Modular Duct Heater Technology

Author: Tracy Rademen, Product Manager

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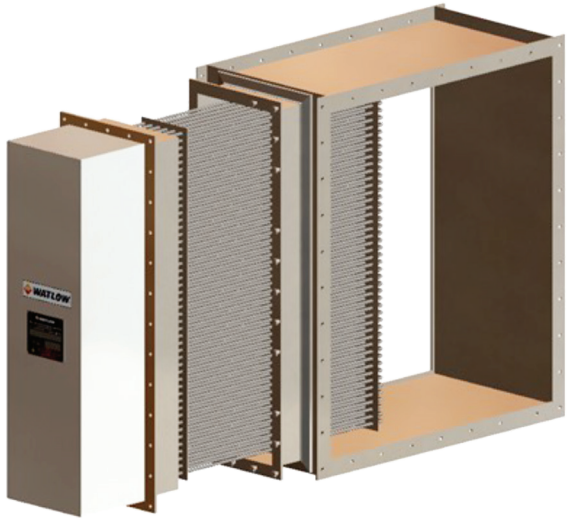
MDH PLUS™

Innovations in Thermal Systems for Industrial Air Applications

How the Modular, Closed Loop Design of Watlow's ***MDH PLUS™*** Creates an "Easy Win" for Decarbonization Efforts in Air Heating Applications



Summary

- As industries continue to find ways to electrify their processes to reach their decarbonization goals, they should look at processes requiring air heating systems for drying and heating.
- Non-electric air heating systems traditionally have been carbon intensive, inefficient and difficult to replace. A more innovative design would make electric duct heaters an "easy win" for decarbonization efforts, as well as a boost to efficiency.
- Watlow's new ***MDH PLUS™*** provides a modular, scalable turnkey solution for those wishing to switch to a more consistent, and more efficient duct heater.
- Designed with larger modules that can be customized and designed with replaceable elements.

Many industries use duct heaters to heat gasses—usually ambient air—in order to heat or dry some other material. These applications require systems that go well beyond what is available with typical HVAC solutions: The temperatures they need to obtain are higher, the scale of the operation is larger and a much greater degree of control is required. While large heating systems that meet these needs have been around for a while, they also face some significant challenges—especially when it comes to initiatives aimed at electrifying processes for the purposes of decarbonization.

These challenges are what prompted the engineers at Watlow to design a scalable, modular system for air heating: ***Modular Duct Heater (MDH) PLUS***. This system already is proving valuable in industries such as gypsum manufacturing providing a more stable and efficient heating and drying process while also allowing plants to wean off fossil fuels.

Generally this means that, for industries still trying to meet their electrification goals, a look at electric air heating systems is potentially an "easy win" that can help spearhead further decarbonization efforts.

Challenges for Traditional Duct Heaters Also Represent Opportunities for Innovation

Most duct heaters used in industrial processes today are steam-driven or gas-fired low-pressure heaters. Their shortcoming are fairly well known:

They are carbon intensive. Many of these heaters burn fossil fuels and are ripe targets for electrification. (Electric heaters can run off of renewable energy sources, which are becoming more efficient even as prices drop.)

They are often inefficient. The designs of traditional duct heating equipment often have features that, in retrospect, serve to create inefficiencies when it comes to thermal transfer and energy use. For example, any air bypass (i.e., any cross-sectional area of the duct where air can potentially miss the heating elements) will make the system much less thermally efficient, which in turn means more elements (and more power) is required to achieve the desired result.

According to the U.S. Environmental Protection Agency (EPA), industry contributes 23% of the total output of greenhouse gasses, most of which come from burning fossil fuels for energy.

Source: Sources of Greenhouse Gas ***Emissions, epa.gov***

They are costly to replace. Duct heaters are costly to replace, not just because of the cost of the heaters themselves, but because of their total cost of replacement. For example, new systems need to be designed and customized, retrofitted with existing duct work, outfitted with the appropriate control panels and data logs and so on. Meanwhile, the older system needs to be removed, and discarded, a process which cannot easily happen piecemeal. These challenges can be alleviated with a more standard, scalable design.

These challenges also represent opportunities for innovation. Duct heating systems have been due for a redesign, and the pressure to decarbonize while maintaining or surpassing current efficiency has spurred a major shift in how engineers think about these systems.

Industries Ready for Innovation in Duct Heater Design

There are a number of industries where traditional, non-electric duct heaters still are used for key processes. We note that these very same industries are experiencing pressure to decarbonize as soon as possible:

Battery manufacturing. Drying battery materials, such as lithium carbonate and lithium iron phosphate, is an essential step in the manufacture of cells. Drying is often the most energy-intensive part of the cell manufacturing process, and the biggest contributor to greenhouse gas emissions for these plants.

Food processing. Warm air often is used to preheat or bake items in large batches. Here, precise control is important, as is energy efficiency.

Duct heaters often are used to heat air for drying out minerals such as alumina, basalt, borax, copper minerals, clay, ferrous minerals, gypsum, limestone and more. Again, the process is energy intensive and requires consistent, predictable air flow.

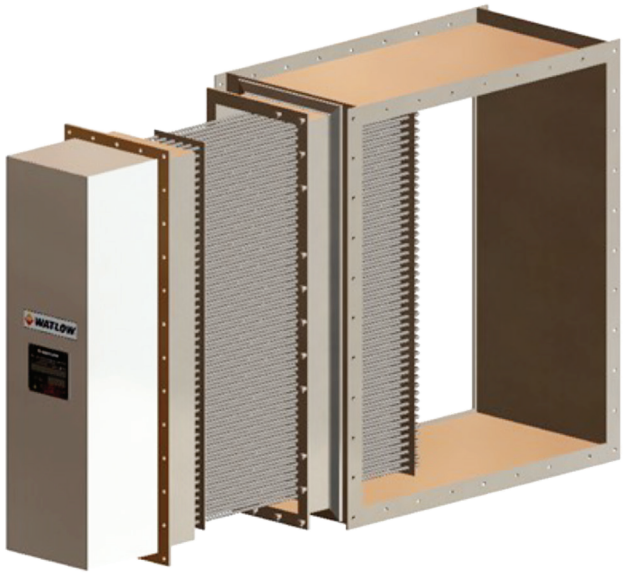
There are other industries as well; basically, any industry where materials are dried or heated in batches using moving air or other gasses is an industry that could benefit from modern duct heater design.

Gypsum processing is a particularly interesting example of an industry where a modular thermal system using electric heaters is providing immediate value. Therefore, it is worthwhile diving into some of the details of this use case below—after seeing how a more innovative design can mitigate some of the issues traditional duct heaters face.

Spearheading Innovation in Duct Heater Design

At Watlow, we help many industries meet their electrification and decarbonization goals. We do this primarily by designing and implementing closed-loop thermal systems, which include all of the elements needed for a thermal solution: heating elements, sensors, controllers and data loggers. Providing a complete thermal solution ensures that all components work together in the most optimized and efficient way possible.

When it comes to air heating for industrial applications, we took this logic a step further: We designed a duct heating system to be modular, with heating modules that can be easily swapped, added or replaced. This guarantees that the entire duct heating system is scalable, and that each component adheres to a single standard. The result is a completely "turnkey" solution for industries looking to replace older steam or gas-fired air heaters. This was the inspiration behind Watlow's new duct heating system, the ***MDH PLUS.***



An "exploded" view of an MDH PLUS module.

The ***MDH PLUS***, resolves many of the challenges that traditional steam or gas-fired heaters face:

MDH PLUS is fully electric. It can run off renewable sources (if available), removing a major consumer of fossil fuels for many industries.

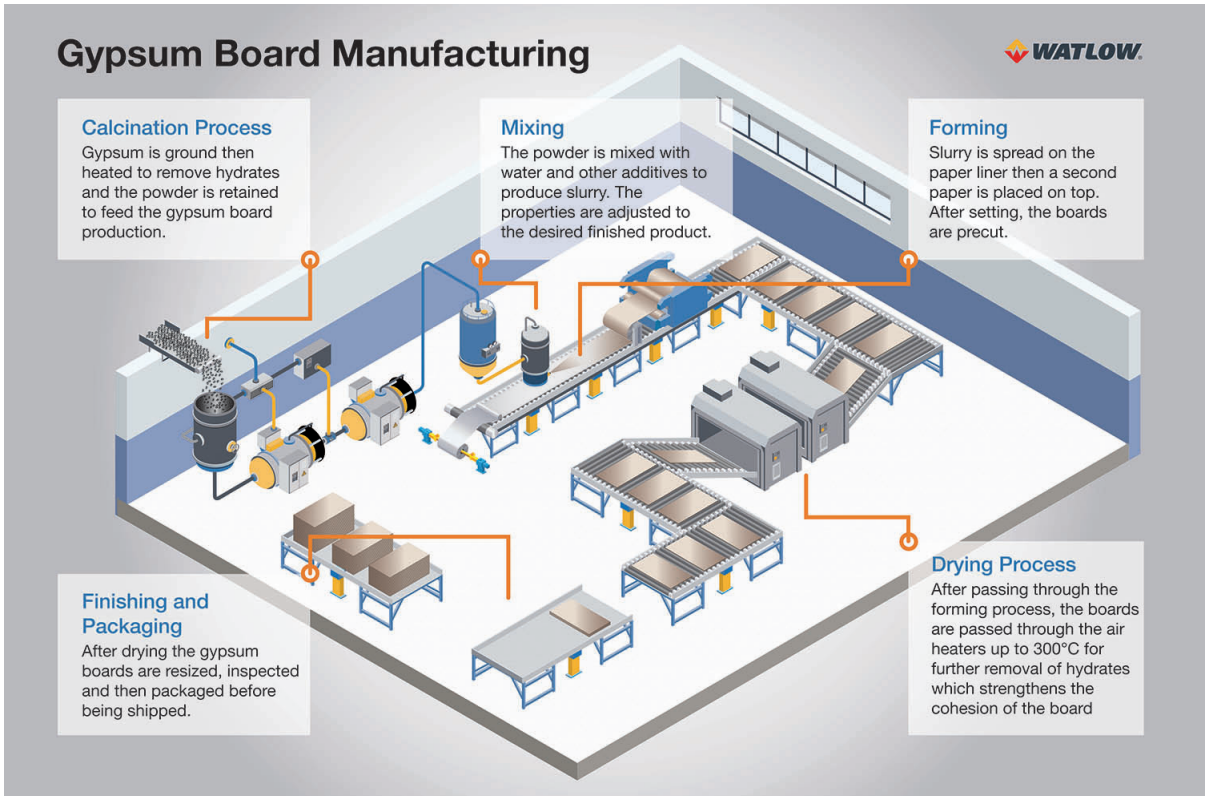
MDH PLUS is a total closed-loop thermal solution designed for efficiency. Temperatures can be measured and controlled precisely using an easy-to-set-up control panel. Every decision made during design further contributes to efficiency—for example, heating elements span the entire cross-sectional area of the duct for maximal heat transfer. In addition, ***MDH PLUS*** can better control sheath temperature and pressure drop, and the modules can be stacked in series and zoned as needed.

MDH PLUS is easy to install. There is no need to reinvent the wheel here; standard components and a modular design mean it is relatively simple to put together a configuration that will work for almost any operation, with minimal downtime and faster speed of implementation. The housing can be adapted to existing ductwork, making it a true turnkey solution. Finally, the system can easily scale easily, with parts that easily can be added or replaced as needed.

MDH PLUS already is being used by some manufacturers in the gypsum industry; their story highlights the immediate benefits that a well-designed closed-loop thermal solution can bring.

An Extended Example: The Gypsum Industry

Plasterboard using gypsum—also known simply as "gypsum board"—is a staple in construction. More than 400 plants in the U.S. manufacture these boards and ship them worldwide.



Steps in the gypsum board manufacturing process.

Creating gypsum board is a multi-step process that involves calcination (grinding and drying gypsum at a high temperature), mixing a slurry made from the resulting powder, forming into sheets and then ultimately drying, finishing and packaging. Two of these stages, the calcination and drying stages, are thermal-intensive processes requiring high heat.

Currently, many gypsum processors are using more traditional gas-fired heating systems for calcination and drying. At the same time, these plants are facing pressure to reduce their Scope 1 emissions, which includes emissions from fuel burned in owned or controlled assets. (Gas used in heating air certainly qualifies.) While there are global and regional incentives to reduce these emissions, some states and regions also are applying penalties to businesses that do not reach their goals—tax penalties, for example.

Furthermore, the bar that is set for thermal solutions in this industry is quite high:

- There needs to be a great deal of thermal uniformity at these stages, as non-uniform heating can cause uneven drying and thereby affect the quality of the final product.
- Pressure drop is a concern, and thermal solutions need to stay within acceptable parameters.
- Downtime is costly. This means that, to stay profitable, manufacturers have to maximize uptime, which in turn means being able to lengthen maintenance intervals.

Electric heaters already are known to be better at providing uniform temperatures within precise ranges—assuming they are paired with sensors and controllers that are up to the task, of course. Together these heaters, controllers and sensors comprise a closed-loop thermal solution that can adjust to ongoing conditions. ***MDH PLUS*** offers a closed-loop thermal solution in a modular, scalable package.

The ***MDH PLUS*** systems currently being used within the gypsum space are already allowing these companies to reduce their carbon footprint and are proving to be a more efficient and more precise thermal solution, assuring product quality and reducing overall operating costs.

Next Step: Determining the Configuration that Works for Your Application

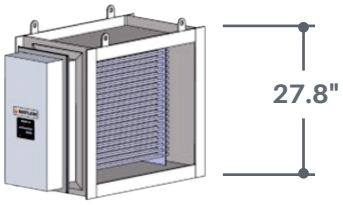
The modularity of ***MDH PLUS*** is one of its greatest strengths—it allows manufacturers to configure, purchase and install a turnkey heating solution easily while also allowing a great degree of customization. Because it is so easy to get started with ***MDH PLUS***, the electrification of duct heating in industrial processes is now "low-hanging fruit" for decarbonization initiatives.

Those who want to see what an implementation of ***MDH PLUS*** would look like for their application are encouraged to contact tyour Watlow sales representative, or send an inquiry to ***watlow.com/contact-us***. Our technical staff can help identify the module sizes needed and their arrangement given key parameters such as wattage (watt density) and flow rate.

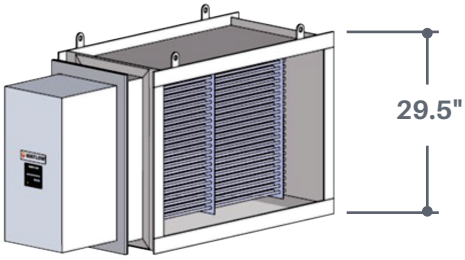
In addition to the new ***MDH PLUS***, Watlow offers a wide variety of traditional duct heater products that may also be suitable for your application. Details for these can be found in our online catalog and online configurator also known as Watlow's Visual Designer.

You also can download a spec sheet for ***MDH PLUS*** at watlow.com, or ***contact a sales rep*** to begin a conversation.

Size comparison of available MDH PLUS modules.



Module 1



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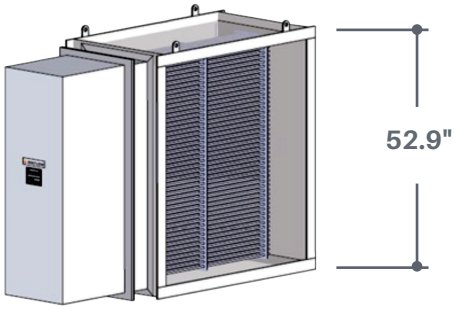

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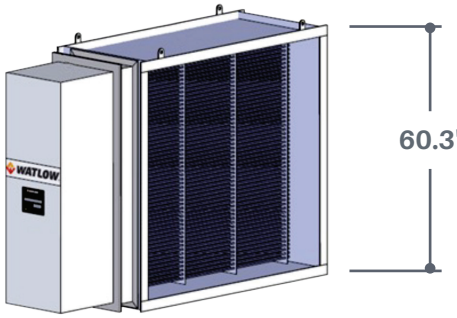

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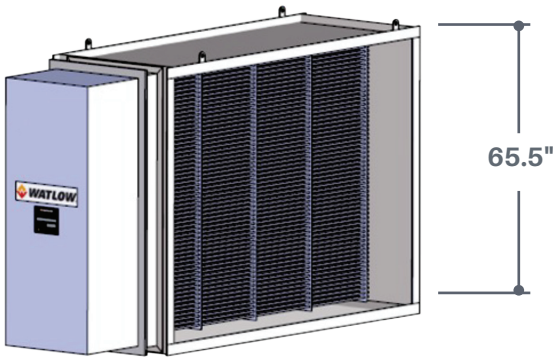

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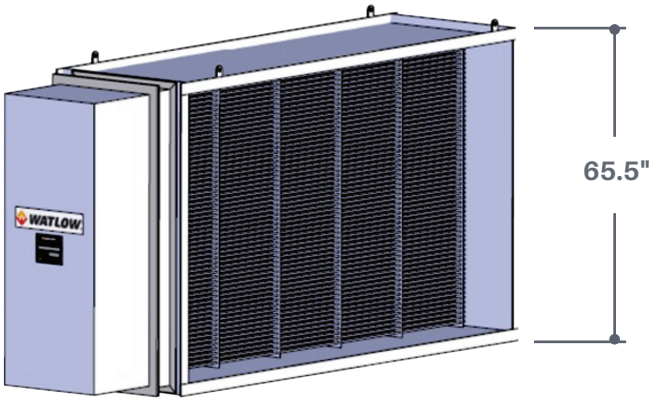

Module 6

Further information is available at: www.watlow.com