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DIRECT VERSUS INDIRECT HEATING TECHNOLOGY

Quite simply, direct heating technology involves a bulk solid material coming into direct contact with a heating gas to change the final temperature of the material. On the other hand, indirect heating technology does not allow the product to come in contact with air or gas or any other heating agent to change the final temperature. Indirect heat transfer uses conduction, radiation or convection to achieve temperature change. There are various types of technologies used in both the direct and indirect heating of bulk solids.

Rotary drum direct heat transfer

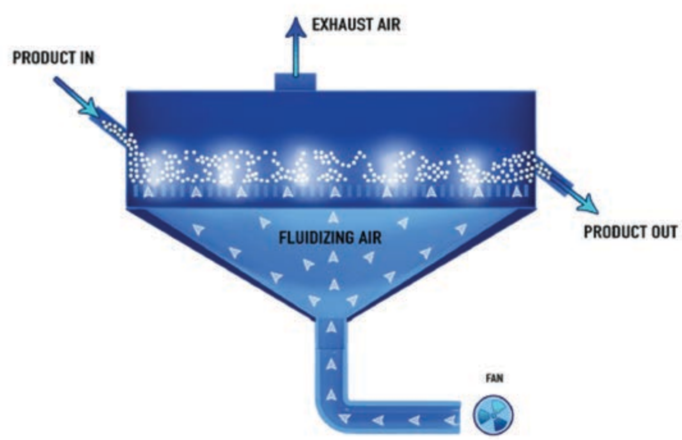
Rotary drums are commonly used to remove moisture content from a free flowing bulk solid, by bringing the material in direct contact with a heated gas, commonly air. A rotary drum is a cylindrical tube, that slopes slightly downwards and rotates rapidly. As the product (ex. powder, fertilizer, sugar) enters the drum dryer, the rotating mechanism lifts the material up onto a series of internal fins lining the outer walls of the dryer. As the material flows toward the discharge end, it falls off the fins and passes through the hot gas stream within the rotary drum, removing moisture. The gas flowing through the drum can flow in either a co-current or counter-current direction.

Rotary drum indirect heat transfer

Rotary drums can also be used in niche applications as an indirect heat transfer mechanism. This works especially well with fine, lightweight materials or highly combustible materials. The indirect heat transfer process relies on the heat from the drum's shell to dry or heat the material through conduction and radiation. The product does not come in direct contact with air in this process. To achieve conduction, hot water is poured over the drum as it rotates, heating the outer shell and in turn the material inside.

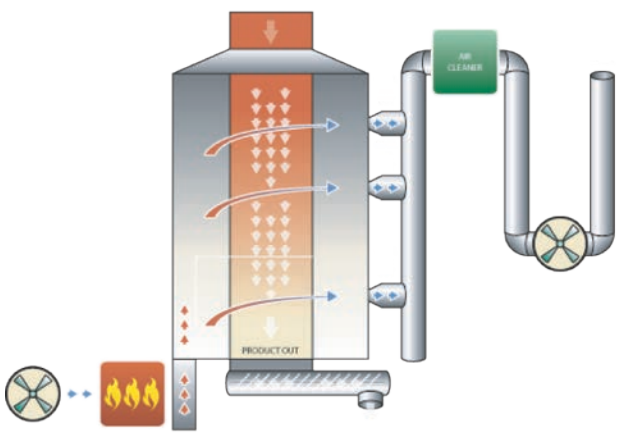
Fluid bed direct heat transfer

Another heat transfer technology is the fluid bed. This technology works well when a precise control of temperature and residence time is required such as in polymer, chemical and pharmaceutical industries. Fluid beds force air through perforated steel beds that fluidizes free flowing bulk solids. As material is added to one end of the fluidized bed, it moves gradually from one end of the bed to the other. Air or gases are introduced in this process, moving between the material particles, removing the moisture and changing the final temperature. Air has two functions in fluid bed technology; first it creates the fluidized state of the material enabling the product to flow and second, it either heats or dries the material through direct contact.



Direct Contact Bulk Solid Heat Exchangers

Direct bulk solid heat exchangers utilize vertical, enclosed hopper bins or silos that allow for the injection of gas, commonly air, to directly heat or cool the free flowing material passing through the equipment. The gas and bulk solid (ex. powder) are both fed into the heat exchanger in two streams, at different temperatures. The gas can either flow counter-current to the bulk solid, fed from the bottom upwards, as the material flows down or cross-current, in a perpendicular fashion across the material as it flows down. For successful operation, adequate heat transfer, uniform flow, proper outlet size, reliable gas flow and sufficient unit volume are required. Unlike rotary drums or fluid beds, bulk solid direct heat exchangers have no moving parts, lowering installation and maintenance costs.



The Use Of Air In Direct Heating Technology

In direct contact heat transfer systems large amounts of air are required for the process to achieve sufficient heating, cooling or drying. This requirement results in the need for air handling systems, large fans, extensive ducting and emission stacks. Pre-heating the air, as well as processing and cleaning the air, requires high energy consumption. Rotary drums and fluid beds can consume over 600kW of energy for a direct heating application of 100 tph to achieve a 25oC temperature change. While these direct heat transfer systems have been in place for decades, they are proving to be an inefficient use of resources, with a high energy consumption.

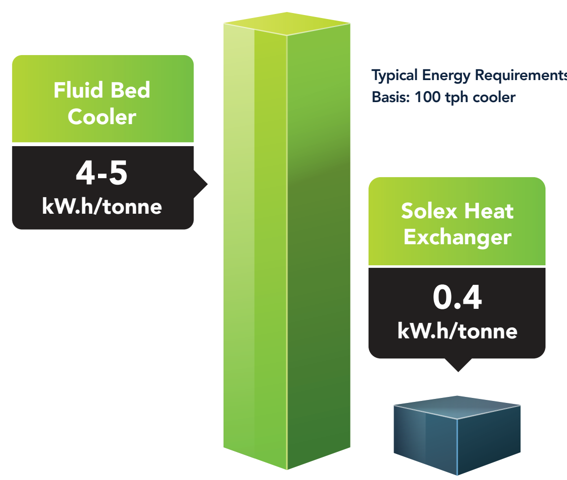
The direct heat transfer systems also results in high dust and emissions. All emissions must be cleaned before being released back into the atmosphere in order to comply with pollution and environmental controls.

Indirect Heating Technology

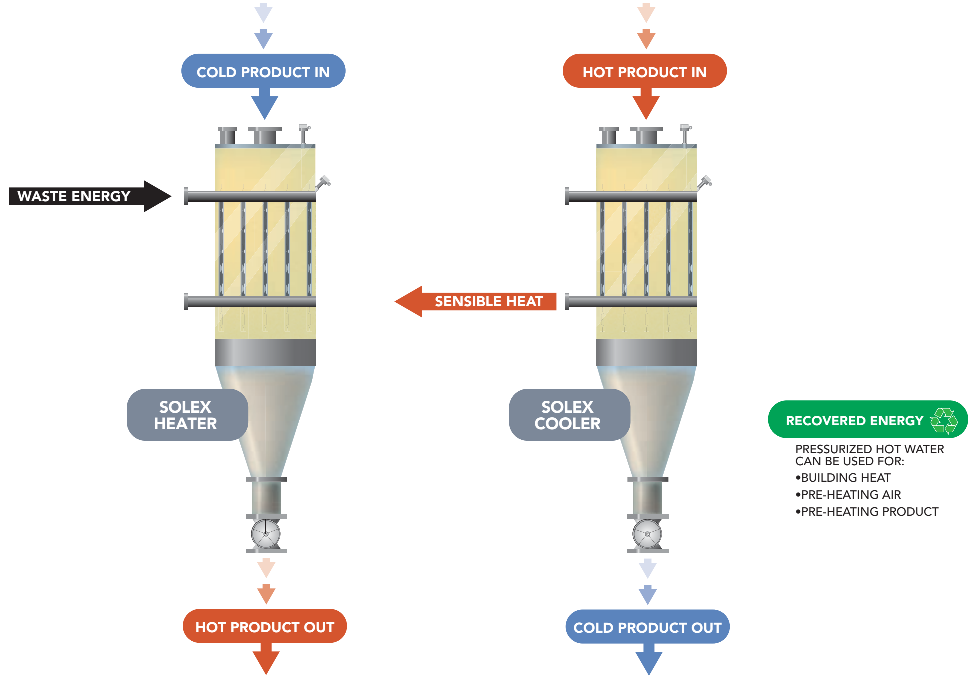
In the last 25 years, a more efficient and cost effective method has been introduced, using indirect heat transfer to heat free flowing bulk solids. A series of vertically stacked modules filled with hollow, stainless steel plates comprise an indirect heat exchanger. This unit uses a counter-current flow of heating water or fluid running through the hollow plates to achieve indirect heat transfer through conduction. As a free flowing bulk solid (ex. sugar, fertilizer, powder) flows downward between the plates at longer residence time, heat transfer occurs between the plates and the material.

There are numerous advantages to using indirect heat transfer systems:

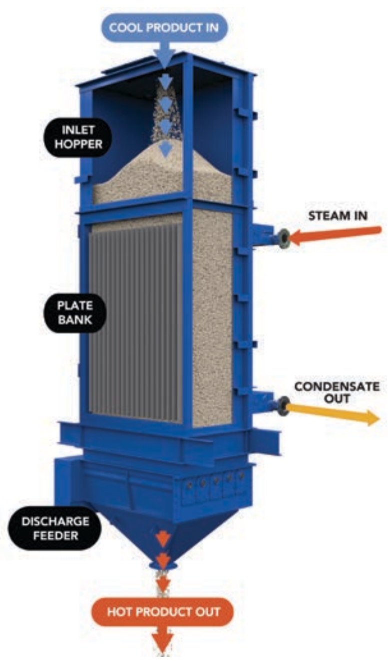
- Increased energy efficiency, as there is no need to use air in this process, eliminating redundant equipment. This process uses up to 90% less energy than traditional technologies.



- Environmentally responsible, as there is no odour, dust or emissions released in the indirect heat transfer process. Water used within this process can also be repurposed to or from other plant processes. For example, thermal energy from an indirect cooling process can be recovered and then used for preheating boiler feed water or elsewhere within the plant. Alternatively, waste energy from other plant processes can be used as a heating fluid within the indirect heat exchanger for a cooling process.



- Indirect heat transfer results in a higher quality final product, as the bulk solid does not come in direct contact with air or fluid, eliminating the risk of contamination. The slow, controlled downward flow through the indirect heat exchanger plates also prevents abrasion and degradation to the material, so there is no change in the final material's characteristics. Additionally, due to the mass flow design, the material flows at a uniform velocity resulting in a stable and even final temperature, allowing for efficient storage and transport, independent of ambient temperatures.



- The vertical orientation of the indirect heat exchanger allows for a small installation footprint, for easy capacity increases, plant retrofits and new facility installs.

- Similar to the direct heat exchanger, this indirect system has no moving parts, leading to decreased maintenance costs. Each individual plate can be removed for cleaning or replacement as required, reducing downtime and offering years of reliable operation.

Conclusion

The main difference between direct and indirect heat transfer systems is the expenditure of air required to achieve heat transfer. Chilling, heating, processing and cleaning air results in high energy consumptions in direct heating processes. While no air is required in indirect heat exchangers, reducing energy costs and allowing for the implementation of energy reuse and recovery systems. With significant efficiencies in energy consumption and process expenditure, indirect heat exchange systems are becoming a more viable solution for mineral, agricultural and powder industries.

To learn more about indirect heat exchange systems and how they can be used in heating and drying free flowing bulk solid applications, visit:http://solexthermal.com/products-solutions/