

RHEOTEST Medingen

Industrial capillary viscometer RHEOTEST® PK for continuous monitoring of suspensions viscosity during screen coating process



Measuring task:

During production of colour picture tubes operating on principle of cathode-ray tube an important task is to apply coating of sensitive to light suspension (that solidify under UV-rays) on internal screen's surface of phosphor screen of green, blue or red colour in form of points or vertical lines. According to the method of "flow-coat" at first one pours suspension of green phosphor into picture tube and obtains a layer with uniform thickness. Suspension viscosity has a decisive influence on thickness and uniformity of a layer in this process of coating application. Hence, it is necessary to set viscosity precisely and keep constant during the whole process. Drying of layer is carried out in the course of subsequent technological operations and solidifying in necessary places (in points or along the lines) with the help of UV-rays and mask.

Blue and red paint are applied in the same way. In "matrix" cathode-ray tubes one applies black paint at first in order to get higher contrast between applied later colour suspension of phosphor.

One of the major world producer of picture tubes LG Philips Display Devices uses our patented viscometers of series RHEOTEST® PK/LK for viscosity control of coating material during some years because these instruments do not require maintenance, operate stable and precisely and measurement results do not depend upon sedimentation processes. Because of this our measurement method with the help of capillary in this concrete case of application has decisive advantages in comparison with rotational, ultrasound as well as high frequency viscometers.

Requirements to the viscometer:

- Measurement range of viscometer is in limits 10 to 30 mPas. It is necessary to have measurement result's accuracy 1.5% and reproducibility 0.5% in this range of low viscosities
- Viscometer should operate stable and reliable during long time also in special production conditions ("yellow area"). Hence, easy calibration, simple cleaning and minor maintenance must be provided
- Measurement results should be constantly indicated on display and output as output signal (analogue one and/or ASCII code)
- Continuous viscosity control is not necessary in every case. In such cases use of our laboratory capillary viscometer RHEOTEST® PK/LK is more justified as this laboratory version by design and arrangement is practically identical to the industrial version and that is why operates just as exactly and reliable and gives identical results in the shortest time (1 measurement cycle lasts approx. 30s)

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Viscometer configuration and installation:

1. Industrial capillary viscometer RHEOTEST® PK is used for continuous viscosity control. It consists of sensor unit and electronic unit. The sensor unit includes drive, measurement system and temperature sensor Pt100. Flowing measurement capillary made of high quality steel is screwed into measurement chamber.

Measurement results acquisition take place in the electronic unit and they are indicated on display as dynamic viscosity value and also is used for further processing as analogue 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.

Sensor unit is mounted in pressureless overflow tank that is connected with tube for paint in such way that capillary and temperature sensor Pt-100 are immersed in polymer solution not less than 5 cm (Fig.1).

The electronic unit could be mounted in control panel or separately on wall. The sensor unit and electronic unit in standard version are connected with cable 10 m length.

2. Laboratory capillary viscometer RHEOTEST® LK is used for periodical viscosity control. Stable surface 0.25 m x 0.25 m should be foreseen for each installation for coating application.

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. Viscosity is indicated at display and could be output as analog signal 4 ... 20 mA or 0 ... 20 mA and also at serial interface.

It is appropriate in case of periodical viscosity control to recalculate the measurement result to the standard temperature on the basis of comparison of measured values. For that, it is necessary one time determine temperature coefficient of viscosity of substance under study and enter it to the software of viscometer. Then automatic recalculation of measured value of viscosity to compensated viscosity is carried out with the help of standard electronic temperature compensation of viscosity that is installed in capillary viscometers of this series.

Industrial capillary viscometer RHEOTEST® PK measures viscosity continuously in pressureless overflow vessels.

One could set individually number of cycles of measurements in laboratory capillary viscometer RHEOTEST® LK. Mean value could be determined from the single measurement results. One use in practice 3 to 5 cycles of measurements to achieve optimal reproducibility of measurement results. Hence one measurement cycle has duration approx. 30s so one obtains results not later then in 150 s on display or at interface.

Minimal volume of sample is 30 ml to measure viscosity with the help of capillary viscometer RHEOTEST® PK/LK.

Advantages for user:

- Saving of labour hours due to automatic viscosity determination with the help of version RHEOTEST® PK or fast determination of the measured value with the help of version RHEOTEST® LK. Individual measurement errors do not occur at all
- Measurement results for substances under study with solid particles are more precise in comparison with many other methods of measurements, as sedimentation processes do not influence considerably on measurement result
- Measurement results are continuously acquired and documented according to established at an enterprise regime of quality control
- It is possible to shorten percentage of defective articles considerably owing to velocity of obtaining measurement results and their accuracy
- Measurement results could be used for continuous adjustment of viscosity in case of implementation of industrial version of viscometer. Further savings on costs and quality improvement are possible thanks to this