DOWNLOAD PDF POWER CONDENSER HEAT TRANSFER TECHNOLOGY

Chapter 1 : Condenser (heat transfer) - Wikipedia

(TEi), a Babcock Power Inc.Â® company, along with its divisions Struthers Wells, is a leading supplier of heat transfer technology to the electric power generation, petro-chemical, pulp and paper, refinery and industrial markets worldwide.

It is a shell and tube heat exchanger installed at the outlet of every steam turbine in thermal power stations. Commonly, the cooling water flows through the tube side and the steam enters the shell side where the condensation occurs on the outside of the heat transfer tubes. The condensate drips down and collects at the bottom, often in a built-in pan called a hotwell. The shell side often operates at a vacuum or partial vacuum, produced by the difference in specific volume between the steam and condensate. Conversely, the vapor can be fed through the tubes with the coolant water or air flowing around the outside. In chemistry , a condenser is the apparatus which cools hot vapors , causing them to condense into a liquid. See " Condenser laboratory " for laboratory -scale condensers, as opposed to industrial-scale condensers. Examples include the Liebig condenser , Graham condenser , and Allihn condenser. This is not to be confused with a condensation reaction which links two fragments into a single molecule by an addition reaction and an elimination reaction. In laboratory distillation , reflux , and rotary evaporators , several types of condensers are commonly used. The Liebig condenser is simply a straight tube within a cooling water jacket, and is the simplest and relatively least expensive form of condenser. The Graham condenser is a spiral tube within a water jacket, and the Allihn condenser has a series of large and small constrictions on the inside tube, each increasing the surface area upon which the vapor constituents may condense. Being more complex shapes to manufacture, these latter types are also more expensive to purchase. These three types of condensers are laboratory glassware items since they are typically made of glass. Commercially available condensers usually are fitted with ground glass joints and come in standard lengths of , , and mm. Air-cooled condensers are unjacketed, while water-cooled condensers contain a jacket for the water. Larger condensers are also used in industrial-scale distillation processes to cool distilled vapor into liquid distillate. Commonly, the coolant flows through the tube side and distilled vapor through the shell side with distillate collecting at or flowing out the bottom. Condenser unit for central air conditioning for a typical house A condenser unit used in central air conditioning systems typically has a heat exchanger section to cool down and condense incoming refrigerant vapor into liquid, a compressor to raise the pressure of the refrigerant and move it along, and a fan for blowing outside air through the heat exchanger section to cool the refrigerant inside. A typical configuration of such a condenser unit is as follows: The heat exchanger section wraps around the sides of the unit with the compressor inside. In this heat exchanger section, the refrigerant goes through multiple tube passes, which are surrounded by heat transfer fins through which cooling air can move from outside to inside the unit. There is a motorized fan inside the condenser unit near the top, which is covered by some grating to keep any objects from accidentally falling inside on the fan. The fan is used to blow the outside cooling air in through the heat exchange section at the sides and out the top through the grating. These condenser units are located on the outside of the building they are trying to cool, with tubing between the unit and building, one for vapor refrigerant entering and another for liquid refrigerant leaving the unit. Of course, an electric power supply is needed for the compressor and fan inside the unit. In a direct-contact condenser, hot vapor and cool liquid are introduced into a vessel and allowed to mix directly, rather than being separated by a barrier such as the wall of a heat exchanger tube. The vapor gives up its latent heat and condenses to a liquid, while the liquid absorbs this heat and undergoes a temperature rise. The entering vapor and liquid typically contain a single condensable substance, such as a water spray being used to cool air and adjust its humidity. Instead of confusing information, the goal is to provide some basic information on the different types of condensers and their applications. Air cooled â€" If the condenser is located on the outside of the unit, the air cooled condenser can provide the easiest arrangement. These types of condensers eject heat to the outdoors and are simple to install. Most common uses for this condenser are domestic refrigerators, upright freezers and in residential packaged air conditioning units. A great feature of the air cooled condenser is they are very easy to clean. Since dirt can cause serious issues with the condensers performance, it is highly recommended that these be kept clear of dirt. Water cooled â€” Although a little more pricey to install, these condensers are the more efficient type. Commonly used for swimming pools and condensers piped for city water flow, these condensers require regular service and maintenance. They also require a cooling tower to conserve water. To prevent corrosion and the forming of algae, water cooled condensers require a constant supply of makeup water along with water treatment. Depending on the application you can choose from tube in tube, shell and coil or shell and tube condensers. All are essentially made to produce the same outcome, but each in a different way. Evaporative â€” While these remain the least popular choice, they are used when either water supply is inadequate to operate water cooled condenser or condensation temperature is lower that can achieved by air cooled condenser. Evaporative condensers can be used inside or outside of a building and under typical conditions, operate at a low condensing temperature. Typically these are used in large commercial air-conditioning units. Although effective, they are not necessarily the most efficient. Equation[edit] For an ideal single-pass condenser whose coolant has constant density, constant heat capacity, linear enthalpy over the temperature range, perfect cross-sectional heat transfer, and zero longitudinal heat transfer, and whose tubing has constant perimeter, constant thickness, and constant heat conductivity, and whose condensible fluid is perfectly mixed and at constant temperature, the coolant temperature varies along its tube according to:

Chapter 2 : Best Practices for Maximizing Condenser Efficiency

Reviews and in all respects the volume maintains the high standards which have come to be expected from this series. The title page and external appearance of Power Condenser Heat Transfer Technology.

Mode of inundation Plain tubes are commonly used for condensation of steam and other fluids with high liquid thermal conductivity. Integral fin tubes and more advanced three-dimensional fin tubes are often used for condensation of organic fluids with low liquid thermal conductivity. Both in-line and staggered tube banks are commonly employed. The vapor flow may be downward, horizontal, upward and any other direction depending on the location in the tube bank. For the downward flow of vapor, the condensate inundation rate depends only on the condensation rate at the upper rows. For the other flow directions, it is not possible to estimate the inundation rate accurately. The mode of condensate inundation depends on the inundation rate and vapor velocity. Discussions on the inundation modes are given by Marto , and Collier and Thome At low vapor velocities, condensate drains in discrete drops Figure 1a , then in condensate columns Figure 1b , and then in a condensate sheet Figure 1c as the inundation rate increases. In a closely packed staggered tube bank, side drainage may occur depending on the condition Figure 1d. The condensate impinging on the lower tube causes splashing, ripples and turbulence on the condensate film Figure 1e. At high vapor velocities, the condensate leaving the tube is disintegrated into small drops and impinges on the other tubes Figure 1f. Review of relevant literature are given by Marto , and Collier and Thome Butterworth discusses condensate inundation without vapor shear. Modes of condensate inundation in horizontal tube banks. For a stagnant vapor, Nusselt extended his analysis of laminar film condensation on a single horizontal plain tube to include the effect of sheet mode drainage See also Condensation and Condensation of Pure Vapors. Jakob generalized the Nusselt analysis and derived the following equation: Based on the observation of condensate drainage in operating condensers, Kern suggested a smaller dependence on the row number such that: Effect of vertical row number on the mean heat transfer coefficient of a bank of horizontal plain tubes. See Marto For condensation without appreciable vapor shear, a number of other methods have also been proposed to account for the effect of condensate inundation. Butterworth have shown that Equations 3 , 5 and 6 are in very close agreement despite their apparent difference. Marto and Collier and Thome recommend Equation 3 for design purposes. When the tube bank is inclined with respect to the horizontal, pendant drops on the tube are driven by gravity toward the lower tube end. As a result, the inundation rate decreases as the angle of inclination increases. This results in an increase in the mean heat transfer coefficient. Effect of the angle of inclination on the mean heat transfer coefficient of a bank of plain tubes: The results for the downward and horizontal flow are almost identical and are correlated fairly well by the following equation: The difference is largest in the region 0. Most of the data for the upward flow in the region of 0. The value of Ref is calculated assuming the gravity drained flow model. The data for moving vapor is close to Eq. For the downward flow of vapor, a number of empirical relationships have been proposed to predict the combined effects of vapor shear and condensate inundation. A common feature of the proposed relationships is that the heat transfer coefficient is calculated from the superposition of two contributions; i. Equation 12 is based on the Shekriladze and Gomelauri analysis for the effect of vapor shear on condensation on horizontal tubes. Fujii and Oda and Cavallini et al. Based on the experimental data for atmospheric pressure steam obtained by Nobbs , McNaught proposed the following empirical equation:

Chapter 3 : Solar | Babcock Power

One heat transfer improvement that could be game-changing for the power industry has little to do with the physical design of a condenser, but rather with how steam condenses inside heat exchangers.

TEi Struthers Wells, a pioneer in developing commercial nitrate salt central receivers and steam generating heat exchangers, has a vibrant history of design and manufacturing of high temperature heat transfer systems using HTF, salts, liquid metals, and steam. In order to guarantee trouble-free operation, we consider partial loads, offset conditions, ramp rates, thermal shocks, and even the effect of reversing the HTF and salt flows alternating between daytime charge and nighttime discharge mode. State-of-the-art engineering correlations used in the design approach allows TEi Struthers Wells to minimize the size of the heat exchangers, simplifying their handling and transportation. We continually address and refine these and other considerations associated with circular designs where space is at a premium. The surface condenser is a critical component in the operation of a steam power plant. Condenser failures can result in forced outages and loss of generation capacity. TEi condensers represent an evolution of advanced technology, offering improved thermal efficiency and advanced mechanical design to reduce forced outages and increase availability. Steam Surface Condenser, Modular Changeouts As the innovator in heat transfer technology, TEi provides exceptional modular changeout options for steam surface condensers. Modular changeouts are an efficient alternative to the conventional retube. Existing condensers can be refurbished, redesigned, and even upgraded to meet new performance demands and power requirements. Complete surface condenser retrofits are possible and can offer a multitude of benefits. A surface condenser is critical to the efficient operation of a power plant. The low pressure feedwater heaters play a key role in maintaining efficient, trouble-free operation of your generation facility and the vertical channel down VCD designs offer a small footprint, piping economics and simplified bundle access. Whether it be sophisticated designs involving extreme superheat, abnormal flow conditions or dissipation of high energy fluids, TEi has the expertise and experience to offer proven solutions to any design problem. TEi provides innovative and practical concepts to ensure peak heater performance from installation to testing through full or part-load operation. We offer a multitude of design configurations for desuperheater and drains cooler zones as well as the latest in channel closure techniques. The three most common are listed below: It requires no gaskets. The SRSG, also known as a boiler or receiver, is a high-efficiency boiler positioned on top of a tower typically to ft above grade , and surrounded by a field of mirrors heliostats that focus and concentrate sunlight onto the receiver tubes. The energy from the sunlight is used to generate and superheat steam in a forced circulation drum-type boiler, with the superheated steam being used to produce electricity. Be the largest solar thermal plant in the world Generate MW, which will serve , homes in California Be the first large-scale solar thermal project built in nearly two decades Double the amount of commercial solar thermal electricity produced in the U.

Chapter 4 : Gland Steam Condenser | API Heat Transfer

SPX Heat Transfer's Advanced Direct Contact Condenser (ADCC) is a licensed technology designed for geothermal power that condenses steam directly from geothermal wells or.

Chapter 5 : Air cooled heat exchanger, air cooled condenser, hybrid evaporative condenser supplier

The surface condenser is a critical component in the operation of a steam power plant. Condenser failures can result in forced outages and loss of generation capacity. TEi condensers represent an evolution of advanced technology, offering improved thermal efficiency and advanced mechanical design to reduce forced outages and increase availability.

Chapter 6 : Graphene layer could quadruple rate of condensation heat transfer in generating plants

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Chapter 7 : TUBE BANKS, CONDENSATION HEAT TRANSFER IN

The improvement in condenser heat transfer, which is just one step in the power-production cycle, could lead to an overall improvement in power plant efficiency of 2 to 3 percent based on figures from the Electric Power Research Institute, Preston says â€" enough to make a significant dent in global carbon emissions, since such plants represent.

Chapter 8 : Thin coating on condensers could make power plants more efficient | MIT News

Power Producers The SPX Heat Transfer business has been producing Ecolaire condensers for power production since and condenser technology. There are over

Chapter 9 : Innovative Heat Exchanger Technology Enhances Proven Designs

Transport Membrane Condenser Membrane water/heat transfer study: Technology Transfer and Commercialization Plan.