porous medium, in either a structured order or randomly. The properties (such as the conduction rates and gradients) of the porous medium can be selected for homogenous heat transfer across the heat exchanger. In one embodiment, the porous medium may be produced by 3-dimensional printing technologies.

The varying cross sectional shape of the structure of a porous medium causes the turbulent flow of fluid pumped into the porous medium, increasing the rate of heat transfer between the fluid and the porous medium (and relatedly, any mediums coupled to the porous medium). Heat transfer (and accordingly, cooling times) can be improved by as much as 300% or more between fluid within the porous medium and the porous medium itself as compared to the heat transfer between a fluid flushed through an empty cavity and walls of the cavity. In addition to the benefit of increased heat transfer, the structure of a porous medium can provide increased structural support within a cooling cavity (a cavity thermally coupled to a medium to be cooled) compared to an empty cavity.

FIG. **4** illustrates a porous medium within an injection molding coolant system, according to one embodiment. The embodiment of FIG. **4** illustrates a cooling system within a male mold component **112**, though it should be noted that such a cooling system can be implemented within a female mold component or any other injection molding component according to the principles described herein.

The male mold component **112** includes a porous medium **404***a* within a first cooling well, and includes a porous medium **404***b* within a second cooling well. It should be noted that although the male mold component **112** of FIG. **4** includes two cooling wells, each filled with a porous medium **404**, in other embodiments, mold components can include any number of cooling wells within any number of porous mediums. In addition, in the embodiment of FIG. **4**, the cooling wells are separated from a mold cavity (formed when the male mold component **112** is coupled to a reciprocal female mold component) by a mold wall **304** (which thermally couples the mold cavity to the porous mediums within the cooling wells).

The male mold component **112** includes a mold inlet **202**, a coolant inlet **120** and a coolant outlet **122**. The coolant inlet **120** is coupled to a pump **410**, which is coupled to a coolant supply tank **408**, which in turn is coupled to the coolant outlet **122**. Coolant is pumped from the coolant supply tank **408** by and through the pump **410** and into the male mold component **112** via the coolant inlet **120**. Coolant in turn flows out of the male mold component **112** via the coolant outlet **122** and into the coolant supply tank **408**. It should be noted that in some embodiments, a pump (not illustrated in the embodiment of FIG. **4**) can pump coolant from the male mold component **112** through the coolant outlet **122** and into the coolant supply tank **408**.

Coolant pumped into the male mold component **112** via the coolant inlet **120** flows into the porous mediums **404***a* and **404***b* via porous medium inlets **402***a* and **402***b*. The porous medium inlets **402** are coupled to the coolant inlet **120** such that coolant flowing through the coolant inlet **120** into the male mold component **112** flows out of the porous medium inlets **402** and into the porous mediums **404**. In some embodiments, the porous medium inlets **402** are located within the porous mediums **404** such that the porous mediums **404** partially or completely surround the porous medium inlets **402**. In other words, each porous medium inlet **402** is located within the porous medium **404** such that the porous medium inlet is not in direct contact with the mold wall **304**. In some embodiments (such as the embodiment of FIG. **4**), the porous medium inlets **402** include a length of pipe and extend into the porous medium **404** such that the pipe walls of at least a portion of the length of pipe is surrounded by the porous medium.

Coolant pumped into each porous medium **404** via a corresponding porous medium inlet **402** flows from the porous medium inlet, through and out of the porous medium via one or more porous medium outlets (such as the porous medium outlets **406***a* and **406***b*), and out of the male mold component **112** via the coolant outlet **122**. The coolant flows through the porous mediums **404**, allowing for the transfer of thermal energy from liquid plastic pumped into a mold cavity, through the mold wall **304**, and to the coolant within the porous mediums **404**. As described above, the porous mediums **404** allow for the cooling of molded components due to the transfer of thermal energy from the molded component to coolant within the porous mediums at a faster rate than hollow cooling wells.

In some embodiments, coolant is pumped from the coolant supply tank **408**, into the male mold component **112**, through the male mold component, and out of the male mold component to the coolant supply tank via piping, tubing, or any other coupling medium configured to allow for the transfer of coolant ("pipe" or "piping" hereainafter). In some embodiments, each porous medium inlet **402** within the male mold component **112** is coupled to the coolant inlet **120** via a first pipe. Likewise, in some embodiments, each porous medium outlet **406** is coupled to the coolant outlet **122** via a second pipe.

In some embodiments, the pump **410** can include or be coupled to a coolant system controller (not illustrated in the embodiment of FIG. **4**) configured to control the pumping of coolant from the coolant supply tank **408** and into the male mold component **112**. For instance, the coolant system controller can determine when liquid plastic is injected within a mold cavity, can pump coolant through the male mold component **112** in response to such a determination, can detect when the temperature of the injected liquid plastic falls below a solidifying threshold, and can stop pumping coolant into the male mold component in response to such a determination. In some embodiments, the coolant system controller can control the injection of liquid plastic into the mold cavity, the coupling and decoupling of mold components, and any other functionality associated with the operation of an injection molding system. In alternative embodiments, an external injection molding system controller controls such functionalities, and is communicatively coupled to the coolant system controller, for instance communicating to the coolant system controller when liquid plastic is injected into the mold cavity. The coolant system controller can be communicatively coupled to one or more thermal sensors coupled to the mold cavity or mold wall **304** and configured to provide the temperature of injected liquid plastic to the coolant system controller.

The coolant supply thank **408** is configured to maintain the temperature of coolant within the tank, for instance by reducing the temperature of coolant flowing out of the coolant outlet **122** and into the coolant supply tank **408** to a predetermined temperature threshold. It should be noted that although the coolant supply tank **408** and the pump **410** are coupled to one mold component in the embodiment of FIG. **4**, in practice, the coolant supply tank **408** can provide coolant to any number of mold components using one or more pumps. For example, the coolant supply tank **408** can provide coolant to a first mold component (such as a male mold component) and a second mold component (such as a female mold com-