actual charge to the rated charge.

3.3 usefulness of the heating equipment - the percentage ratio of the number of days on which the heating equipment actually works in a year to the specified annual working days.

3.4 air coefficient - the ratio of the quantity of air actually supplied during combustion in the furnace to the quantity of air needed for theoretical complete combustion.

3.5 energy source for heat treatment - the fuels (solid, liquid and gaseous) and electrical energy that can serve as the heat source for heat treatment, together with the gases and liquid fuels used to prepare a controlled atmosphere.

4 Routes to energy saving in heat treatment

4.1 The greatest saving of heat treatment energy can be achieved through effective technique and management. 4.2 Heat treatment heating equipment should be used continuously and should work at close to full load. 4.3 Reduce the heat losses of the heating equipment and raise its thermal efficiency. 4.4 Recover and use the waste heat and the waste gas of combustion. 4.5 Fuel should be burnt completely under conditions as sensible as possible. 4.6 Adopt energy-saving heat treatment processes. 4.7 The enterprise should appoint a person to manage energy and should establish a sound management system.

5 Raising the load rate and the utilization rate of heating equipment

5.1 The production capacity of the heating equipment should suit the production programme of the enterprise. 5.2 The load rate of heat treatment heating equipment should not be lower than 50 %. 5.3 Heating equipment should be run in three continuous shifts and should keep an operating time of five days a week or more. 5.4 Single-piece and small-batch production, and parts whose heat treatment is very discontinuous, should be entrusted to a specialist works for cooperative processing.

6 Raising the thermal efficiency of electrically heated equipment

6.1 The thermal efficiency of resistance furnace heating (850 to 950 degrees C) shall not be lower than 35 %. Equipment that has served beyond its life, and whose thermal efficiency is lower than 35 %, shall undergo energy-saving refurbishment.

6.2 The thermal efficiency of resistance furnaces should be raised generally above 50 % by the following measures. 6.2.1 Improve the structure of the equipment and reduce the heat-dissipating area. 6.2.2 Use lightweight refractory brick in place of heavy brick. 6.2.3 Use ceramic fibre refractory material in place of refractory brick. 6.2.4 Use high-quality heat-resistant steel for fixtures, charge trays, retorts and similar components, so as to reduce their mass. 6.2.5 Improve the sealing of the equipment, avoid openings in the furnace wall so far as possible, and reduce the time for which the furnace door is open and the frequency with which it is opened.

7 Raising the thermal efficiency of fuel-fired heating equipment

7.1 Fuel-fired heating equipment should use high-quality fuel, for example producer gas, coke oven gas, blast furnace gas, town gas, natural gas, liquefied petroleum gas, light oil or heavy oil; each enterprise may choose according to local conditions. From the point of view of the environment and of convenience, natural gas is the most advantageous. 7.2 The thermal efficiency of fuel-fired heating equipment shall not be lower than 30 %.

7.3 Besides the measures listed in 6.2, the following methods of improving combustion are needed, so as to raise the thermal efficiency above 50 %. 7.3.1 Keep the air coefficient of combustion within the range 1.1 to 1.2. 7.3.2 Burners and radiant tubes shall meet the specified quality standard. 7.3.3 Use an automatic control system able to control the furnace temperature and the air coefficient strictly. 7.3.4 The burner shall suit the fuel, and changing the fuel without changing the burner is strictly forbidden. 7.3.5 Use combustion waste heat to preheat the air above 300 degrees C. 7.3.6 Burners and radiant tubes shall have an air preheating function. 7.3.7 Maintain and overhaul the burners regularly, so that they always keep a normal combustion state and the specified consumption level.

8 Energy-saving process measures achieving results with no or little investment

8.1 Correct the heating calculation coefficients of the various types of heating equipment by actual measurement, so as to shorten the heating time as far as possible. 8.2 For carbon structural steel and low-alloy structural steel, use non-uniform austenitizing quenching so far as possible, doing away with the holding time at temperature, that is, so-called zero-holding quenching. 8.3 Adopt accelerating measures for chemical heat treatment. 8.4 Use low-temperature heat treatment in place of high-temperature heat treatment. 8.5 Use

local (induction or flame) heat treatment in place of through heat treatment. 8.6 Use induction quenching of medium-carbon structural steel in place of carburizing and quenching. 8.7 Use the residual heat of forging for heat treatment so far as possible. 8.8 Use metallic materials that can undergo rapid heat treatment, such as rapid carburizing steel, rapid nitriding steel and low-hardenability steel. 8.9 Establish a strict overhaul and maintenance system for heat treatment equipment, control strictly the quality of the tooling and the process materials, and strive to reduce and avoid rework, repair and scrapping.

9 Improving energy management and organizing production sensibly

9.1 A heat treatment enterprise, or a heat treatment branch works or shop, should appoint a full-time or part-time energy manager who, under the direct leadership of the relevant management of the enterprise, is responsible for the energy management work of the enterprise, the branch works or the shop.

9.2 The energy manager shall have been trained on an energy management course held by the national competent department for energy and shall have obtained the certificate of completion before taking up the post.

9.3 The energy manager is to keep regular records of the fuel and electricity consumption of the unit or department, of the energy use indicators and of the energy consumption statistics of each item of equipment (see Annex A, a normative annex), and to calculate the energy consumption per unit of output, the fulfilment of the energy-saving indicators and the effect of the specific energy-saving measures (see Annex B, a normative annex). All indicators shall be calculated in accordance with GB/T 17358, GB/T 50162, JB/T 50163 and JB/T 50164.

9.4 The energy manager should press for the drawing up of energy-saving process specifications for the various heat-treated parts and should supervise their implementation.

9.5 The energy manager should put forward proposals for energy-saving measures regularly and should organize collective energy-saving technical improvement activities.

10 System of rewards and penalties

10.1 The national and local government competent departments should encourage and reward, in moral and in material terms, enterprises whose energy efficiency in heat treatment is outstanding, and should penalize those who waste energy seriously. It is recommended that the national competent department entrust supervision to a national or local sector association acting on its behalf.

10.2 Within the enterprise, rewards and penalties are applied to the heat treatment departments according to how well or badly they perform in energy saving. The specific arrangements are decided by each enterprise itself and submitted to the sector association