

The installation of integrated high-temperature heat pump equipment system has brought carbon emission savings by 59% in a spray dryer pump of one of the dairy processing companies of Europe



Introduction

In response to growing environmental concerns and a commitment to reducing its carbon footprint, one of Europe's leading dairy processing companies embarked on a mission to minimize energy consumption and CO2 emissions. This company is well-known for its extensive use of spray drying technology to process milk powder, a process that traditionally relies on energy-intensive methods, often fueled by fossil fuels. In order to meet sustainability targets, the company partnered with GEA to install an integrated high-temperature heating pump system. This solution, the GEA AddCool, delivered substantial reductions in carbon emissions—around 59%—while maintaining high operational efficiency and product quality. This case study explores the challenges the company faced, the solution implemented by GEA, the results achieved, and the broader business impacts.

Market Situation

The dairy industry in Europe and globally is under mounting pressure to reduce carbon emissions and adopt more energy-efficient practices. Dairy production, particularly spray drying, is a highly energy-intensive process. Traditionally, the energy used in spray dryers comes from the combustion of fossil fuels like natural gas, which contributes to significant greenhouse gas (GHG) emissions. For this reason, companies are increasingly turning to alternative, more sustainable technologies to meet regulatory requirements and improve their environmental performance.

Market dynamics are shifting towards sustainability, driven by stricter government regulations, increasing awareness among consumers, and the ongoing threat of climate change. As part of this movement, dairy processors are looking for solutions that can reduce both their carbon emissions and energy consumption while ensuring that the quality of their products remains unaffected. In particular, the spray drying process—often a significant energy sink—is an area that companies have identified for potential improvements in energy efficiency.

Market Trends:

In recent years, a significant trend has emerged in the industrial sector: the adoption of heat pump technology, particularly high-temperature variants capable of replacing traditional combustion-based heating methods. Heat pumps are known for their energy efficiency, as they utilize electricity to transfer heat rather than generating it through burning fossil fuels. This can result in significant energy and cost savings, especially in energy-intensive operations such as spray drying.

High-temperature heat pumps, like the GEA AddCool system, can be integrated into industrial processes to capture and reuse waste heat. This approach is highly effective for decarbonization since it reduces reliance on fossil fuels and minimizes CO2 emissions. In addition, heat pumps can operate on renewable electricity, further enhancing the sustainability of operations. With increasing pressure from governments and consumers, there is a clear market demand for such energy-efficient technologies.

The shift toward decarbonization is also being supported by EU regulations, which aim to reduce industrial emissions in line with the broader goal of achieving net-zero emissions by 2050. These regulations are compelling companies in energy-intensive sectors, like dairy processing, to adopt cleaner technologies and integrate sustainability into their core business practices. Consequently, the demand for advanced, energy-efficient systems like high-temperature heat pumps is expected to rise in the coming years.

Client Challenges

The dairy processing company in question faced several significant challenges in its pursuit of sustainability. Spray drying, a key part of its production process, required large amounts of thermal energy to convert liquid milk into powder. This energy, which typically came from natural gas or other fossil fuels, contributed to a high carbon footprint. The client needed a solution that could drastically reduce emissions without compromising on production efficiency or the quality of the final product.

Additionally, the company needed to comply with increasingly stringent environmental regulations aimed at reducing industrial emissions. At the same time, they had to ensure that any energy-saving solution would not result in increased operational costs or negatively impact product consistency, as any significant changes to production could lead to financial losses.

Finally, the company had already made investments in energy efficiency but recognized that there were still substantial improvements to be made, particularly in the energy-intensive spray drying process. The challenge was to identify a solution that could address these issues and deliver a measurable reduction in both energy use and emissions.

Our Approach

After conducting an energy audit, GEA identified the potential for the installation of an integrated high-temperature heat pump system to provide a sustainable solution. The proposed system, GEA AddCool, was designed to replace the traditional fossil fuel-based heating method used in the spray drying process. It offered a highly energy-efficient alternative by utilizing renewable electricity to capture and transfer heat from the environment, making it an ideal choice for the dairy company's decarbonization goals.

GEA's solution involved retrofitting the existing spray drying system with the AddCool high-temperature heat pump. This system provides both heating and cooling capabilities, using waste heat to reduce the need for natural gas consumption. The heat pump captures and reuses waste heat from the cooling process, thus significantly lowering the amount of natural gas required for heating primary air in the dryer.

In addition to the technical installation, GEA worked closely with the client to ensure that the new system could be integrated seamlessly with existing operations. This required careful planning to minimize downtime during installation and to ensure that the transition to the new system would not disrupt production schedules. The system was designed for optimal efficiency, ensuring that product quality and production capacity were maintained while achieving the targeted emissions reductions.

Our Recommendations

GEA recommended the installation of the AddCool heat pump system as a comprehensive solution for reducing the dairy company's carbon footprint. Specifically, the solution would:

<p>Significantly reduce natural gas consumption: The system would reduce the reliance on natural gas for heating purposes, cutting fuel consumption by over 55%.</p> <p>Achieve substantial CO2 savings: The heat pump system would lower CO2 emissions by approximately 59%, significantly reducing the company's environmental impact.</p> <p>Maintain production efficiency: The solution was designed to operate seamlessly with the existing spray dryer, ensuring that production capacity and product quality would remain unaffected.</p>	<p>Provide long-term cost savings: The heat pump system would reduce electricity consumption on the existing chiller system, delivering ongoing operational savings.</p> <p>Ensure reliable performance: With a six-year guarantee on the heat pump's performance, the system was expected to provide a reliable and efficient solution over its lifetime.</p>
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The key advantage of the GEA AddCool system was its ability to decouple heat and power generation from fossil fuels, using electricity to transfer and recycle heat within the system. This approach was not only energy-efficient but also aligned with the company's broader sustainability objectives.

Business Impact

The installation of the integrated high-temperature heat pump system has had a profound impact on the client's operations, both in terms of environmental performance and business performance. The key outcomes include:

<p>Substantial reduction in CO2 emissions: By installing the GEA AddCool system, the dairy company reduced its CO2 emissions by 1,300 tons annually, which equates to a 59% reduction in emissions from its spray drying process.</p> <p>Operational savings: The system significantly reduced the need for natural gas consumption—by an estimated 610,000 Nm3 per year—resulting in considerable cost savings. These savings were not only from reduced fuel costs but also from the decreased electricity consumption associated with the existing chiller systems.</p> <p>Enhanced sustainability credentials: The company's adoption of the heat pump technology has strengthened its position as an industry leader in sustainability, helping it to meet regulatory requirements and gain a competitive edge in the marketplace. This commitment to environmental responsibility has resonated positively with consumers, who are increasingly prioritizing sustainable products.</p>	<p>Improved energy efficiency: The GEA AddCool system improved the overall energy efficiency of the spray drying process, reducing both the overall energy footprint of the company's operations and the associated costs.</p> <p>Future-proofing operations: The company has positioned itself for continued success in a regulatory environment that increasingly favors low-carbon technologies. By investing in the heat pump system, the company is ensuring its operations are compliant with future emissions targets, which will continue to tighten over time.</p>
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Conclusion

The installation of the GEA AddCool high-temperature heat pump system has been a resounding success for the dairy processing company. The 59% reduction in carbon emissions from the spray drying process not only helped the company meet its sustainability targets but also resulted in significant operational cost savings. The integration of this innovative heat pump technology has allowed the company to decouple its heating needs from fossil fuels, providing both an environmentally responsible and economically viable solution.