RENEWABLE ENERGY AND ENERGY CONSERVATION TECHNOLOGIES

HIGH – TEMPERATURE TUBE RECUPERATOR OF ENHANCED THERMAL RESISTANCE

Description:
Heat recovery process by operation of fuel furnaces makes the ground of power efficiency increase. The last time trend is to increase temperature of combustion air (oxidant) at steel reheating furnaces till 600°C. The modern designs of the recuperators being exposed to extremely high temperature action, are usually made of stainless steel tubes. Operation situation becomes more complicated in case of utilization of sulphur-containing fuels, particularly of coke-oven gas. That’s why the recuperator should be manufactured of high quality heat-resistant steel tubes of corrosion-resistant composition. Service life of the recuperators of mentioned purpose usually doesn’t exceed 1-2 years.

The task of work was to develop new conception, designs and mathematical models of high-temperature tube recuperators of prolonged 2-5 times service life in condition of attack of corrosive media

The main ideas:
1. Breaking time by rupture stresses is enhanced 12…20 times for the tubes and welded joints in the range of 530-650°C by 70-100°C decrease of the tube wall temperature only.
2. The limiting step of heat exchange within the system: combustion products flow - recuperator tubes' walls - combustion air flow falls on internal (within the tubes) constituent.
3. Intensification of heat exchange within mentioned system is expedient by implication of radiative component into the limiting step of heat transfer by means of arrangement of the secondary emitters within air pathway.

Innovative aspect and main advantages:
New generation differs from old ones by improvement in design, materials used and fabrication practice (technology of production). The improvements include the following engineering decisions and measures:
• using of the secondary emitters (inserts) of optimal geometry inside the main heat exchanger tubes;
• using of devices for control and redistribution the air flow rate
  - between heat exchanger tubes within the separate recuperator section,
  - between recuperator sections;
• using of tubes of increased heat (thermal) and oxidation (including relevant to sulphur compounds) resistant (scale-resistant and stainless) types of steel;
• using of new welding technology.
Above mentioned improvements permit to rise air preheating temperature no less than 100...150°C simultaneously with decrease of the recuperator tube wall's temperature and increase of service duration for 3 years and more being installed within corrosive high temperature medium.

Areas of Application:
Mentioned advantages may be realized in the heat exchangers of an other designs as well. High temperature tube recuperator RER may be used for heat recovery of high – temperature combustion products and installed behind the reheating furnaces of rolling mills and the forging furnaces in machinery building, the glass melting furnaces etc. Recuperators RER ensure 30% fuel saving in the furnaces and has enhanced service life, particularly by condition of corrosion medium (for example, of sulphur content – combustion products – of coal and heavy oil, of coke – oven gas).

The external views of high-temperature tubular recuperator

Stage of Development:
Development phase – the design has been tested with using of mathematical model and long-term laboratory tests at firing bench; the prototypes elements has been investigated during prolonged tests at the industrial furnace in Hungary.


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