



Quantum

Truflow Heater™

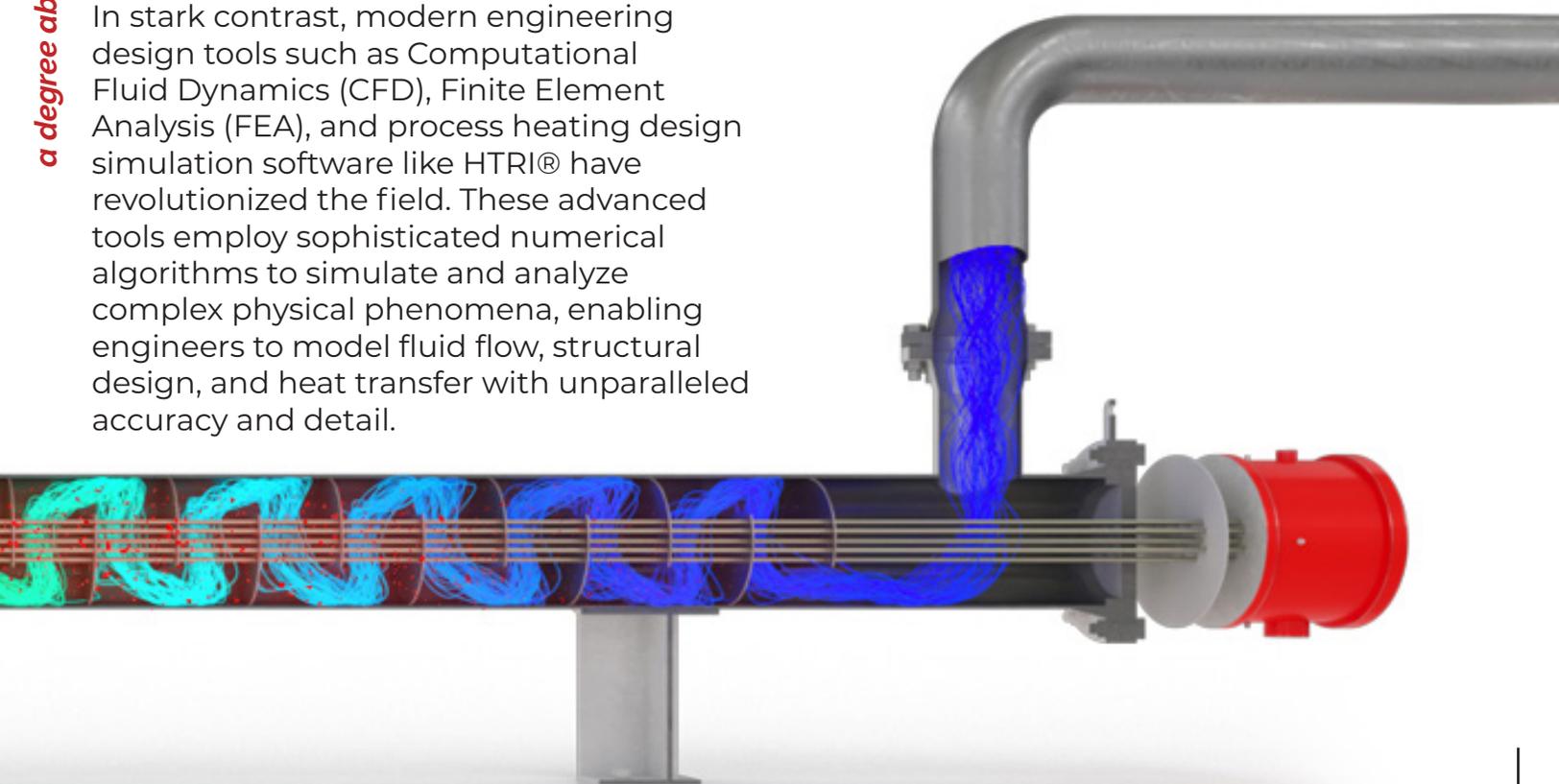
Revolutionizing Electric Process Heating: Modern Engineering Design Tools Transform Industrial Heater Performance

The history of electric process heating traces back to the late 1800's, when electric resistance heating emerged as a promising alternative to conventional heating methods. Since then, electric heaters have undergone significant advancements, evolving into specialized equipment for industrial applications. With the advent of modern engineering design tools and simulation software, engineers are now able to create more accurate, efficient, and customized designs for electric process heaters.

In the past, engineers relied heavily on rule-of-thumb heating element watt density or heat flux selection guidelines developed throughout the years for various fluids and gases. However, these methods lacked precision and often resulted in suboptimal designs. Legacy design rules were based on approximations and simplified assumptions, failing to account for process specific factors like fluid flow patterns and thermal behavior. This led to over-engineered or underperforming designs that limited optimization possibilities.

In stark contrast, modern engineering design tools such as Computational Fluid Dynamics (CFD), Finite Element Analysis (FEA), and process heating design simulation software like HTRI® have revolutionized the field. These advanced tools employ sophisticated numerical algorithms to simulate and analyze complex physical phenomena, enabling engineers to model fluid flow, structural design, and heat transfer with unparalleled accuracy and detail.

By leveraging these tools, engineers can optimize electric process heater designs for maximum efficiency, improved performance, and reduced energy consumption. Parameters such as mass flow rate, specific heat capacity, thermal properties of the fluid, power requirements, and physical design constraints can be precisely modeled and analyzed. This comprehensive approach captures the intricacies of heat transfer phenomena, leading to designs that are smaller, more efficient, and tailored to specific requirements.





Quantum

Truflow Heater™

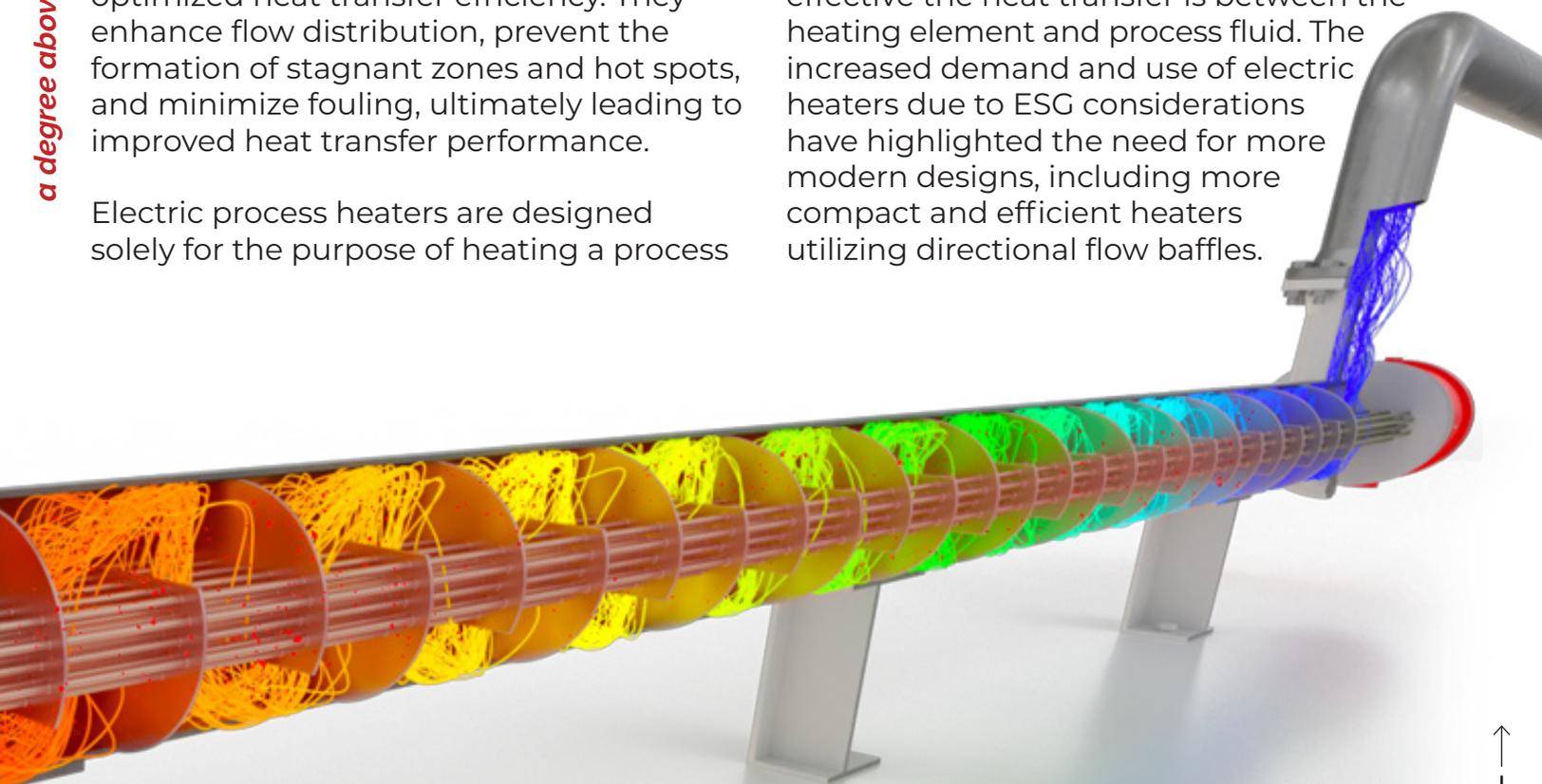
Revolutionizing Electric Process Heating: Modern Engineering Design Tools Transform Industrial Heater Performance

Electric process heating equipment plays a vital role across various industries, serving as energy-efficient and reliable tools for facilitating efficient heat transfer to fluids in numerous industrial applications. Their ability to provide precise temperature control makes them indispensable in modern industrial processes. Achieving maximum heat transfer rates while minimizing energy consumption is crucial for optimal operation. One innovative solution to enhance heater performance is the implementation of directional flow baffles.

Directional flow baffles have long been utilized in heat exchanger designs to enhance heat transfer efficiency. Heat exchangers are devices used for transferring heat between two fluids, with the goal of heating or cooling the process fluid. Directional flow baffles are strategically engineered structures placed within heaters to control fluid flow patterns. These baffles induce turbulence and promote fluid mixing, resulting in optimized heat transfer efficiency. They enhance flow distribution, prevent the formation of stagnant zones and hot spots, and minimize fouling, ultimately leading to improved heat transfer performance.

Electric process heaters are designed solely for the purpose of heating a process

fluid to the desired temperature, using an electric heating element. Electric heaters do not involve the transfer of heat between fluids but rather the direct conversion of electrical energy into heat energy. While the operating temperature of the heat exchanger tubes are limited by the temperature of the hot side process fluid, the operating temperature of electric heating element sheath depends on the heat flux of the heating element and how effective the heat transfer is between the heating element and process fluid. The increased demand and use of electric heaters due to ESG considerations have highlighted the need for more modern designs, including more compact and efficient heaters utilizing directional flow baffles.





Quantum

Truflow Heater™

Revolutionizing Electric Process Heating: Modern Engineering Design Tools Transform Industrial Heater Performance

The advantages of optimized directional flow baffles in industrial electric process heating equipment are critical for design optimization. Firstly, they enhance heat transfer by creating controlled turbulence and reduced phase separation, reducing the boundary layer thickness, and preventing stagnant zones. This leads to higher overall heat transfer coefficients, enhanced heat transfer rates, and more compact heater designs.

Furthermore, properly designed directional flow baffles improve flow distribution by guiding the flow uniformly across the heat transfer surfaces. This optimized flow distribution minimizes thermal gradients, ensures efficient heat transfer throughout the heater, and eliminates hotspots. As a result, the heater's surface area is more effectively utilized.

Dead zones and fouling present a risk, which can hinder heat transfer efficiency but can be effectively mitigated by correctly designed directional flow baffles. These baffles disrupt the formation of stagnant regions by inducing fluid motion and turbulence, preventing the accumulation of deposits and fouling. This, in turn, reduces cleaning and maintenance cycles, leading to improved heater performance and reduced downtime.

Directional flow baffles also contribute to energy efficiency and cost savings. By enhancing heat transfer rates and reducing fouling, these baffles enable lower temperature differences (ΔT) between the heating element and the process fluid to achieve the desired process requirements. This reduction in ΔT translates into lower heat loss to surroundings and lower energy consumption, resulting in cost savings and improved sustainability. Moreover, the improved heat transfer efficiency achieved with directional flow baffles allows for smaller heater designs, reducing heat loss, and lower material and installation costs.

One notable advantage of optimized directional flow baffles is their ability to increase element watt density without raising the element temperatures. By promoting efficient heat transfer and reducing thermal gradients, these baffles enable more heat to be transferred per unit area. This increased element surface watt density facilitates the design of smaller, more cost-effective heaters, offering benefits in terms of equipment size, installation space, and overall system costs. In contrast, incorrectly designed flow baffles could lead to hot spots and dead zones thereby reducing heater performance and heater life. For this reason, modern design tools are critical to ensure safe and reliable heater operation.

In summary, the integration of modern engineering design tools such as CFD, FEA, and HTRI® thermal design software, coupled with detailed validation testing, has transformed the electric process heating landscape. These advanced tools have replaced outdated design methods, empowering engineers to create more accurate, precise, and efficient designs. By considering complex physical phenomena and optimizing designs



Quantum

Truflow Heater™

Revolutionizing Electric Process Heating: Modern Engineering Design Tools Transform Industrial Heater Performance

Accordingly, engineers can achieve enhanced efficiency, superior functionality, and overall better performance in process heater designs.

Carefully designed directional flow baffles with the support of modern design tools offer improved heat transfer, optimized flow distribution, prevention of dead zones and fouling, energy efficiency, cost savings, and the ability to design compact, high-performance heaters. As industries continue to evolve, these advancements will play a pivotal role in meeting the increasing demand for efficient and sustainable process heating solutions.

With over 60 years of experience in process heating engineering, Thermon provides the most reliable products and services from around the globe. We specialize in innovative solutions to keep your industrial processes operating without disruption - regardless of environmental conditions or hazardous settings. Harnessing our thermal technology and industry knowledge, we continually deliver energy-efficient products tailored to your project requirements so you can confidently trust us with all your industrial process heating needs across multiple sectors worldwide.

Thermon's energy efficient industrial electric process heating solutions include:

- [Electric Boilers](#)
- [Circulation Heaters](#)
- [Catalytic Methane Heat](#)
- [Immersion Heaters](#)
- [Electric Heat Tracing](#)
- [Removable \(Blanket\) Heat](#)
- [Environmental Heaters](#)
- [CEMS/Tubing Bundles](#)

To learn more, visit us at www.thermon.com, or contact your local [Thermon Sales Representative](#) today.

