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Decentralized Energy Generation for Sustainable Production

Raw pastry producer uses trigeneration power and cooling concept at its new location.

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++ In Waren an der Müritz a container style trigeneration plant is constructed. The modular systems can be flexibly expanded and allow more space for production processes

The German company Steinofen-Meister GmbH & Co. KG is building a new production facility in Waren with a total area of 3,000 m². The Mecklenburg manufacturer of frozen baked goods chose a decentralized trigeneration (CCHP) energy system for its new location. This will diminish its use of primary energy sources significantly and in the process reduce CO_2-emissions and production costs.

Dynamic markets influence the range of services and products of trades enterprises and the bakery industry. A growing demand for individualized products with variable delivery times requires highly flexible production and distribution processes, which can have an additional negative effect on operational energy management and its environmental impact. E.g. deep freeze methods for preserving and storing bakery products create important opportunities for improved capacity and demand planning on the one hand, but on the other cause significant consumption and cost because of their high energy needs.

Conversion technologies such as trigeneration can attain maximum efficiencies through their multiple use of primary energy and are therefore considered a key instrument for economical, yet environmentally sound, energy generation. In the Mecklenburg Müritz Lakes Area the building project of an expanding producer of raw dough and pastry products demonstrates how an intelligent trigeneration plant concept can be planned and implemented within a matter of months. On a 3,000 square meter area in Waren an der Müritz, a new location for the production of frozen baked goods for domestic and international market is being built. Among the trading partners of Steinofen-Meister GmbH are regional and national wholesalers and supermarkets as well as clients on the Scandinavian market. In order to continue meeting the specific needs of its varied client base, the company produces just-in-time in close consultation with the client. This firm strategic approach of exclusive production brings with it a large product portfolio with a wide range of variety, which Steinofen-Meister produces and sells predominantly in Clean Label Quality – guaranteeing chemical purity and freedom of additives.

Around 30 tonnes of frozen baked goods are to be produced at the Waren location on a daily basis. The 2,000 square meter production hall has two convertible production lines, which allow for production of dough items in variable types and shapes. Downstream, the product is either pre-baked and flash frozen or deep frozen to be finished fresh in baking stations and palletized goods are finally stored in large high-bay pallets, ready for shipping.

Greenfield systems concept

The average energy requirement for securing deep-freeze and cold storage processes alone is approx. 1.5 MW. Increasing energy consumption causes additional emissions of climate-damaging CO_2: The largest part of the PCF (Product Carbon Footprint – CO_2 footprint) of baked goods (bread, rolls, pastries), up to 50 percent, is caused by industrial processing (see Study Ökoinstitut e.V., 2010).

Both from an economic and an environmental perspective, the application of energy conversion technologies such as trigeneration create excellent leverage in the development of saving potentials. A prerequisite for this is optimum design as a result of robust system planning. Steinofen-Meister GmbH developed the trigeneration concept for their factory in Müritz in collaboration with the engineering firm EcoEnergyTherm near Hannover, a general contractor specializing in the overall management of cogeneration and trigeneration projects for the food industry. The experts implemented the idea of integrated sustainable energy technologies into a turnkey supply system in this specific greenfield situation. The realistic time frame for planning, design and execution was less than one year.

Unlike existing properties which usually already have an infrastructure for energy and technical facilities, the erection of a new greenfield building complex increases the demand for planning and coordination efforts. Time-critical application and permit procedures and the systematic integration of the involved TGA trades - including coordination with the regional grid operator - were centralized and carried out by the general contractor EcoEnergyTherm GmbH.

Being the expert listed with BAFA for sorption facilities, it also performs the authorization check and application for

eligible funding. Up to 25 percent (maximum 100,000 euros) of the costs can, for example, be funded towards the absorption chiller of a trigeneration plant, provided the relevant conditions are met. Moreover, the federal states grant assistance by means of relevant funding programmes. In Mecklenburg-Vorpommern, for example, there are the climate funding guidelines that support the Action Plan Climate Protection.

Container modules

The greenfield site situation created an essential advantage for the design of the power supply as the system technology could be accurately planned in the proposed energy infrastructure from the get-go. The integration solution developed for Steinofen-Meister was based on a modular container construction, which compared to other relocatable housed systems shows a significantly reduced construction time and a flexible option of choice of the location. The space gained within the manufacturing plant can hence be used as valuable production areas.

Above all do the open energy generation systems help adapt the production technology to changing market conditions. If new sales structures for the company open up, product demand increases or if there are process-related changes to the product portfolio, the resulting increased energy requirements can quickly and effectively be met by additional integrated units. As a rule, neither the original installation nor the subsequent extension of the container modules require special regulatory approvals according to building code.

The components of an energy system are manufactured based on the design specifications by experienced producers and project partners and are factory pre-assembled, so that all that is needed is a connection to the already pre-wired media lines to be ready for use. The selection and configuration of the units is always done in the form of an individual solution for the client's specific application.

The trigeneration plant developed for the new production facility in Waren is a multi-stage, interconnected, energy technology system consisting of a natural gas-fired, combined heat and power unit (CHP) and an absorption chiller, connected to three additional compression chillers. On the basis of the advanced cogeneration principle through effective use of heat, the trigeneration concept includes the decentralized generation of electricity as well as heat and cold, thereby achieving the maximum efficiency of its primary energy.

The CHP is powered with an Otto gas engine with a rated electrical output of 404 kilowatts and has an air-cooled synchronous generator. The combustion process generates a predefined amount of heat as well as electric power that can entirely be used in operational processes and does not require partial feeding into the public grid. The decentralized generated electricity also supplies the running power for the connected chilling units, a large part of which goes into supplying the integrated compression chillers for freezing processes.

The heat generated by the CHP plant is at the same time entirely transferred to the connected absorption chiller and converted to cold by means of a thermodynamic process. The natural refrigerant ammonia that is used in the two-stage process is absorbed into an NH3 solution in the absorbers and later separated again by means of heat (rectified). In this first stage, the liquefied ammonia reaches a temperature of minus 10 degrees Celsius. By coupling the CCM, additional conversion in the second process stage to minus 32 degrees Celsius is possible to ensure the required deep-freeze temperatures for storage and preservation. Via distribution lines process refrigeration is subsequently passed on to the respective consumers (blast freezers, cold storage etc.).

In principle, combined cogeneration chiller systems can be planned and operated as technically autonomous supply units. They can, however, also be seamlessly integrated in existing cooling systems that work with brine or ammonia refrigeration processes. Optimally, the existing systems can be relieved to such an extent that they only need to be switched on during critical peak load periods.

Due to its multiple use of the primary fuel source, trigeneration technology is one of the most efficient energy solutions; the potential overall efficiency of the implemented in plant in Waren, for example, exceeds 90 percent.

At the same time does the combined generation of cooling energy lead to a year-round utilization of the CHP with an efficiency of 97 percent and a life expectancy of 8,500 operating hours. Maintenance and repair time is estimated at around 260 hours per year.

In future, Steinofen-Meister GmbH will be able to produce 60 percent of its own electricity needs. Considering the rising electricity prices and a high electrical base load during operation, the CCHP savings can in the long be assessed as economically significant. Overall, a cost reduction of 40 percent compared to conventional power plants with identical usage conditions is a conservative estimate. This corresponds to - based on evaluations of similar projects - a total amount of about 360,000 euros per year. ROI can be achieved in less than three years.

Last but not least, the high efficiency of a trigeneration system has a positive effect on the environmental performance of its operator: With 3,200 tonnes of CO_2 saved per year, the investment in a progressive technology also results in an important contribution to environmental sustainability for the baking industry. +++


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