Process optimization of stabilizer manufacturing

by Albert Book

Chassis stabilizers in automobiles are probably few known but very important components. They contribute significantly to the vehicles' driving safety. The stabilizers have hardly changed over the last years. The following article takes the manufacturing optimization of stabilizers as an example to explain how the reliability and reproducibility of the production process could be improved by using modern sensor technology and today's technical possibilities to ensure the constant quality of the products.

Function of the stabilizer

A stabilizer is a multi-bent metal tube of the chassis of each automobile. It connects the wheel suspension of the two wheels of an axle with each other as well as with the car body. The task of this spring element is to prevent uneven swinging and rolling of the two opposite wheels when taking curves, on slopes or uneven surfaces and to transmit the movement to the entire chassis. Without the stabilizer, a car would tip over in a curve. It therefore contributes significantly to driving safety and driving comfort (**Fig. 1**).

Fig. 1 *Chassis stabilizer of an automobile*

Production process of stabilizers

Stabilizers have hardly changed for decades. First, the tube is bent to its basic form by various bending processes. For thermal treatment, the ends are guided by a robot into an induction coil for heating. The hole is then flattened, ground and inserted in rapid consecutive production steps.

The ends are heated to approx. 950 °C for heat treatment within a few seconds. The decisive factor for the subsequent production steps is to achieve the defined target temperature and fast processing to ensure the reproducibility of the manufacturing process and constant material properties.

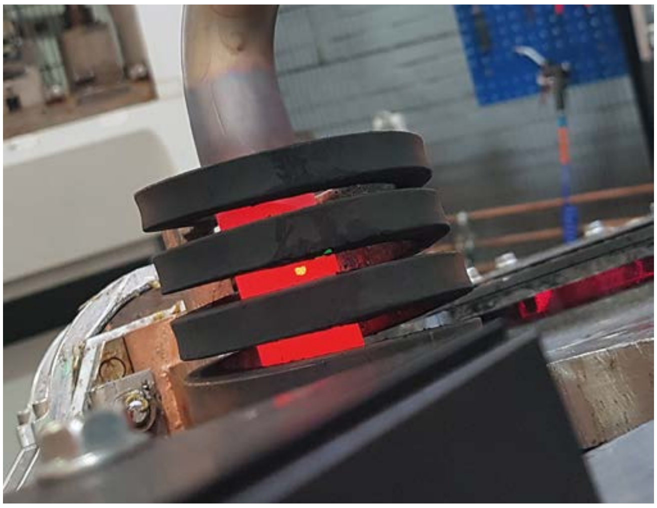

Fig. 2 *Precise alignment of the measuring spot on the stabilizer in the induction coil*

The temperature is controlled by the optical temperature measuring method. The pyrometer measures the heat radiation of the tube from a distance of approx. 200 mm within milliseconds. The measurement takes place directly during heating through the winding of the induction coil to achieve a high cycle rate (**Fig. 2**). Since the space between the windings is only a few millimetres, a device with parallax-free optics, high optical resolution and precise imaging of the measuring spot is required for the measurement. This is necessary for the exact alignment and focusing of the sensor. A pilot light is absolutely necessary to check the alignment and to mark the measuring spot in the correct size and position. It is advantageous to use a green LED light so that the measuring spot on the red glowing object is clearly visible.

Optimization of the production process

In many cases, single-colour pyrometers or single-channel pyrometers have been used to measure the infrared radiation at one wavelength and to determine the temperature. These devices must be aligned exactly to the space between the windings and used at the correct focal distance. Even with small deviations, there is a danger that parts of the cold coil could be in the measuring area. This leads directly to a decrease in temperature and consequently to an overheating of the tube ends. In addition, production-related vapours in the view field of the pyrometer or contaminations on the lens of the device also weaken the signal and directly effect the measured value. For example, a single-colour pyrometer with an object temperature of 950 °C and a signal reduction of 10 % would already result in a measurement error of approx. 20 °C.

In order to increase the reliability and reproducibility of the production process, modern infrared thermometers were used which work according to the two-colour measuring method (**Fig. 3**). Two-colour pyrometers measure the radiation at two wavelengths. The object temperature is determined from the quotient of the two radiation intensities. The main advantage of this measuring method is that disturbing influences such as steam, dust or contamination of the lens have significantly lower influence on the measurement result. Even if the signal is weakened by an imprecise alignment of the instrument or if it is operated outside the defined measuring distance, a two-colour pyrometer is much less sensitive than single-colour pyrometers. Two-colour pyrometers still deliver safe measured values even with a degree of decrease of infrared radiation of 90 %. To further increase the reliability of the measurement, modern two-colour pyrometers are provided with a function for permanent monitoring of the signal strength. If this reaches a critical value, a warning message is generated. If the radiation energy is weakened to such an extent that reliable temperature measurement is no longer possible, the device switches off.

Since pyrometric temperature measurement is an optical measuring method, the surface and the material have a direct influence on the radiation property and therefore on the measured temperature. Therefore, when commissioning a single-colour pyrometer, the emissivity of the measured object must be set. This always raises the question of the correct emissivity under the given measuring conditions. If possible, this is determined by a comparative measurement using a contact thermometer. Single-colour pyrometers react immediately with a false indication, if the emissivity has not been set correctly or varies from tube to tube. The algorithm of the two-colour measurement has the advantage that the influence of the emissivity will compensate to a certain degree. Therefore, no correction is necessary when using two-colour pyrometers to measure the metallic tube in the induction coil.

Fig. 3 *Modern two-colour pyrometer with LED pilot light and IO-Link interface*

Connection of the sensors to the plant control system

The digital interface becomes more and more popular for the connection of sensors. In addition to higher interference resistance, another advantage is that other measured variables, interference information or diagnostic data can be transmitted and evaluated in parallel to the measurement signal. The parameterization of the devices is achieved centrally via the control system, so that in the event of a possible exchange, incorrect parameter settings are excluded and an incorrect sensor can be immediately detected.

With the new IO-Link interface technology introduced a few years ago, a generation change is currently taking place in the field of digital communication. With IO-Link a standardized, manufacturer-independent and fieldbus-independent communication concept was developed in accordance with IEC 61131-9. Devices with IO-Link interface can be operated in all common fieldbus control systems such as Profibus, Profinet, Ethernet, Modbus, EtherCAT or CAN-Bus for process automation by means of standardized IODD drivers. Another major advantage of IO-Link is the very simple, fast, reliable and cost-effective wiring via standardized cabling and screw connections.

Conclusion

By using modern sensors – as the above example of the production of chassis stabilizers shows – the reliability and reproducibility of production processes can be improved to guarantee a consistently high quality of the finished parts. The interference-free digital interface for the connection to the machine control system contributes to the safety of the production process when evaluating further measured variables and diagnostic data. With the implementation of Industry 4.0, intelligent service management can now be realised.

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