TURBOCOLLECTOR®

BY MuoviTech®

SAVING 30% ELECTRICITY

- SAVING DIRECTLY 30-50% ELECTRICITY FOR THE CIRCULATIONS PUMP.
- SHORT PAYBACK TIME FOR THE WHOLE SYSTEM.

HIGHER COP

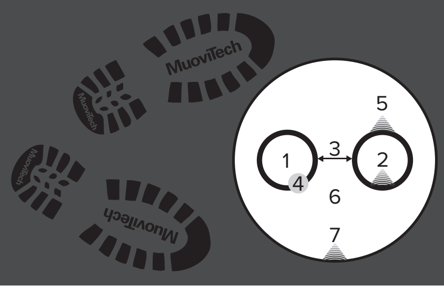
- LOWER FLOW RATE WITH THE SAME EFFECT. TURBOCOLLECTOR® NEED 1.5 m^3/h WHEN A SMOOTH PROBE NEED 1.8 m^3/h.
- REYNOLDS NUMBERS 3.300-3.500. (SMOOTH 3.400-3.800)

SLEEP WELL GUARANTEE

- THE ENVIRONMENTAL CHOICE WITH LOWER $C0_2$ EMISSIONS.
- BETTER MATERIAL COMPOSITION FOR AVOID LEAKAGE.

MuoviTech®

BEST IN EARTH.



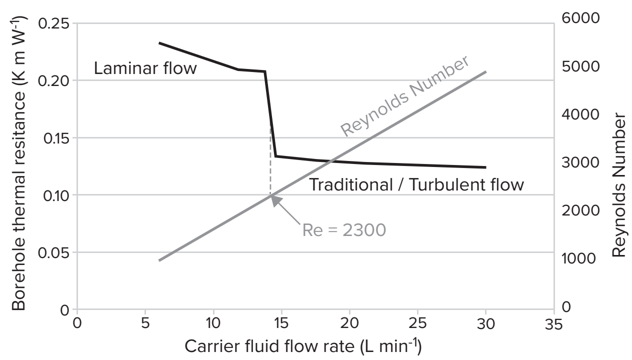
THERMAL PROPERTIES OF A BOREHOLE

1. Convective resistance for the fluid.
2. Thermal resistance of the fluid/pipe. (Laminar sub layer)
3. Short circuit for upwards and downwards. Space between pipes.
4. Conductive resistance of the pipe.
5. Contact resistance of the pipe and the backfilling material.
6. Conductive resistance of the backfilling material.
7. Contact resistance of the backfilling material and the ground.

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 Rb, 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 back filling 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.



1. The dependence of borehole thermal resistance and fluid flow rate.
2. Calculations were made using the program EED.
3. Based on a 127 mm borehole diameter with a single U pipe 32 mm SDR11 and carrier fluid 25% ethylene glycol.

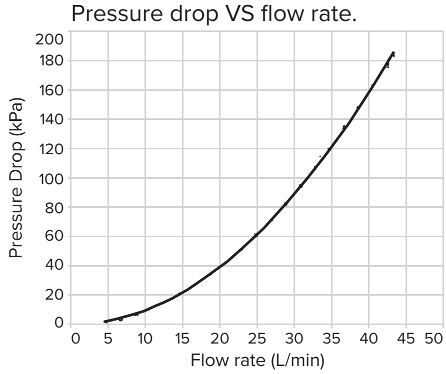
DECREASE THERMAL RESISTANCE

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 coefficient of performance known as COP. Here it can be concluded so far 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.

Pressure drop VS flow rate.



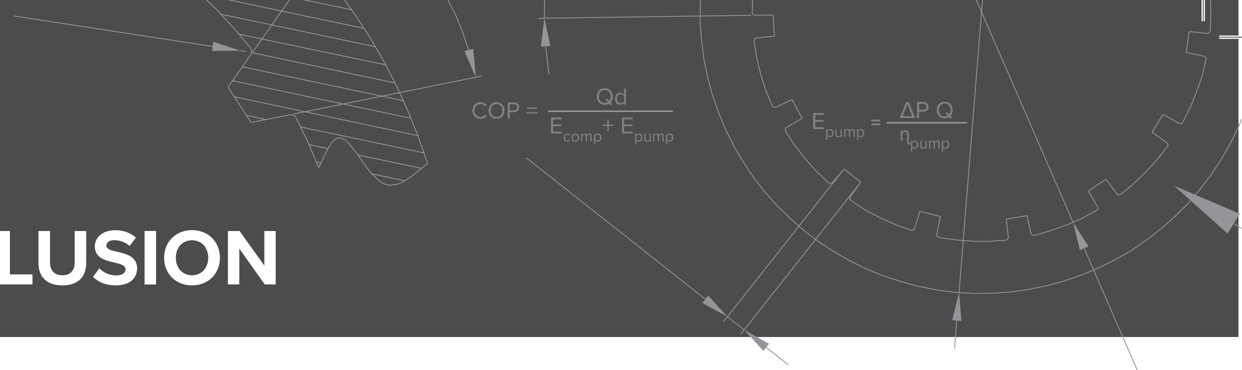
Borehole 200m with single U pipe 40 mm diameter with SDR11. Water as fluid at 10°C.

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

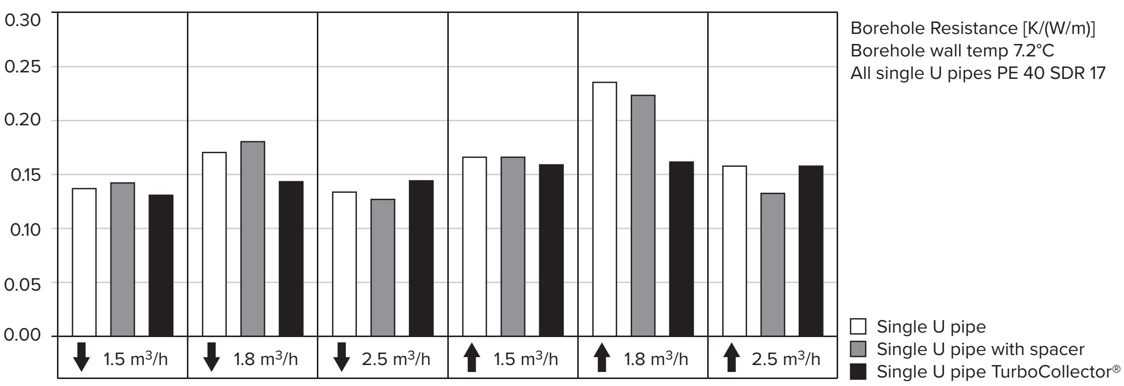
MuoviTech has been conducting a number of research studies to improve the quality of the system through achieving a low value of Rb. Based on these research studies a geothermal collector with a turbulator mechanism (passive) known as the Turbo Collector® has been developed. TurboCollector® is the state 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

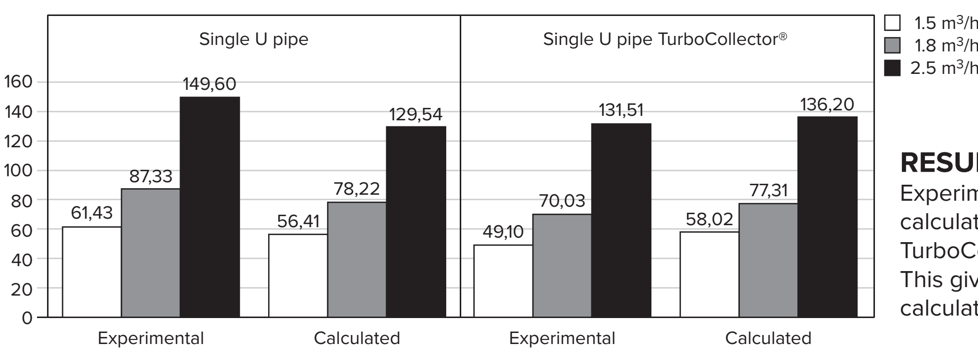
GET LOWER BOREHOLE RESISTANCE WITH TURBOCOLLECTOR® AT LOWER FLOW RATES.

Check Borehole Thermal Resistances at different flow rates.



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 lower than calculated / theoretical values for TurboCollector®.
This gives an extra mariginal 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%.

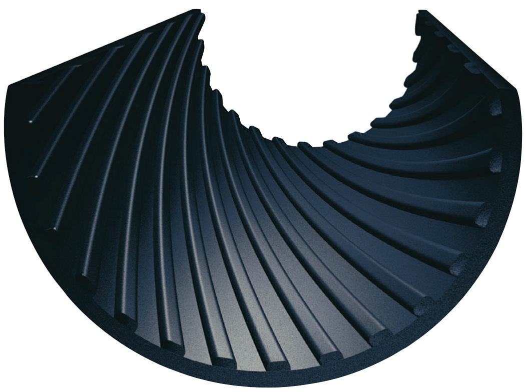
CONCLUSION

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.



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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
2x45mm	PE 45x2.4 PN10 SDR17
2x45mm	PE 45x3.7 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.