CONSTRUCTIVE FEATURES OF TRANSCRITICAL BOOSTER REFRIGERATION SYSTEMS

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Natural refrigerants are becoming increasingly important (air, water, hydrocarbons, carbon dioxide and ammonia) in connection with the measures which are taken by the international community for reducing of production and consumption of ozone destruction substances and greenhouse gases.

Dioxide of carbon (carbon dioxide, CO₂, R744) is one of the most promising natural refrigerants, which can be used as working substance in various refrigeration systems.

Distinctive feature of refrigeration systems which operate on the base of transcritical cycle with use of CO₂ is the state of overcritical fluid in which refrigerant is on the high pressure side, it causes high values of the heat transfer coefficient and low values of viscosity. Transcritical refrigeration systems with use of CO₂ became widespread in refrigeration systems of retails. Compared with traditional plants with use of chlorofluorocarbons (CFC) refrigerants, the use of the scriptorial system under moderate climate allows reducing annual energy consumption by 15–20%. To date, transcritical booster refrigeration systems become the most widespread. The booster system is a system where two stages of compression of one refrigerant exist. The computational pressure in the high pressure section, as a rule, is from 90 to 120 bars, working pressure is from 45 to 100 bars.

The main difference of the transcritical booster refrigeration system is the heat exchanger; it is gas cooler which is intended for cooling of the compressed to high pressure refrigerant.

The construction of the gas cooler compared to the existing traditional condensers is much more complex, including increased working pressure (up to 150 bars), which is almost in 4 times higher, and in 2 times higher temperature (+150°C) and it has a number of features.

One more significant constructive difference is the necessity to maintain intermediate pressure in the receiver of the transcritical refrigeration system in case of idle time.

Increasing of the maximum working value of pressure for system’s components should be taken into account. For the system with use of CO₂ the pressure under idle time can reach values of 65–80 bars (which corresponds to the temperature of 25–30°C). It exceeds the maximum working pressure of most components of the system and requires additional measures for pressure reducing and maintaining.

The auxiliary cooling system of the receiver and partial release of CO₂ into the atmosphere are the most commonly used measures for pressure maintaining under the transcritical refrigeration plant stoppage.

The vaporizers of transcritical refrigeration plants are not exposed to particularly high pressures. Usually the maximum working pressure is within 45–60 bars. Such pressure does not require special construction of evaporator, but only some adjustments to the thickness and diameter of the pipes. The sizes of the pipelines of plants can be significantly reduced due to the efficiency of CO₂. Usually the diameter is from 3/8 “to 5/8”, and it is possible to use evaporators of smaller sizes for necessary productivity providing.

It is necessary to note one more important constructive feature it is the possibility of efficiently use of recuperation for receiving hot water for technological needs and heat-transfer agent heating in transcritical systems with use of CO₂. All heat is highly potent, that is why actually all overheating can be used by shutdown of gas cooler if it is necessary.

**Keywords:** CO₂, transcritical phase, booster system, working pressure, gas cooler, receiver, pipelines, carbonic acid.