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Optimum Turbomachine Preliminary Selection for Power Regeneration in Vapor Compression Cool Production Plants

Authors : Sayyed Benyamin Alavi, Giovanni Cerri, Leila Chennaoui, Ambra Giovannelli, Stefano Mazzoni

Abstract : Primary energy consumption and emissions of pollutants (including CO2) sustainability call to search methodologies to lower power absorption for unit of a given product. Cool production plants based on vapour compression are widely used for many applications: air conditioning, food conservation, domestic refrigerators and freezers, special industrial processes, etc. In the field of cool production, the amount of Yearly Consumed Primary Energy is enormous, thus, saving some percentage of it, leads to big worldwide impact in the energy consumption and related energy sustainability. Among various techniques to reduce power required by a Vapour Compression Cool Production Plant (VCCPP), the technique based on Power Regeneration by means of Internal Direct Cycle (IDC) will be considered in this paper. Power produced by IDC reduces power need for unit of produced Cool Power by the VCCPP. The paper contains basic concepts that lead to develop IDCs and the proposed options to use the IDC Power. Among various selections for using turbo machines, Best Economically Available Technologies (BEATs) have been explored. Based on vehicle engine turbochargers, they have been taken into consideration for this application. According to BEAT Database and similarity rules, the best turbo machine selection leads to the minimum nominal power required by VCCPP Main Compressor. Results obtained installing the prototype in “ad hoc” designed test bench will be discussed and compared with the expected performance. Forecasts for the upgrading VCCPP, various applications will be given and discussed. 4-6% saving is expected for air conditioning cooling plants and 15-22% is expected for cryogenic plants.

Keywords : Refrigeration Plant, Vapour Pressure Amplifier, Compressor, Expander, Turbine, Turbomachinery Selection, Power Saving
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