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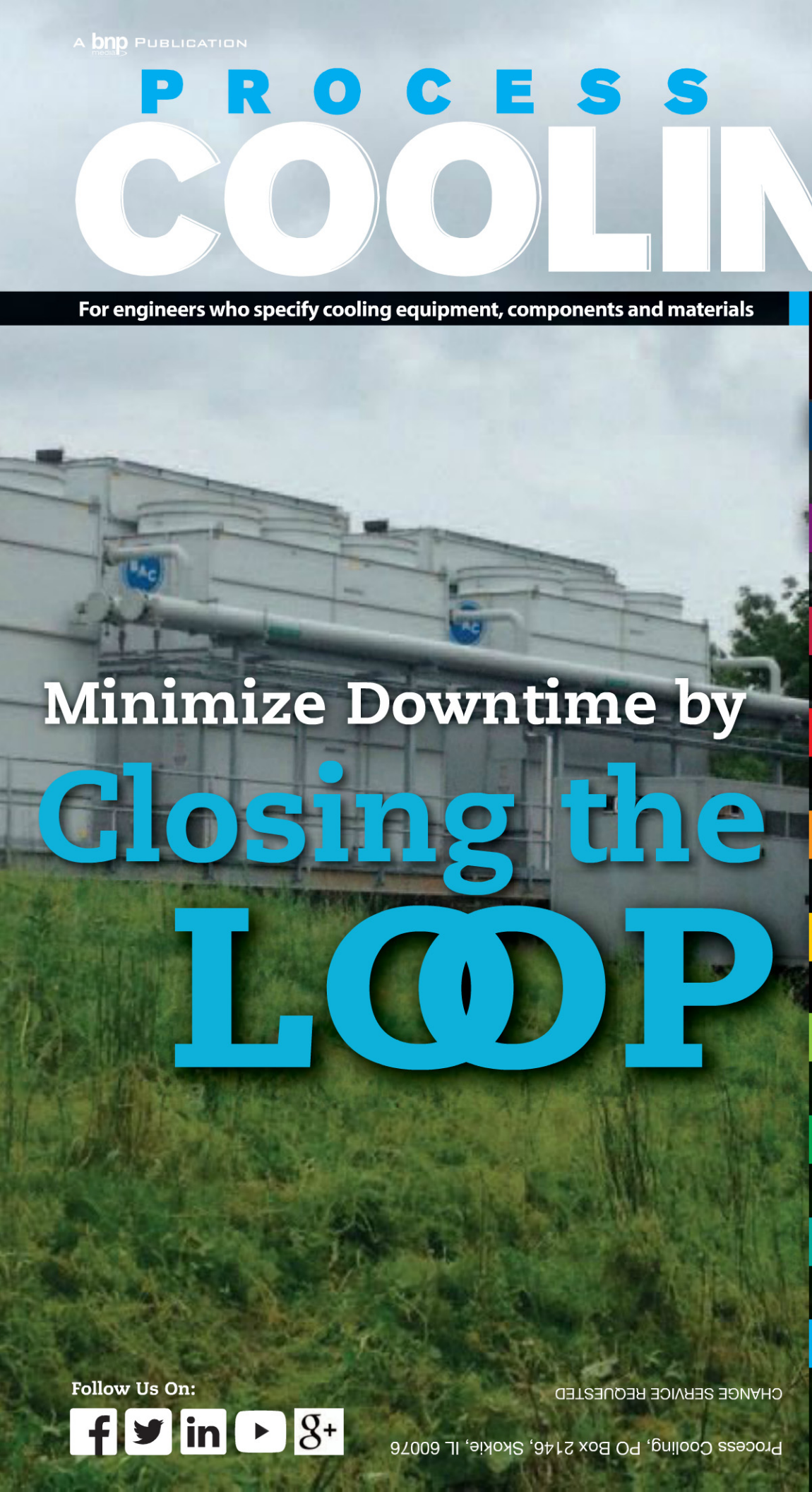

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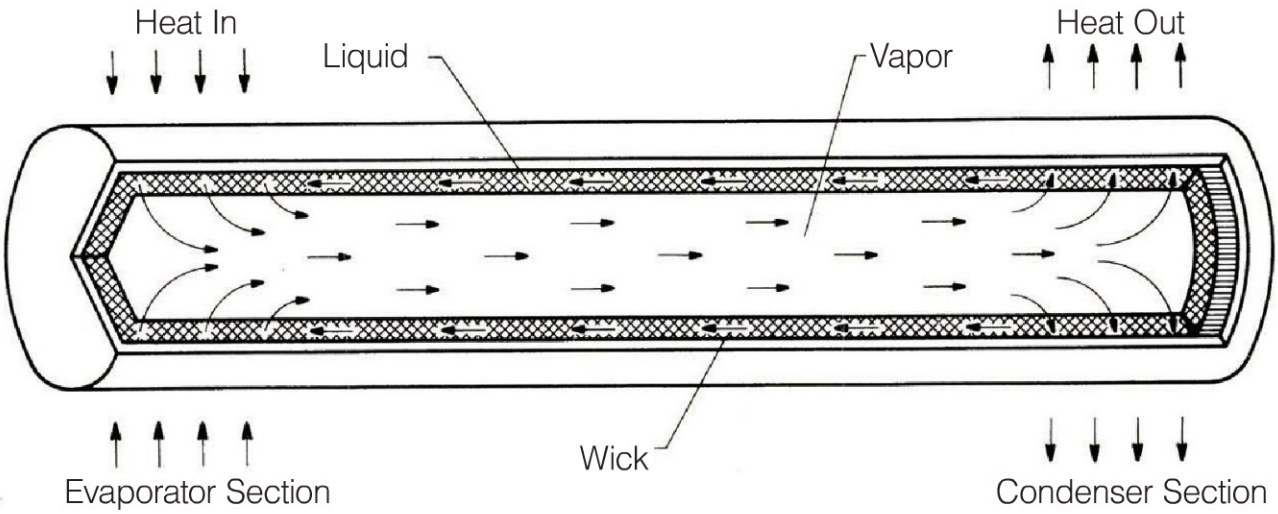


P & R

How to Achieve *Uniform Parts Cooling* and Cut Cycle Times

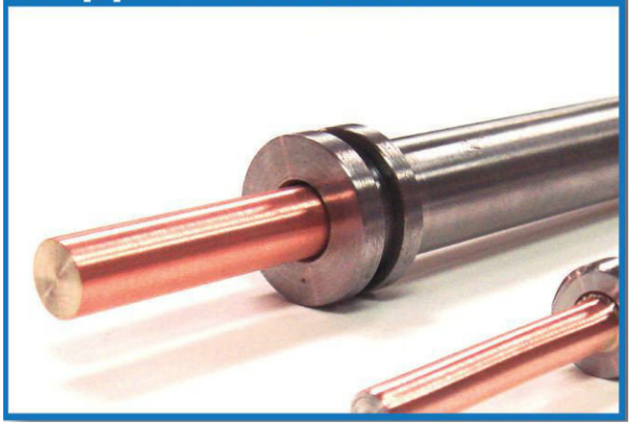
Thermal pin heat conductors can be used in plastic-molding equipment to quickly remove heat from parts to increase yields and cut cooling time.

By Eric Galliant, Noren Products

For too long, cooling parts in the injection-molding process has been a less than satisfactory process because of the occasionally high number of deficient parts that must be discarded. The problem is the significant amount of cooling time required for temperature reduction. An article by Muhammad Khan in *ISRN Mechanical Engineering* warns that "decreasing cooling time can result in excessive shrinkage and (warped) parts…so there is a need of a cooling technique to reduce the cooling time without compromising parts quality." Efforts at reduction have not always met with success, resulting in a considerable and frankly unacceptable cost impact.

For an example, just ask the bottling industry. When plastic bottles are loaded into a container during the cooling process, some if not many tend to lose clarity. For the most part, the industry's customers demand clear bottles. Lost clarity means lost dollars — the cost of bottles that must be rejected, thereby necessitating additional expenditures to replace them. While the industry seems to have accepted that some waste is likely to occur during the injection-molding process, it is well aware of the need for

Copper Thermal Pins



The copper thermal pin can serve as a thermal pathway by which heat is extracted from plastic-molding processes.

a uniform cooling process that is quicker, more efficient and less costly.

Companies have been looking at several technological solutions to rectify this drain on budgets. Some have turned to the dual narrow-water systems — sometimes referred to as bubbler systems. Another option proving to be efficient and effective for its ability to cool parts uniformly and reduce cycle times and product deficiencies is the thermal pin heat conductor (TPhc), a high-temperature heat pipe.

Thermal Pin Technology

Thermal pin applications are not limited to injection molding. Although thermal pin technology first appeared more than 40 years ago, its use continues to grow in the blow-molding, extrusion-molding and thermoforming industries as the technology has become even more sophisticated. The military relies upon TPhcs for high temperature heat transfer and dissipation for its heat-intensive computer systems in aircraft and ships.

TPhcs are thoroughfares for thermal phase change. Their value for injection molding is the capability of even cooling throughout the mold; that is, the quick reduction and removal of heat, which reduces the cycle time while increasing the yield from the process. A seemingly simple pin component — a copper mesh wick — is one important element of the pin's function. The other is a specific type of proprietary liquid enclosed in a thin copper shell. When heat is applied to the evaporator end of the TPhc, the liquid quickly vaporizes and moves to the condenser end, causing the vapor to reduce its latent heat. At this stage of the process, the fluid, now condensed, moves through the pin due to capillary action (its ability to flow freely in the narrow space) along the wick and returns to the evaporator end.

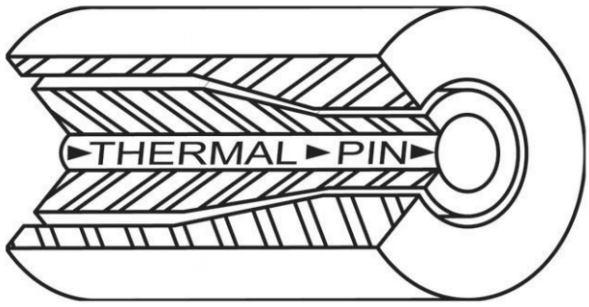
The TPhc capability of withstanding temperatures as high as 428°F (220°C) requires the use of a thicker copper wall and, of course, a higher soldering level. Some soldering levels can go as high as SN 600, but for lower temperatures, levels such as SN 63 or SN 93 should be sufficient.

While thermal pins can be manufactured to meet most sizes and configurations including finned and baffled, product manufacturers strongly warn against users attempting to machine, cut or bend TPhcs after their installation into the core. At the same time, despite the pins' resiliency, the product managers caution against applying force directly against TPhcs and any attempt to mold onto a thermal pin.

The level of solder used in the thermal pin is also its biggest safety feature. In the event of pin overheating and solder joints failing, the solder simply melts and the pin becomes inoperative. This important safety feature prevents the possibility of either explosion or melting should severe overheating occur.

One major point of differentiation between the pin and water bubblers is protection against contamination that can lead to the blockage of passageways. Thermal

Extrusion Molding

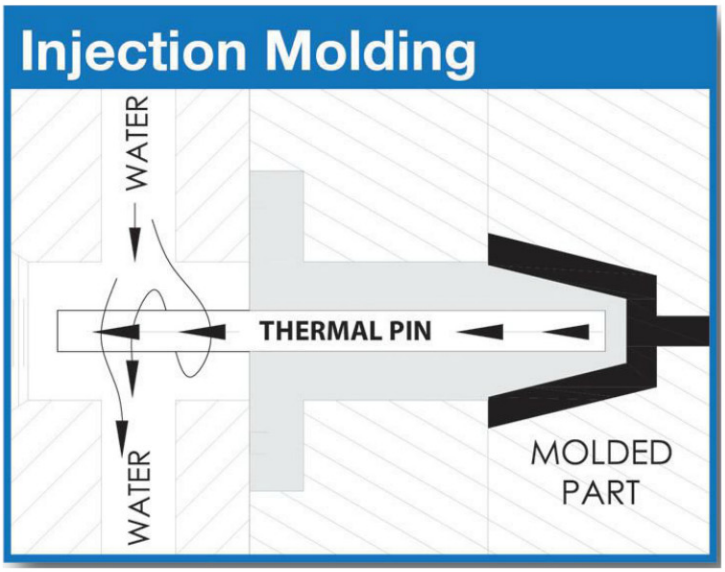


Thermal pins are suitable for applications in plastics molding, including extrusion molding.

pins can be inserted into the mold and then extended into the perpendicular water line — a process that lessens the likelihood of water becoming trapped. It is an important feature because trapped water can build up contaminants such as calcium. Dual narrow-water systems, by contrast, tend to flow around the mold, increasing the potential for calcium or other contaminant buildup because of the wider water flow.

For some in the plastic molding industries, there is a question as to whether to rely on thermal pins or gas charging. Like the thermal pin, gas charging of cores was developed to reduce cycle times and improve the yield from injection molding. In this process as the gas cycles through the core, it too undergoes a thermal phase change, starting with the liquid stage, converting to gas and finally completing the process as liquid. The choice of gas charging of cores or a thermal pin to control heat is likely to depend on the application.

Some molds already have cores where pins can be inserted while for others, it could be more suitable and efficient to drill into the mold and insert the thermal pin. It should be noted that thermal pins have been proven to last a number of years despite numerous high temperatures stresses and cycle times. The decision to use gas charging of cores will probably depend upon the length of time the mold and its process has been run.



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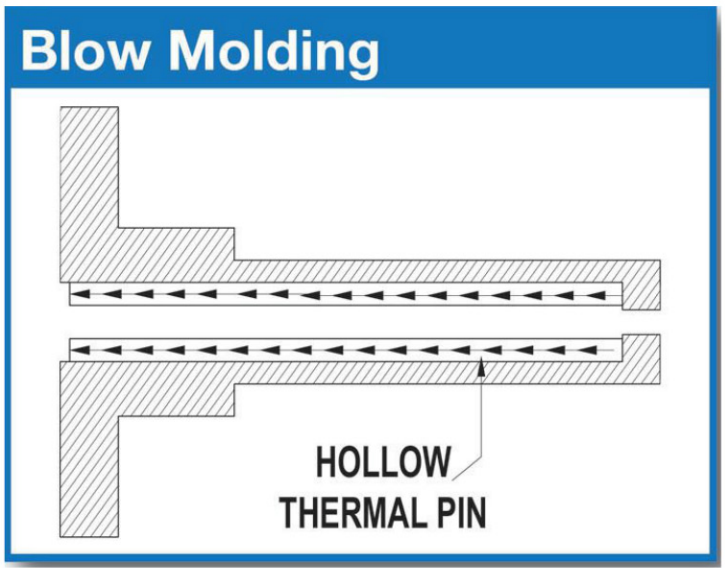
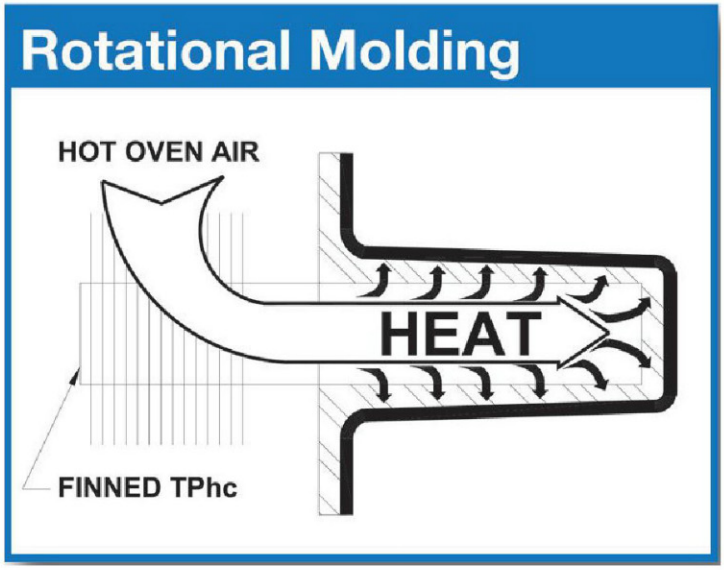


Thermal pins have been show to last a number of years despite high thermal stresses.

Practical Application

The experience of a Southwestern U.S. manufacturer of pill bottles for the medical industry can attest to the lessening of cycle time and waste reduction through the use of a TPhc in the injection-molding process. In this case, prior to converting to thermal pins, the company had to rely on an offsite holding and packaging facility due to the length of the cycle and cooling times. Employees would have to pull from the previously produced stock to cycle the pill bottles and establish whether the containers met the clarity and clearness the company's customers mandated. Often times, many of the bottles did not because of the length of time the product required to cool. The time and quality issues quickly resolved when the firm made the switch to TPhcs. Cycle and cooling times were so greatly reduced that the company could eliminate



Thermal pin heat conductors also can be used in rotational-molding applications to effect cooling.

the offsite area for box packaging. Instead, the company reports it can take the boxes to its production area to begin immediate filing even with the increased production brought about by the process change.

While there may be some differences of opinion as to the more effective approach for injection molding, TPhcs have been shown to fulfill their design specifications by improving parts quality, reducing cycle times, cutting mold costs, eliminating scale and plugging from contamination, and upgrading molds. Thermal pin technology continues to evolve for the benefit of manufacturers focused on resolving age-old problems associated with unacceptable, lengthy cycle times and parts quality. **PC**

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