

ELFORSK-projekt 351-022

Optimization of steam systems powered by heat pumps

The present project has aimed to develop a concept for the establishment and optimization of heat pump-based steam production systems. The concept is based on the latest technology concerning components and control - as well as the upcoming technology that is currently in various stages of development.

Steam systems are a well-established and widespread systems for distributing energy in a number of industries - especially in the food industry. The technology has matured and well described, and guidelines have been established and offered for designing and optimizing the systems. The present project describes the individual components and how they work in the central steam plants, and the possibilities for optimizing of both system and operating conditions. References to sources for further details, courses, optimization tools, etc. are listed.

A new calculation tool has been developed for steam-consuming systems. The starting point is data on the steam-consuming processes such as product quantities, temperature level and cycle times. The tool can be used to determine the actual steam consumption for the individual processes in order to determine the steam demand as well as the approximate loss in the boiler and distribution system for existing steam system. The tool contains a database of a very large number of common materials and products that makes it is easy for the user to determine values for the relevant products at the individual company. The tool can be used both for analysis of existing plants and when planning new processes.

The high temperature heat pump technology has been reviewed with regards to methods, refrigerants, temperature ranges, development stage, etc. The temperature range up to approx. 90 ° C is covered by traditional NH₃ heat pumps among others, while there are only quite a few commercial heat pumps that can deliver temperatures up to approx. 120 ° C, and only prototypes and development projects in progress can deliver temperatures up to 160 °C. However, a Danish development project among others aims to develop a heat pump that can deliver temperatures of up to over 200 ° C and thus to the vast majority of applications for steam systems. So, at present there are very limited options for heat pump powered steam systems, but the heat pumps will no doubt become commercially available in a few years.

Finally, a design guide has been developed to illustrate how heat pumps can be integrated or how a full conversion to heat pumps can be realized. The guidelines can support companies and their consultants for designing new steam systems or improve existing systems.

Four industrial cases have been reviewed in the project, where it is exemplified and illustrated how heat pumps can be incorporated into the steam system and be the primary energy source. The cases show how systems can be established either as central supply units or how the heat pumps can be integrated in the processes and thus establish a decentral structure.

Two heat pump manufacturers have given very concrete suggestions on how plant design, price, etc. will be for the four reviewed cases. Some can be implemented directly, while others have to wait for the necessary technology to be developed and made available.

The target group for the project is primarily industrial companies and their consultants. In addition, suppliers of heat pump systems and energy consultants are a significant part of the target group.

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