ALL THE BENEFITS OF TURBOCOLLECTOR®
- WITH THE SYSTEM CONDITIONS:
  • Reynolds Number less than 2000
  • High viscosity fluid
  • High concentration of antifreeze
  • Cooling mode with oscillation loads

TURBOCOLLECTOR® GIVE HIGH COP

• Lower operating time for the circulation pump
• 5-10% faster payback of the entire system
• Lower borehole resistance with lower flow rate
CONDUCTIVITY / RESISTANCE

The amount of heat that can be transferred between surrounding ground and heat carrier fluid depends on the two thermal properties: The thermal conductivity of the soil and the thermal resistance of the borehole. The soil quality is usually related to geological situation which cannot be changed by planer but borehole thermal resistance can be engineered and must be kept as low as possible.

Borehole thermal resistance $R_b$, consists of the convective resistance of the fluid, thermal resistance of the fluid/pipe, short-circuiting effect between the shanks, the conductive resistance of the pipes, contact resistance of pipe and backfilling material, conductive resistance in the backfilling material and contact resistance of backfilling material and soil. The first three parameters can be reduced by increasing the flow rate of the fluid but increasing the flow rate has some side effect on the efficiency of the heat pump. Therefore there is a need to have a verified, scientificallybased design tools to warrant of an optimal system that works prefect in long term.

DECREASE THERMAL RESISTANCE

The picture up to the right shows that higher flow rate can improve the performance of the system by decreasing the borehole thermal resistance. However this advantage is tradeoff by higher energy consumption of the circulation pump. The circulation pump must overcome the system's pressure drop. It means a bigger pressure loss, a larger circulation pump is required and greater pump power consumption.

SMALL CHANGES IN THE FLOW RATE CAN CAUSE A RATHER BIG CHANGE IN PRESSURE DROP

The picture illustrates that small changes in the flow rate can cause a rather big change in pressure drop, in fact the pressure drop is proportional of power 2 of flow rate. At the same time, pump consumption is linear dependent on both pressure drop and flow rate. An important practical conclusion is that, the energy consumption of the circulation pump in the heat pump is roughly proportional to the third power of the flow rate. Pumping power is essentially important and plays a big role in the coeffi- cient of performance known as COP. Here it can be concluded so fer that flow rate in a GSHP system is an important factor; COP would be maximized when the flow rate is in an optimal set up.

A GOOD GSHP SYSTEM HAS THE FOLLOWING CHARACTERISTICS:

- Has high heat exchange efficiency with the surrounding heat source (with low borehole thermal resistance) particularly at the peak load.
- Has a turbulent flow regime in the system for the higher heat transfer.
- Has an acceptably low pressure drop to minimize circulation pump power consumption.

RESEARCH STUDIES

MuoviTech has been conducting a number of research studies to improve the quality of the system through achieving a low value of $R_b$. Based on these research studies a geothermal collector with a turbulator mechanism (passive) known as the Turbo Collector® has been developed. TurboCollector® is the state of the art technology and patent pending which has an internally-twisted fin that can apply for different U pipe collectors in the GSHP systems. These fins disturb the laminar sublayer adjacent to the internal pipe surface and enhance the heat transfer.
CONCLUSION

GET LOWER BOREHOLE RESISTANCE WITH TURBOCOLLECTOR® AT LOWER FLOW RATES.
Check Borehole Thermal Resistances at different flow rates.

Borehole Resistance [K/(W/m)]
Borehole wall temp 7.2°C
All single U pipes PE 40 SDR 17

PRESSURE DROP CAN BE ESTIMATED BY THEORETICAL MODELS
Check Pressure loss for different BHE at different flow rates. Pressure drop [kPa]

RESULT
Experimental values are higher than calculated / theoretical values for TurboCollector®. This gives an extra marginal in calculations for TurboCollector®.

HEATING / COOLING
This study carried out in the heat extraction (simulating the heating mode). It is also of interest to see the results in the cooling mode. Another study was therefore conducted to check the behavior of an inner-finned pipe at two different flow rates in one borehole. This was done by a conventional Thermal Response Test (TRT) in a water-filled borehole equipped with a 200 m length with a TurboCollector® with double U-pipe 32 mm SDR 17. The fluid was mixture of water and ethanol 15%.

CONCLUSION
There are several important factors in GSHP systems. Among of them is the flow rate of the secondary fluid of the ground side. Flow rate can significantly effect on pressure drop and also on pump energy consumption. Heat exchange characteristics of a collector with turbulator (TurboCollector®) in a passive mode with smooth collectors in different arrangement were evaluated. Results indicate that micro fins can contribute to better heat transfer and pipes with the inner finned improve the performance of the system by lower borehole thermal resistance. This type of collectors can be applied for both cooling and heating mode meanwhile the flow rate can be set in a lower value compared to the smooth pipes. Moreover, the pressure drop in the collectors with turbulent promoter can be estimated by theoretical models.
REDUCE THE FLOW RATE WITH 10-20%

BENEFITS FOR END USERS
- TurboCollector® gives 5-10% faster pay back time and a greater value on sale.
- TurboCollector® allows the heat pump to use less energy because it can run with a lower flow rate.
- Additional benefits are that the heat pump service life will be longer and require less maintenance.
- The characteristics of TurboCollector® make the heat pump works longer time before turning over to direct electricity at peak loads.

WHAT IS THE MAGIC?
TurboCollector® is a patented development with fins inside the pipe. The fins gives more turbulent flow and extract more energy than a traditional smooth pipe.

PRODUCTION DIMENSIONS
- 2x32mm PE 32x3.0 PN16 SDR11
- 4x32mm PE 32x2.0 PN10 SDR17
- 4x32mm PE 32x3.0 PN16 SDR11
- 2x40mm PE 40x2.4 PN10 SDR17
- 2x40mm PE 40x3.7 PN16 SDR11
- 4x40mm PE 40x2.4 PN10 SDR17
- 4x40mm PE 40x3.7 PN16 SDR11
- 2x50mm PE 50x3.0 PN10 SDR17
- 2x50mm PE 50x4.6 PN16 SDR11
Available in PE 100, PE 100+ and PE 100 RC

CERTIFICATE
P-mark by SP SC1106-11.