Go the safe way
Measuring technology for melting & holding equipment
With over 20 years' experience, Saveway is an internationally established company specializing in measuring technologies. We manufacture and distribute diagnostic systems for refractory linings and other components of melting, holding and treatment equipment. Global service is ensured by our international operating subsidiary companies and distribution partners.

Based on our years of experience, we develop customized solutions even for very specific applications. The close cooperation with our customers, universities and professional associations is an important component in turning innovative ideas into practical solutions.
Your qualified partner for furnace safety and lining diagnostics

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SAVEWAY® Measurement of remaining lining thickness

SAVEWAY®

- Continuous measurement of refractory wall thickness during furnace operation
- Display accuracy: 1/16 of initial wall thickness
- Localization of wear
- Reliable indication of smallest metal fins
- Reliable indication of drying condition and cooling water leakages
- Detection of overheating caused by bridging

Operating principle

The measurement is based on intense decrease in specific electrical resistance of the refractory material with increasing temperature. With progressive wear, molten metal penetrates towards the sensors and the temperature of the adjacent refractory material rises. Thereby the measured resistance by the sensors is decreasing and will be displayed as appropriate remaining wall thickness.

- Prevention of furnace damages and molten runouts
- Reduced costs for maintenance and production losses
**Technical realization**

To locate the wear, the monitored area is covered with separate sensor segments. The initial wall thickness of the lining is divided into 16 stages. The minimum distance between approaching molten metal and each sensor segment is displayed continuously. The recorded wear data allows the optimization of furnace operation and the risk-free extension of refractory life. The safety for operating staff and furnace operation is increased significantly.

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- Optimized service life of refractory linings and components
- Increased safety for operating staff and equipment
SAVEWAY® Application examples

Standard sensor panels installed on a coreless induction furnace

S-shaped-sensor panels for large coreless induction furnaces and special applications

Sensor electrode in the floor construction of a glass melting tank
Sensor panels and vacuum sealed feed through on a RH degasser

Special sensor panel in the insulating layer of a ladle furnace lining

Sensor panels in a submerged arc furnace
SAVELINE® Comprehensive measurement of hot spots and wear monitoring

SAVELINE®

• Comprehensive temperature monitoring of refractory linings and components during furnace operation
• Calculation of remaining lining thickness
• Always measuring the highest temperature of a sensor segment
• Localization of wear by placement of multiple sensors
• Reliable measurement in electrically conductive linings
• Measuring range of sensors 100 °C - 1350 °C (210 °F - 2460 °F)

Operating principle

Linear sensors are used for the measurement. If the temperature rises at any spot, the electrical resistance of the ceramic sensor filling will decrease there. Each measured resistance is associated with a temperature. The sensor measures not only at one point like thermocouples, but always the highest temperature along is entire length. Various sensor ceramics are available for different temperature ranges. The remaining wall thickness is calculated from the temperature and the thermal conductivity of the refractory lining.

• Increased equipment uptime
• Optimized work and operating safety
Technical realization

The SAVELINE sensor is placed in the refractory according to the measurement task. The sensor is flexible. Comprehensive monitoring can be realized by a serpentine arrangement of the sensors. By using multiple sensor segments, wear can be located specifically. Because of its coating, the sensor can also be used in graphitic linings, or where electrically conductive precipitation can be expected. The measuring system displays the current status and records the temporal wear and temperature trend.

• Tool for improving refractory construction and furnace handling
• Improvement of process control and documentation
SAVELINE® Application examples

SAVELINE sensor on the upper part of a channel inductor to monitor the flange gap

SAVELINE sensors on the bushing before casting the safety lining

SAVELINE sensors in a steel ladle

SAVELINE installation for remaining length measurement on a porous plug
Application examples

SAVELINE sensor on the upper part of a channel inductor to monitor the flange gap

SAVELINE sensors in a steel ladle

Monitoring the heater casing of a casting furnace

SAVELINE installation for remaining length measurement on a porous plug

Floor monitoring in a coreless induction furnace
SAVEDRY®

Drying measurement and leakage monitoring

SAVEDRY®

- Continuous measurement of remaining moisture in refractory linings
- Reliable detection of cooling water leakages
- Localization of moisture problems
- Reliable display of drying condition
- Monitoring of furnaces during relining, sinter heat and regular operation

Measuring unit

Control and visualization unit

Operating principle

Certain substances such as salts or oxides dissociate in water to mobile ions. Ions are charge carriers and lead to electrical conductivity, which is measured. The number of mobile ions, and therefore the measured conductivity, depends on the water content. Based on the sensor type, the dissociated substances are absorbed into the sensor ceramic.

Moisture

Dissociation

Mobile ions

Electric conductivity

Drying

No water

Immobile ions

No electrical conductivity

- Prevention of plant damage and furnace explosions
- Optimized sinter and drying time
Technical realization

Depending on the measurement task, the sensors are placed in specific locations in the refractory material or the furnace wall. There are different types of sensors available which are placed in the furnace during relining, as well as sensor types which can be replaced during furnace operation. The localization of water leakages or remaining moisture is possible by the arrangement of multiple sensors. The measuring system records the temporal trend of the remaining moisture and displays the current condition. For water leakages, customized warnings are issued.

- Reduced production losses and maintenance costs
- Significantly increased safety for operating staff and equipment
SAVEDRY® Application examples

SAVEDRY sensor type 3 installed on a submerged arc furnace for monitoring the tap holes

SAVEDRY sensor type 1 on a cooling water channel before installing castable of the heat shield

Replaceable SAVEDRY sensor type 4 in the furnace wall of an arc furnace
SAVEDRY sensor type 2
in an arc furnace

SAVEDRY sensor type 4 installed in the furnace wall of an arc furnace

SAVEDRY sensor type 2 in an arc furnace

SAVEDRY installation type 1 below the cooling water channel of an arc furnace

SAVEDRY sensor type 1 installed on top of the cooling water pipe in the bottom of a graphitization furnace

SAVEDRY installation type 1 below the cooling water channel of an arc furnace
SAVESEARCH® Monitoring of coil-shunt-insulation

SAVESEARCH®

- Preventive maintenance tool for coreless induction furnaces
- Detection of impending insulation faults
- Clear localization of insulation faults
- Significantly higher ohmic measurement range compared to ground leakage indicator
- Moisture detection in the insulation structure
- Separate monitoring of each shunt

Operating principle

Common ground leakage indicators measure the electrical resistance between the water-cooled coil and ground connections. Therefore ground leakages between coil and shunt cannot be located and detected early. The SAVESEARCH system measures the insulation resistance between the individual ground-isolated sensor electrodes and the coil. As a result, a much higher impedance measurement range is covered and developing insulation faults are detected at an early stage. The condition of the electrical insulation of each shunt is monitored separately.

- Enormous time savings when searching for insulation faults
- Minimized production losses and maintenance costs
Technical arrangement

Sensor electrodes are arranged in the coil-shunt-insulation so that the regular electrical insulation is not weakened. The sensors are transparent to the electromagnetic field. A self-diagnosis function ensures the system is operating properly. The high impedance measurement range allows preventive maintenance, and “flashovers” between coil and shunt can be avoided. For visualization, the instantaneous values of the insulating resistance and temporal trend are available.

• Increased equipment uptime
• Optimized work and operating safety
SAVESEARCH® Application examples

SAVESEARCH electrode in a 4 t vacuum induction furnace

Horizontally divided SAVESEARCH electrodes in a 12 t furnace

Electrical connections of the SAVESEARCH electrodes on a 12 t furnace
SAVESEARCH electrodes in a high-performance furnace 8 t / 8 MW

SAVESEARCH connections after coil installation on an 8 t furnace

High-Voltage resistant wiring of the SAVESEARCH electrode
**OPTISAVE F**

- Continuous temperature measurement up to 600 °C (1110 °F)
- Local resolution: 0.25 m (10“)
- Maximum 8 sensors with sensor lengths up to 2000 m (1.25 miles)
- Up to 8000 temperature values per sensor
- Measurement not influenced by surrounding environment
- Insensitive to electrical and magnetic fields
- Calculation of remaining wall thicknesses

**Operating principle**

The temperature measurement is based on the Raman Effect. For this purpose, light is transmitted through the optical fibre, and the intensity of the temperature-dependent part of the reflected spectrum is analyzed. By the runtime of the light, the location of the specific temperature points can be determined.

**Main fields of application**

- Water-cooled components and surfaces
- Arc furnaces
- Melting equipment for primary and secondary smelting
- Reaction tanks
- Recycling smelting furnaces
- Combustion plants

**Return signal intensity**

- Stokes amplitude
- Anti-Stokes amplitude
- Input light

**Graph**

- Prevention of furnace damages and molten runouts
- Increased equipment uptime
Technical arrangement

The mechanically-protected optical fibre sensor is placed over long distances or large areas. For monitoring water-cooled components, the sensor fiber can be placed in grooves on the surface or in embedded channels inside the component.

Main fields of application

- Water-cooled components and surfaces
- Arc furnaces
- Melting equipment for primary metallurgy and smelting
- Reaction tanks
- Recycling smelting furnaces
- Combustion plants

- Optimized work and operating safety
- Improved process control and documentation
SELECTIVE TEMPERATURE MEASUREMENT

• Continuous temperature measurement up to 650 °C (1200 °F)
• Position measurement
• Sensors with user definable measuring points
• High measurement accuracy

Operating principle

The system uses optical fibres with integrated Bragg gratings. The arrangement of the Bragg gratings over the sensor length is customized for each application. A change in fibre length, caused by temperature influences, results in a change of grating distance; and therefore in a varied wavelength. The wavelength difference is evaluated to identify the temperature at the discrete sensor points.

• Prevention of furnace damages and molten runouts
• Increased equipment uptime

OPTISAVE G G G

• Position measurement
• Sensors with user definable measuring points
• High measurement accuracy

Operating principle

The system uses optical fibres with integrated Bragg gratings. The arrangement of the Bragg gratings over the sensor length is customized for each application. A change in fibre length, caused by temperature influences, results in a change of grating distance; and therefore in a varied wavelength. The wavelength difference is evaluated to identify the temperature at the discrete sensor points.
Technical arrangement

The optical fibre sensor is mechanically protected by being placed in a stainless steel or monel tube. There are a wide variety of industrial heating and melting functions where OPTISAVE can be applied. Project-specific installation solutions are implemented based on individual monitoring tasks.

Main fields of application

- Equipment and components with small dimensions
- Measurement tasks with high demands for local resolution

- Optimized work and operating safety
- Improved process control and documentation
OPTISAVE Application examples

Cross section of a worn out wall panel with embedded OPTISAVE sensors

DC (direct current) arc furnace with OPTISAVE F for remaining wall thickness measurement of the MgO-lining

OPTISAVE installation on the inside wall of a water-cooled submerged arc furnace

Slag tap hole of a submerged arc furnace with integrated OPTISAVE G sensor

OPTISAVE installation on the inside wall of a water-cooled submerged arc furnace
Detailed view of an embedded OPTISAVE sensor in front of the cooling channel in the copper panel

Slag tap hole of a submerged arc furnace with integrated OPTISAVE G sensor

Water-cooled copper module of a slag tap hole with integrated OPTISAVE G sensors
SAVEWAY was installed after a run-out that caused extensive damage to our VIM furnace. [...] Thyssen Krupp VDM USA has not experienced any molten metal runouts or contact with the induction coil since the inception of this system. [...] SAVEWAY provides the level of operational safety we demand, and we will not operate the furnace without it.

S. Chapman, TK-VDM USA

[...] In 2012 we installed the SAVEWAY system for measuring the remaining lining thickness in both furnaces. The reason for the installation was to objectively evaluate the influences of the furnace operating characteristics and other production parameters on the lining life. Because of the safety the system provides, we extensively tested different refractory materials and analyzed the influence of all production parameters.

We reached double the previous lining life by optimization of the furnace operating characteristics and production process. [...] S. Zovak, VULKAN INOX GmbH

[...] As there had been frequent unpredictable faults between the coil and the shunts on our 8-t-coreless induction furnaces, we decided to install the SAVESEARCH shunt monitoring system at the beginning of 2009. [...] The availability of our coreless induction furnaces was clearly increased by the SAVESEARCH system. The time necessary to search for ground leakages was minimized and production losses have been avoided.

H. Bauch, M. Gaag, SIEMENS Gusstechnik GmbH
[...] We are operating two 6-t MF induction furnaces for melting and two 6-t induction furnaces for pouring steel at tapping temperatures of 1,650°C. The initiation for utilizing a SAVEWAY system was primarily to increase safety in our melting shop. [...] Lining life in our crucibles using a silica-based refractory was extended up to 100 %, where lining life of a crucible using neutral refractory material was extended to approximately 250 %. [...] The SAVEWAY system has been very useful equipment for our company. We definitely are going to use the SAVEWAY system for new induction furnaces in the future.

S. Kulka, METALLTECHNIK SCHMIDT GmbH & Co. KG

In summer 1993 VAC Hanau installed a SAVEWAY system on a 4-t vacuum induction furnace (VIM) for the first time. The main reason for that decision was the fact that there was a potential risk of explosion and serious injuries to employees caused by runouts.

Our experience proved that only the SAVEWAY system provides appropriate and reliable safety concerning runouts. [...] Due to these positive experiences and our safety philosophy, all our furnaces have been equipped with a SAVEWAY system. [...] T. Scheidig, VACUUMSCHMELZE GmbH & Co. KG

[...] The SAVEWAY system was installed after a heavy metal run through which was accompanied by serious injury of an operator on both furnaces in 1996 and 1997. With those installations we made sure that such accidents never happened again! Furthermore we now fulfill working on demands of the OSHA (Occupational Safety and Health Administration) and the industrial insurance companies regarding increasing the operational safety. Based on our experience, proof can be given that only the SAVEWAY system ensures that high safety standard. [...] Based on the objective measurement of the remaining lining thickness we were able to increase the number of heats from 170 to 250 now. [...] C. Sohm, W. Geser, MAHLE KÖNIG KOMMANDITGESELLSCHAFT Ges.m.b.H. & Co KG