METER
ENVIRONMENT

SCIENTISTS MEASURE THERMAL PROPERTIES IN FAMOUS JAPANESE TOMB

Named for the tall pine tree that sits at the top of the tumulus earth mound, Takamatsuzuka Tomb is located in the Asuka village, just south of Nara, Japan. Located within the tomb are some of the most beautiful and famous Japanese wall paintings. Discovered in 1972, the paintings are believed to have been made at the end of the seventh and beginning of the eighth centuries. Though it is unknown who is actually buried in the tomb, the murals are worthy of a nobleman. They depict a small-scale universe, including star constellations, the sun, the moon, and guardian gods, for the deceased.

In 2001, this national treasure became threatened by mold growing on the interior lime plaster walls. High humidity and high water content of the lime plaster walls are believed to be the main contributor to mold growth. As a short-term solution, a cooling system was put in the structure to prevent further growth. To optimize efficiency, scientists used a METER thermal properties analyzer to determine the thermal properties of the tomb and surrounding soil.

As a long-term solution, the Agency of Cultural Affairs has decided to move the stone interior of the tomb to another location where the environment can be more easily controlled.

WHY MEASURE THERMAL PROPERTIES?

Thermal properties tell scientists important things about soil or other porous materials. Thermal conductivity is the ability of a material to transfer heat. Thermal resistivity, the inverse of conductivity, illustrates how a well a material will resist the transfer of heat. Volumetric heat capacity is the heat required to raise the temperature of unit volume by 1 °C, and thermal diffusivity is a measure of how quickly heat will move through a substance.

Thermal property measurements are needed in varying industries and research fields. One example is underground power cable design. Electricity flowing in a conductor generates heat. Any resistance to heat flow between the cable and the ambient environment causes the cable temperature to rise. This can harm the cable and may even cause power outages in large sections of major cities. When cables are buried, soil forms part of the thermal resistance, and thus soil thermal properties become an important part of cable design.

Other popular applications for thermal property measurements include thermal conductivity of concrete, thermal conductivity of nanofluids, thermal resistivity of insulating material, and thermal properties of food. Unique applications range from measuring human tissue to adobe houses.

The METER TEMPOS thermal properties analyzer differs in that heat is only applied to the needle for a short amount of time and temperature is measured as the material heats and cools

THE LINE HEAT SOURCE METHOD IS THE ONLY WAY TO MEASURE MOIST, POROUS MATERIALS

The standard technique for measuring thermal properties is called the steady-state technique (guarded hot plate method). The steady-state technique requires a needle to be heated until it comes to a steady state, at which time it measures the temperature gradient and determines the thermal properties of the measured material.

The transient line heat source method used in the METER TEMPOS thermal properties analyzer differs in that heat is only applied to the needle for a short amount of time and temperature is measured as the material heats and cools. The steady state technique is a good fundamental method because it uses the simplest equation. However, it takes a full day to make a measurement because of the wait for steady state. In addition, when measuring a porous material that contains moisture, heat flow will make moisture move away from the heated area and condense on the cold area. Thus, the thermal properties of the material will change.

This means there's no way to measure the properties of moist, porous materials with the steady-state method. The transient line heat source method, however, is able to measure the thermal properties of moist, porous materials, and it can even measure thermal conductivity and thermal resistivity in fluids.

Discover the TEMPOS