

Thermosel

A practical guide to thermosel, covering the reader intent, the relationship to thermosel, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the landscape of industrial fluid dynamics and process control, the ability to accurately measure and manage high-viscosity materials at elevated temperatures is a critical requirement. The term "thermosel" typically refers to a specialized system designed for the viscosity measurement of materials such as hot melt adhesives, resins, waxes, and asphalt. While the thermosel system is a staple of the laboratory and quality control environment, the materials it characterizes—often referred to as "thermosel-tested" fluids—present unique challenges when transitioning from the lab to large-scale industrial storage and processing tanks.

For engineers and plant managers, understanding the rheological properties provided by a thermosel system is the first step in selecting the appropriate industrial level measurement instrumentation. This article explores the principles of high-temperature viscosity measurement and provides a comprehensive guide to selecting and installing level sensors for the demanding environments where these materials are processed.

| Understanding the Thermosel Measurement Principle

Before discussing the industrial level measurement of high-viscosity fluids, it is essential to understand how a thermosel system operates. In a laboratory setting, a thermosel system is used in conjunction with a rotational viscometer to measure the resistance of a fluid to flow at specific, controlled temperatures.

The system consists of a thermo-container (a heating chamber), a proportional-plus-integral (PI) temperature controller, and specialized spindles (often SC4 spindles). The material is placed in a small sample chamber, which is then inserted into the thermo-container. The heating element ensures that the sample reaches a stable, uniform temperature, which can range from room temperature up to 300°C (572°F).

As the viscometer spindle rotates within the heated sample, the system measures the torque required to overcome the fluid's internal friction. Because viscosity is highly temperature-dependent, the precise thermal control of the thermosel allows for the creation of viscosity-temperature profiles. These profiles are vital for determining the pumpability of a fluid and for selecting level measurement technologies that can withstand the same thermal and physical stresses found in the production line.

Transitioning from Lab to Tank: Level Measurement Principles

When materials characterized by a thermosel system are scaled up to industrial volumes, the focus shifts from measuring viscosity to measuring the volume or level within a vessel. The high temperatures and potential for material buildup (caking) mean that traditional contact-based level measurement often fails. Here, we examine the primary principles used for monitoring these complex fluids.

1. Non-Contact Radar (Microwave) Technology

Non-contact radar level meters emit high-frequency electromagnetic pulses (typically in the 26 GHz or 80 GHz range). These pulses travel at the speed of light, reflect off the surface of the material, and return to the sensor. The time-of-flight is used to calculate the distance. For materials like hot resins or bitumen, radar is often the preferred choice because it is unaffected by the high temperatures and vapors that would interfere with other technologies.

2. Ultrasonic Level Sensing

Ultrasonic sensors use sound waves to detect the material surface. While cost-effective, they are generally less suitable for "thermosel-type" applications. High temperatures can change the speed of sound in the air gap above the liquid, leading to inaccuracies unless sophisticated temperature compensation is used. Furthermore, heavy vapors or steam common in heated tanks can attenuate the acoustic signal.

3. Guided Wave Radar (GWR)

GWR utilizes a probe that extends into the material. The microwave pulse travels along the probe, reflecting at the point where the dielectric constant changes (the liquid surface). While highly accurate, the high viscosity of materials tested by thermosel systems can lead to "bridging" or material buildup on the probe, which may require frequent cleaning or specialized probe coatings.

4. Hydrostatic Pressure Measurement

This method measures the pressure exerted by the liquid column at the bottom of the tank. For high-temperature, high-viscosity fluids, a diaphragm seal (chemical seal) with a capillary tube is required to isolate the sensor electronics from the heat. However, if the fluid's density changes significantly with temperature—a common trait in thermosel-tested materials—the level reading must be compensated accordingly.

Selection Criteria for High-Temperature Level Instrumentation

Choosing the right instrument requires a balance between the physical properties of the fluid and the environmental conditions of the tank. The following table provides a comparison of technologies for applications involving high-viscosity, heated materials.

Technology	Temperature Limit	Viscosity Tolerance	Accuracy	Suitability for Vapors/Steam
Non-Contact Radar	Up to +450°C	Excellent (No contact)	±2 mm to ±5 mm	Excellent
Guided Wave Radar	Up to +400°C	Moderate (Buildup risk)	±2 mm	Good
Ultrasonic	Up to +150°C	Good (No contact)	±0.25% of range	Poor
Hydrostatic	Up to +315°C	Good (With seal)	±0.1% to ±0.5%	Good

With remote diaphragm seals and high-temperature fill fluids.

For most industrial applications involving polymers, hot melts, or bitumen, the non-contact radar level meter offers the highest reliability. You can Review product options and application support on the Welk Main Page to find specific models tailored for these high-temperature environments.

| Practical Installation Considerations

When installing level measurement instruments in tanks containing materials that require thermosel-level temperature control, several engineering factors must be addressed to ensure longevity and accuracy.

| Standoff Pipes and Nozzles

For non-contact radar and ultrasonic sensors, the nozzle length and diameter are critical. If the nozzle is too long or narrow, internal reflections (parasitic echoes) can interfere with the signal. In high-temperature tanks, a standoff pipe is often used to move the sensor electronics further away from the heat source. However, the pipe must be designed to prevent the material from splashing up and solidifying inside it.

| Heat Dissipation and Cooling

Even if the sensor is rated for high temperatures, the electronics housing usually has a lower thermal limit (typically 60°C to 80°C). In applications exceeding 200°C, engineers should utilize:

- Cooling fins: Integrated into the sensor neck to dissipate rising heat.
- Air purging: Injecting compressed air into the nozzle to keep the sensor face cool and free of condensation.
- Remote electronics: Mounting the transmitter head several meters away from the process connection via a specialized cable.
- Insulation: Ensuring the tank top is well-insulated, but leaving the sensor's cooling fins exposed to ambient air.

| Material Dielectric Constant

Radar technology relies on the dielectric constant (ϵ_r) of the material. Many organic compounds characterized by thermosel systems, such as waxes and oils, have low dielectric constants ($\epsilon_r < 3$). In these cases, a high-sensitivity radar or an 80 GHz sensor with a narrow beam angle is necessary to ensure a strong enough return signal from the surface.

| Limitations and Maintenance

While modern instrumentation is robust, there are inherent limitations when dealing with thermosel-tested materials:

1. **Coating and Buildup:** In tanks with agitation or splashing, material can accumulate on the sensor face or probe. Even non-contact sensors can fail if a thick layer of solidified resin blocks the antenna. Regular inspection or the use of PTFE-coated antennas is recommended.
2. **Vapor Space Dynamics:** In highly heated tanks, the gas phase above the liquid is not air; it is a mixture of air and evaporated process fluids. This can change the dielectric properties of the "gap," slightly affecting radar travel time, though this is usually negligible compared to ultrasonic errors.
3. **Solidification:** If the heating system fails, the material may solidify around a GWR probe or hydrostatic diaphragm, potentially damaging the instrument during the next heat-up cycle.

| Frequently Asked Questions (FAQ)

Q: Why is a thermosel system used in the lab instead of a standard water bath?

A: Standard water baths are limited to 100°C and cannot provide the stable, high-temperature environment required for materials like hot melt adhesives or asphalt, which may need to be tested at 180°C or higher. The thermosel provides precise dry heat and a small sample volume for rapid stabilization.

Q: Can I use a standard ultrasonic sensor for bitumen level measurement?

A: It is generally not recommended. Bitumen is stored at high temperatures (150°C+), creating heavy vapors and temperature gradients that significantly degrade ultrasonic performance. Non-contact radar is the industry standard for bitumen.

Q: How does viscosity affect radar level measurement?

A: Viscosity itself does not affect the radar signal, as the signal is electromagnetic. However, high-viscosity fluids are more likely to create surface turbulence or foam when agitated, and they are more prone to sticking to the tank walls and internal probes, which can create false echoes.

Q: What is the benefit of 80 GHz radar for these applications?

A: The 80 GHz frequency allows for a much smaller antenna and a narrower beam (as small as 3 degrees). This makes it easier to install the sensor in tanks with internal obstructions like agitators or heating coils, which are common in vessels holding viscous materials.

| Conclusion

Managing materials that require thermosel characterization demands a deep understanding of both rheology and instrumentation physics. By acknowledging the high-temperature and high-viscosity nature of these fluids, engineers can move beyond the laboratory and implement robust level measurement solutions in the plant. Whether utilizing non-contact radar to avoid the hazards of material buildup or employing hydrostatic seals for pressurized vessels, the goal remains the same: accurate, reliable data that ensures process safety and efficiency. For detailed technical specifications on radar and ultrasonic solutions suitable for these environments, please visit our [Main Page](#).