

RHEOTEST Medingen

Industrial capillary viscometer RHEOTEST® PK for continuous control of hardening solutions concentration during metallic parts hardening



Measuring task:

Thermal treatment and the following cooling of material play a decisive role during purposeful impact on mechanical properties of metallic materials. Based on polymers hardening solutions are used for cooling. Achievement and maintenance of necessary material's mechanical properties such as for example hardness and toughness substantially depend upon technologically set constant concentration of polymer. Since concentration of hardening solution changes during process of cooling due to water evaporation and consumption determined by the process, it is necessary to monitor them constantly and in case of overstep the upper or lower limits one has to adjust the pre-set value by adding water or polymer.

The following technologically different hardening processes are known to us from the practice:

- monitoring and documentation of polymer's concentration in hardening solution in automatic hardening plants (e.g., hardening of surface of toothed gears)
- monitoring and documentation of polymer's concentration in hardening solution during hardening of big blanks.

Methods of direct measurement of concentration are very labour-intensive, expensive and could not be used online in production conditions. For this reason indirect methods of measurements are used such as measurement of light dispersion (refractometer) or method of viscosity measurement. Producers of polymer solutions confirm that our capillary viscometer has better measurement accuracy in comparison with refractometer because measurement results do not depend on degree of polymer solution contamination by our method. This has an essential significance during concentration determination of used and consequently impure hardening solution. In refractometer impurities influence on light dispersion and, correspondingly, influence on the results of measurements. Because of this e.g. more high concentration of polymer is "simulated" as it is in fact.

Requirements to the viscometer:

- Automatic measurement of hardening solution concentration
- Measurement results have to be registered not permanently but every 15 minutes only
- Temperature of hardening solution: 20 ... 70°C
- Ambient temperature: 10 ... 50°C
- Concentration range: approx. 5 ... 20% by weight; depending on polymer solution and hardening characteristics
- Range of viscosity measurements: approx. 1 ... 10 mPas
- Output of concentration value to the display as analog signal and as ASCII code.

Viscometer configuration and installation:

Capillary viscometer RHEOTEST® PK has been designed for installation into vessels at zero pressure conditions. It consists of sensor unit and electronic unit. The sensor unit includes drive, measurement system and temperature sensor Pt-100. Flowing measurement capillary made of high quality steel is screwed into measurement chamber.

Measurement results acquisition and their further processing take place in the electronic unit with the help of electronic compensation of viscosity using special software. Measurement result is indicated on display as concentration value. Besides, it is on hand as analog output signal 4 ... 20 mA or 0 ... 20 mA and at interface RS 232C. 4 control keys and display are situated on the front side of the electronic unit.

In automatic hardening installations sensor unit is mounted directly on the vessel in such way that capillary and temperature sensor Pt-100 are immersed in polymer solution not less than 5 cm (Fig.1).

It is recommended to mount the sensor unit in bypass with temperature control and filter during hardening of big blanks (Fig.2).

In both cases the electronic unit could be mounted in control panel or on a separate wall. The sensor unit and electronic unit in standard version are connected with cable 10 m length.

Principle of operation:

Method of measurement using the patented capillary viscometer of series RHEOTEST® PK/LK is based on Hagen-Poiseuille equation that describes laminar flow through a tube. For this, in practice piston moves evenly and sucks medium under study through a capillary into measurement chamber and after that pumps it back into the tank through the same way. At that one measures pressure produced in measurement chamber and determines viscosity according to pressure signal value. Temperature is measured with the help of Pt-100 and electronic-temperature-compensation of viscosity is carried out by means of recalculation of viscosity value at standard temperature. Concentration value is calculated by temperature compensated viscosity and this value is indicated at display and could be output as analog signal 4 ... 20 mA or 0 ... 20 mA and at serial interface RS 232C.

Advantages for user:

- Saving of labour hours due to automatic data acquisition on concentration of hardening solution; elimination of individual measurement errors
- Measurement results for used polymer solutions are more precise in comparison with refractometric determinations as do not depend upon degree of contamination
- Measurement results are continuously acquired and documented according to established at an enterprise regime of quality control
- Measurement results could be used for continuous adjustment of concentration. Further savings on costs and quality improvement are possible thanks to this
- One could install capillary viscometer into tanks, receivers or basins without considerable expenditures. It is possible integration for machines control also