Remote monitoring

GECCO2 has developed a thermal response test rig, suitable for remote use by non-specialists

A closed-loop ground-source heat-pump (GSHP) heating or cooling system comprises three basic elements – a ground loop or geo-exchange, heat pump and heat-distribution system.

The system circulates a glycol solution through the geo-exchange, which is buried in the ground; installed either horizontally or vertically.

The circulant used is at a lower temperature to the surrounding ground and is gently warmed as it progresses through the system. The low-grade heat captured during this process is then transferred to a heat pump, where it is used to heat a refrigerant, which is then compressed, generating further heat.

A thermal response or thermal conductivity test determines an essential design parameter. It enables the accurate design of a ground array for a GSHP system, by directly establishing the thermal properties of the ground conditions at the exact location of the proposed borehole field. It thus reduces design risk and increases the potential for value engineering of a system.

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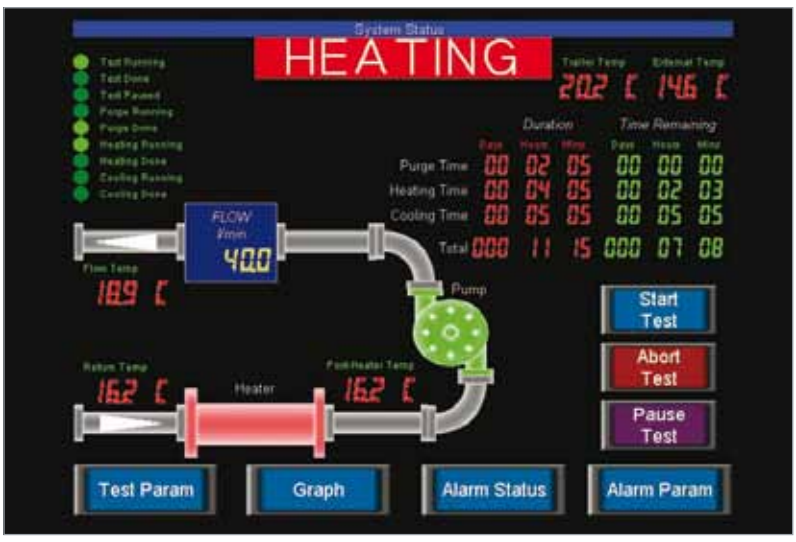
As the ground array is the most expensive element per kW of a GSHP installation, oversizing one can have a dramatic impact on its cost and thus economic viability. Oversizing also has implications in terms of the amount of time it takes to physically install the ground array, leading to further additional costs in terms of labour, materials, plant and equipment.

On the other hand, an undersized ground array will place too much strain on the ground, greatly reducing the coefficient of performance (CoP) of the heat pump, making it much more expensive to run.

A sustainable and well-designed heat pump system should provide a CoP of about four; meaning that, for every unit of electricity the heat pump uses, it produces four units of heat energy. If the CoP is reduced, not only will it cost far more to run the system, but it will also reduce or possibly even negate any carbon savings.

The UK has some of the most complex and varied geology in Europe. Whereas other countries may be able to rely on published data to provide accurate and reliable thermal conductivity values for a particular location, this is not the case in the UK.

Of course, published data exists and can provide a useful starting point for determining a system design, but to ensure sustainability, particularly for larger or commercial schemes, a thermal response test (TRT) is vital for establishing the properties of the unique ground conditions for a particular project. Depending on the size of the ground array or conditions on site, it may even be necessary to conduct more than one TRT.



The rig's control panel operation status screen

Conducting a TRT

During a TRT, a glycol solution is circulated through a geothermal loop installed in a borehole or pile of a certain length, depending on the design of the system, for a set period of time (usually 72 hours). This allows the thermal conductivity properties of the ground conditions at a particular site and depth to be determined.

A TRT can be conducted on a borehole that was either installed early on in a larger scheme to verify the design (with a greater or lesser number subsequently drilled, according to the results), or on a borehole specifically drilled for the test, possibly prior to a design being finalised. Either way, the borehole used for the test can be fully included in the final scheme.

A TRT cannot, however, be carried out on a freshly installed borehole. There should be at least five full days after drilling before a TRT is conducted, depending on the drilling technique and ground conditions. This ensures any exothermic reactions from the drilling and grouting process have completed, and will not affect the results.

Good TRT practice is to run a test for a minimum of 50 hours. Additional testing during the TRT can also give an indication of other factors that may affect GSHP system performance, such as groundwater flow, for which there has been little published data.

Exacting specifications

GECCO2 has developed a TRT rig. Built in-house to exact specifications, the rig has been refined over the last two years to produce a streamlined product that overcomes many of the issues traditionally associated with undertaking a TRT.

Running 24 hours per day over several days, taking multiple readings every minute, the rig has the ability to operate

The GECCO2 TRT rig

in any geographical location and in almost all weather conditions. The product has now been further developed to allow clients to operate their own rig and perform their own TRTs, should they wish.

The GECCO2 TRT rig is subject to a six-week build programme from the receipt of the order, followed by a comprehensive two-week programme of testing, calibration and commissioning. GECCO2 offers a full 12-month warranty, as well as an operation and maintenance manual.

Options include an after-sales package that allows non-specialist operators to perform TRTs; the results of which are forwarded to GECCO2, which then analyses and interprets the data, and prepares the report.

The rig's new features were developed in response to an approach by a world-leading, geothermal supplier in 2009. The supplier was very impressed with the advanced functionality and technology offered by GECCO2.

Following an online demonstration of a TRT, the client visited the company's UK offices for a working demo of the rig's capabilities, and to discuss in further detail their exact requirements. A bespoke rig was commissioned, with options selected to meet the client's specific requirements.

During the manufacturing process, GECCO2 worked closely with the client to ensure the rig met its exact specifications. The company considered project case studies and ascertained the key usage parameters for the rig, advising the client on the best options to maximise functionality.

For example, GECCO2 found that the rig would often be in remote locations, so the inclusion of a remote operation/monitoring option was essential.

As well as developing a specific and technologically advanced product, GECCO2 offered the client a full after-sales and support package. This included remote test monitoring from the client's office in Norway, as well as from the UK.

GECCO2 also offered full interpretation of the test data and report preparation, and ongoing maintenance services.

For information visit www.gecco2.com

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