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Fine ceramics (advanced ceramics, advanced technical ceramics) — Measurement of thixotropic behaviour of ceramic slurry by use of a rotational viscometer

Céramiques techniques (céramiques avancées, céramiques techniques avancées) — Mesurage du comportement thixotropique d'une barbotine de céramique à l'aide d'un viscosimètre rotatif

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Foreword

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This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Measurement of thixotropic behaviour of ceramic slurry by use of a rotational viscometer

1 Scope

This document specifies a method for measurement of thixotropic behaviour of ceramic slurry with rotational viscometer. The slurry with high-solid loading, which is used in ceramic manufacturing, has a generally non-Newtonian property. This method is limited to measurement of thixotropic behaviour of high-solid loaded ceramic slurry with "coaxial double cylinder viscometer", "cone and plate viscometer" and "a parallel plate viscometer" as rotational viscometers.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
shear stress
force developed on the plane which is perpendicular to the shear force when there is shear applied to the fluid

3.2
shear rate
proportion of laminar flow rate change perpendicular to the fluid flow

3.3
Newtonian property
slurry property of which the shear stress is proportional to the shear rate

3.4
non-Newtonian property
slurry property of which the shear stress is not proportional to the shear rate

3.5
viscosity
proportion of shear stress and shear rate

Note 1 to entry: The proportion is a representation of resistance to flow.

3.6
flow curve
curve showing the relationship between shear rate and shear stress

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3.7
thixotropic behaviour
behaviour of fluid which has time-dependence of flow behaviour so that the apparent viscosity decreases with time at controlled shear and recovers gradually with removal of the shear force

3.8
ceramic slurry
suspension of grinding ceramic powders mixed or dispersed in water or other liquid

Note 1 to entry: The suspension is used in the ceramic process, for example screen printing, slip casting, tape casting, granule production.

4 Principle

4.1 Evaluation of thixotropic behaviour by hysteresis measurement of flow curve

Measurement of flow curve of ceramic slurry is performed using a rotational viscometer, which can monitor shear rate and shear stress at the same time. The thixotropic behaviour is evaluated from the magnitude of hysteresis that is indicated by the process of the flow curve.

4.2 Evaluation of thixotropic behaviour by time-dependence of shear stress at constant low shear rate

Measurement of the flow curve of ceramic slurry is performed using a rotational viscometer, which can monitor shear rate and shear stress at the same time. After the viscosity of ceramic slurry is decreased by destruction of aggregated or flocculated structure in ceramic slurry at high shear rate, the thixotropic behaviour is evaluated by measuring the recovery process of viscosity at low shear rate. The relationship between fabrication of re-flocculated structure and time can be detected at low shear rate. Therefore, the thixotropic behaviour is evaluated by using data from low shear rate.

5 Apparatus

A rotational viscometer has various measuring geometrics. In this document, the rotational viscometers with defined shear rate are a coaxial double cylinder system, a cone and plate system and a parallel plate system.

5.1 Measuring system

The measuring system consists of two surfaces with symmetrical and coaxial geometrics, between which is the slurry whose viscosity is measured. One of these surfaces rotates at a constant angular velocity while the other remains at rest. A device for torque measurement is connected to one of the surfaces, thus permitting determination of the torque required to overcome the viscous resistance of the slurry.

A measuring system of a coaxial double cylinder system and a cone and plate system, which can decide shear rate at every measurement, is desirable. The measurement is possible by a parallel plate system, which is suitable for ceramic slurry with high viscosity.

5.2 Basic capacity of the instrument

The instrument for measurement shall be designed to permit alternative rotors and stators to be fitted for generation of a range of defined rotation frequency. In addition, it is necessary to use apparatus which can measure the torque. The apparatus has torque-measurement accuracy within 2 % of the full-scale reading. At the working range of measurement, the accuracy of rotational frequency measurement is within 2 % of the measured value. Furthermore, the repeatability of viscosity measurement has an accuracy of ±2 %.

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