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PHESO RHEOMETER

PHESO RHEOMETER: DESIGNED FOR CONCRETE TESTING

Background: Rheology in concrete testing.

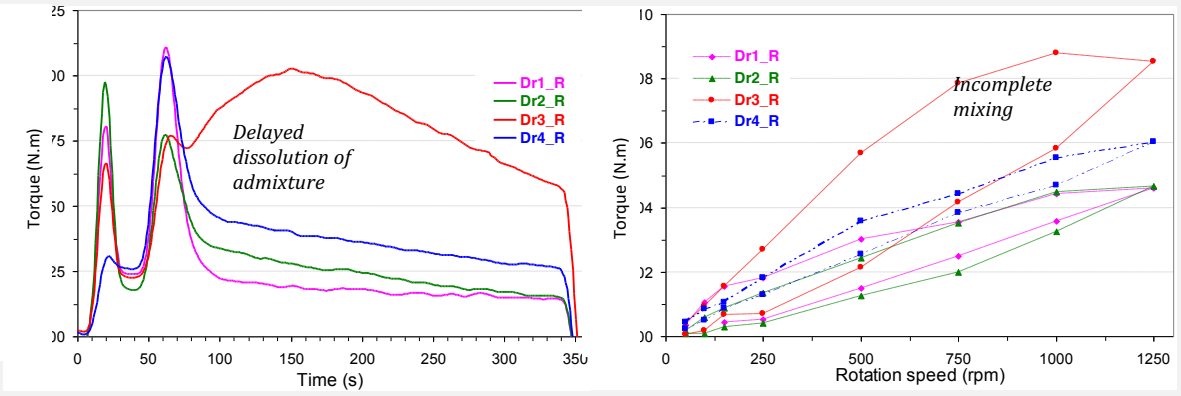
Rheology measures the flow and deformation of matter. In the concrete industry, rheology is a crucial part of material science. The quest for concrete with a lesser water-to-cement ratio poses ever-increasing challenges to maintain adequate rheology during transportation, placement and finishing. Whether it is in the development of new admixtures, the creation of industry norms and standards, the understanding of material interaction, or the complex mix designs and quality control required in technically challenging projects, it is important to measure rheology precisely and in conditions that mimic job site conditions in order to both optimize the financial return and the quality of concrete in built structures.

Pheso: a rheometer designed for Cement and Concrete Professionals.

The Pheso rheometer was designed and developed by true concrete research professionals and therefore incorporates design elements that are typically missing from other alternatives in the market. Pheso is exceptionally versatile, as its torque range is suitable for soft & stiff suspensions, from liquids all the way to dry powder materials in sample volumes anywhere from 0.5 to 20 liters. With options to operate in either central or planetary mode, and interchangeable impellers, users have access to all the flexibility allowing them to measure different material characteristics in cement paste, mortar or concrete, in high or low fluidity, including “0 slump” concrete, as well as dry materials or fibrous suspensions. The operation in planetary mode and the high shear mixing using the attritor shaped impeller allow for long term testing without segregation in a realistic simulation of field conditions. One can emulate the entire chain of events from the batch process at the concrete plant through delivery and placement at the job site. Long term testing for several hours can be conducted without interruption as mixing occurs directly in the Pheso rheometer, concurrently with the rheological measurement, such that rheology is measured in the exact sequence of mixing, without the need to transfer material from outside mixers.

“Attritor-shaped” impeller

Example of application: admixture selection and shearing cycle in a self–consolidating concrete



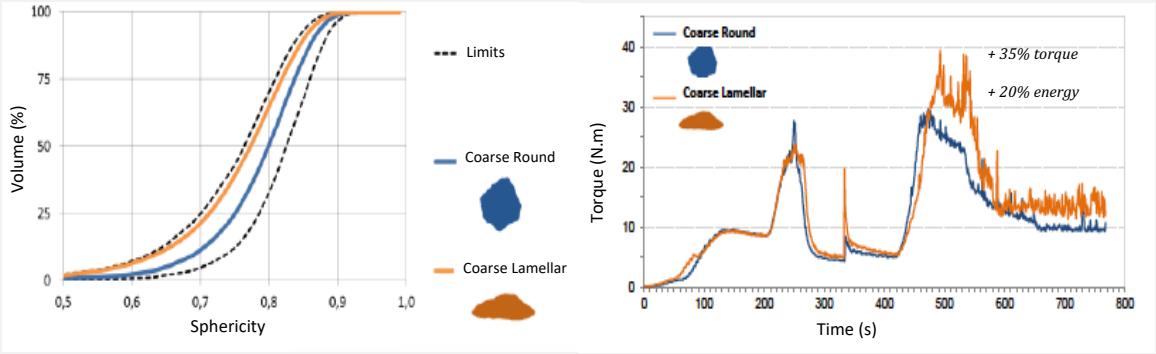
The charts above show the mixing profiles and shearing profiles with different admixtures in a self-consolidating Concrete. The red curve, with delayed dissolution of the additive shows a case of incomplete mixing.

Examples of applications and uses.

Pheso can be used to study rheological parameters such as mixing profiles, shearing profiles and mixing energy in a wide range of situations and mix designs, including cement paste, mortar or real concrete in soft and stiff suspensions, as well as dry or fibrous materials. Typical applications are:

- Determine the effect of different aggregate size distributions, or different shapes of aggregates on rheology
- Study the impact of different chemical admixtures (air entraining agents, plasticizers, retarders) and their interaction with other materials such as supplementary cementitious materials or fibers
- Compare the effectiveness and ease of placement of different specialty mortars
- Conduct long-term studies of rheological behavior from initial mixing to delivery on the job site
- Determine the optimum dosage, addition time and mixing time for self-consolidating concrete
- Measure the effect of water addition or admixture addition rate on concrete rheology
- Quality control of concrete mixes, mix design optimization, selection of raw materials, etc.
- Find the optimum mixing sequence for concrete with fibers (when to add the fibers)

Example of application: influence of the shape of aggregates on the rheological profile



In this example, a selection of more spherical coarse aggregates (blue) was compared to an equivalent particle size aggregate of a more lamellar shape. The mixture containing the more lamellar aggregate resulted in 35% increased torque and 20% increased mixing energy.

Graphs courtesy of Markus Rebmann, "Robustness of concrete with low Portland cement consumption: deviation sin proportioning and variation of particle size and aggregate morphology", doctoral thesis.

Specifications.

Specifications			
Operating Voltage	220 V / 380 V / 400 V - 50 Hz / 60 Hz	Testing modes	Mixing / shearing cycles / long-term testing
Maximum torque	147 N.m (coaxial) / 38 N.m (planetary)	Mixing bowls	5 - 25 liters (multiple interchangeable bowls)
Accuracy	+/- 0.01 N.m	Sample volume	0.5 - 20 liters
Rotation speed	0.005 - max. 140 rpm (coaxial) / 0.018 - max. 550 rpm (planetary)	Availalble impeller types	Attritor, Vane, Custom
Maximum aggregate size	9.5 - 25.4 mm	Dimensions	Measurement block: 68 (L) x 65 (W) x 38 (H) cm Max. shaft height: 85 cm
Compatible suspensions	very soft fluid - hard fluid / dry powder / fibrous	Weight	130 kg (287 lb.)

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