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SLIDING PIPE RHEOMETER - SLIPER

Introducing SLIPER (Sliding Pipe Rheometer), a cutting-edge instrument designed specifically for assessing the pumpability of fresh concrete and other building materials. Its primary function is to accurately determine the pumpability of fresh concrete, serving as an essential tool in ensuring efficient construction processes. Additionally, SLIPER plays a crucial role in product development and quality control endeavors, providing invaluable insights for enhancing construction materials and ensuring high standards of performance and durability.

Sliding Pipe Rheometer - SLIPER - for fresh concrete and other building materials

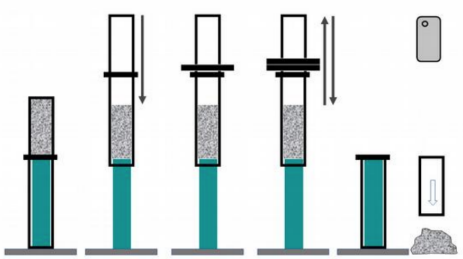
- Designed for assessing the pumpability of fresh concrete and various building materials.
- Primarily used to determine the pumpability of fresh concrete, ensuring smooth construction processes.
- Essential for product development and quality control efforts, ensuring high standards of performance and durability in construction projects.

APPLICATIONS

Sliding Pipe Rheometer - SLIPER for Fresh Concrete

The SLIPER rheometer - for fresh concrete presents a globally distinctive opportunity to economically assess the pumpability of building materials on a laboratory scale. Operating on the piston principle, the SLIPER consists of a vertical tube filled with fresh concrete. The tube, housing the sample, is facilitated to slide with support from weights. Integrated pressure and distance sensors measure both speed and pressure during the process.

Measurement data are conveniently stored on a smartphone and can be graphically displayed in a p-Q diagram, enabling a direct comparison of various mixtures. This evaluation system serves to delineate the properties of fresh concrete, facilitating forecasts for its intended pumping applications. Furthermore, a calculation model integrated into SLIPER enables the predetermination of pressure losses in concrete pumps and pipes.



The SLIPER rheometer - for fresh concrete is robust and versatile, suitable for use both in laboratory settings and on construction sites. Its electronic components are powered by a battery, ensuring operation independent of mains power. Wireless data transmission occurs promptly after measurement values are generated.

Furthermore, users can conveniently export the measurement data either as an Excel file or generate a report in PDF format, enhancing accessibility and usability for analysis and documentation purposes.

FEATURES

Key Features of Sliding Pipe Rheometer - SLIPER:

- Compact design for easy portability and space efficiency.
- Wireless functionality for seamless data transmission.
- Economical operation for cost-effectiveness.
- Requires low sample volume, optimizing material usage.
- Mains-independent operation with battery power, ensuring flexibility in usage.
- Measurement results displayed directly on a smartphone for immediate access and analysis.
- Ideal for quality control purposes, particularly suited for use on construction sites where mobility and on-site evaluation are crucial.

THEORY & METHOD

Sliding Pipe Rheometer (SLIPER): Pumpability Testing for Fresh Concrete

Predicting pumping pressure before concrete reaches the pump line saves time, prevents blockages, and cuts costs on every pour. The sliding pipe rheometer SLIPER gives engineers and concrete technologists a direct, field-ready method to quantify concrete pumpability, replacing guesswork with measured pressure-flow rate data.

Unlike conventional workability tests such as the slump test (ASTM C143), which only indicate yield stress, SLIPER measures the actual relationship between pressure and flow rate in a real pipe geometry. This makes it the only portable instrument that replicates pipe flow conditions on a laboratory or construction site scale. Developed by Putzmeister and manufactured by Schleibinger, the SLIPER targets a gap that traditional rheometers and slump tests cannot fill: reliable, economical estimation of pumping pressure for fresh concrete, mortar, and other thick building materials.

How a Sliding Pipe Rheometer Works

A sliding pipe rheometer measures concrete pumpability by simulating real pipe flow on a small scale. A vertical pipe filled with fresh concrete slides downward over a stationary piston under controlled weight, while sensors record pressure and velocity. The resulting pressure-flow rate (p-Q) curve characterizes how the concrete will behave inside an actual pumping circuit.

The Underlying Principle: Piston-Driven Pipe Flow

During real concrete pumping, a piston pushes fresh concrete through a pipeline. The SLIPER reverses this geometry: the pipe moves while the concrete column and piston remain stationary relative to each other. This inversion produces the same relative motion between pipe wall and concrete, so the measured forces directly represent pipe flow resistance.

As the pipe slides, the concrete near the pipe wall forms a thin lubricating layer. This layer, rich in cement paste and fine aggregate, carries most of the shear stress during pumping. The bulk concrete inside this layer moves as a near-rigid plug. This two-phase behavior, plug flow in the core and shear flow in the lubricating layer, matches what occurs in full-scale pump lines. Because the SLIPER uses an actual pipe section as its central element, it captures this lubricating layer formation naturally.

From Measurement to Pressure-Flow Rate Curve

The operator fills the vertical pipe with a fresh concrete sample, attaches calibrated weights, and releases the pipe. Integrated pressure and distance sensors record the pipe's sliding speed and the pressure the concrete exerts during each stroke. The SLIPER software app converts these raw readings into a p-Q diagram.

Each point on the p-Q curve represents a specific combination of pressure (mbar) and flow rate (m/s). By running multiple strokes with different weight combinations, the operator builds a complete curve that describes the concrete's pumping behavior across a range of flow rates. This curve allows direct comparison between different mix designs, admixture dosages, or aggregate proportions.

Predicting Full-Scale Pumping Pressure

The SLIPER's built-in calculation model extends the laboratory p-Q data to real pumping circuits. The software applies the Bingham model, which describes fresh concrete as a material with both yield stress (the minimum stress to initiate flow) and plastic viscosity (the resistance to continued flow). Using these rheological properties along with the measured lubricating layer characteristics, the model estimates pressure losses for specific pipe lengths, diameters, and configurations.

This prediction capability turns the SLIPER from a simple comparison tool into a planning instrument. Engineers can evaluate whether a given concrete mix will pump through a planned circuit before mobilizing equipment on site.

Applications and Industries

The sliding pipe rheometer serves any project or operation where concrete pumping reliability matters.

1. Ready-Mix Concrete Production

Ready-mix producers use the SLIPER to verify that each batch meets pumpability targets before dispatch. By testing representative samples, they detect mix variations caused by changes in aggregate moisture, admixture dosage, or cement

source. Early detection prevents pump blockages and delivery delays.

2. High-Rise and Long-Distance Pumping

Projects that pump concrete vertically to great heights or horizontally over long distances face elevated pressure demands. The SLIPER's pressure loss prediction model helps engineers confirm that the planned mix can reach the pour location within the pump's capacity. This is especially relevant for self-compacting concrete (SCC) mixes, which behave differently under pressure than conventional vibrated concrete.

3. 3D Concrete Printing

Additive manufacturing with concrete requires precise control of flow rate and extrusion pressure. The SLIPER characterizes printable mixes by quantifying their pressure-flow rate relationship, helping researchers and producers optimize mix designs for consistent extrusion without nozzle blockage.

4. Research and Mix Development

Universities and material laboratories use the SLIPER to study the influence of mix parameters (water-to-binder ratio, superplasticizer type, aggregate shape, and air content) on pumpability. The p-Q diagram provides a quantitative basis for comparing formulations, replacing subjective assessments with reproducible data.

How to Evaluate Your Pumpability Testing Needs

Selecting the right approach to pumpability assessment depends on the project's complexity and the stage of the workflow.

When the Slump Test Falls Short

The standard slump test (ASTM C143 / EN 12350-2) measures only one dimension of workability: it correlates with yield stress but reveals nothing about plastic viscosity or pumping pressure. For straightforward pours with short, horizontal pipe

runs, slump may be sufficient. For any scenario involving long pipe lengths, vertical lifts, bends, reducers, or high-performance mixes with low water-to-binder ratios, the slump test does not provide the information needed to prevent blockages or pressure overloads.

Matching the Instrument to the Question

A conventional concrete rheometer (rotational viscometer) measures yield stress and plastic viscosity in a controlled shear environment, but it does not replicate pipe flow geometry or account for lubricating layer formation. The SLIPER complements these instruments by providing data that directly corresponds to pipe pumping conditions. For comprehensive pumpability characterization, engineers often combine rotational rheometry for fundamental rheological properties with SLIPER testing for applied pumping predictions.

Key Parameters to Consider

When specifying a pumpability testing program, consider the following factors:

- **Pipe length and configuration:** longer circuits and more bends increase pressure loss; use SLIPER data to validate pump capacity.
- **Concrete type:** SCC, fiber-reinforced concrete, and high-strength mixes each form lubricating layers with different thicknesses and viscosities.
- **Aggregate characteristics:** angular or elongated aggregates increase internal friction and affect the p-Q relationship.
- **Admixture sensitivity:** superplasticizers, viscosity-modifying agents, and air-entraining admixtures all shift the pressure-flow rate curve.
- **Environmental conditions:** temperature and elapsed time after mixing change rheological properties; test at conditions representative of the pour.

Frequently Asked Questions

What Does a Sliding Pipe Rheometer Measure?

A sliding pipe rheometer measures the relationship between pressure and flow rate in fresh concrete flowing through a pipe section. It produces a p-Q diagram that quantifies pumping resistance, characterizes lubricating layer behavior, and enables prediction of pressure losses in full-scale pumping circuits. This data goes beyond what slump or flow table tests provide.

How Is SLIPER Different from a Concrete Viscometer?

A concrete viscometer rotates a probe inside a sample to measure yield stress and plastic viscosity. SLIPER replicates actual pipe flow by sliding a real pipe section over the concrete sample. Because it captures lubricating layer formation and pipe wall friction directly, SLIPER provides pressure-flow rate data that viscometers cannot. The two instruments complement each other: the viscometer for fundamental rheology, SLIPER for applied pumpability prediction.

Can SLIPER Test Materials Other than Concrete?

Yes. The sliding pipe rheometer tests any thick, pumpable building material that flows through pipes, including mortar, grout, shotcrete mixes, and specialty thick matter. Any material that forms a lubricating layer during pipe transport is suitable for SLIPER testing, provided the aggregate size fits within the pipe diameter.

How Accurate Are SLIPER Pumping Pressure Predictions?

Research studies at TU Dresden and other institutions have validated SLIPER predictions against full-scale pumping measurements. The predicted pressure-flow rate curves show strong correlation with field data for both conventional and self-compacting concretes. Accuracy depends on representative sampling and correct weight selection during testing.

Is the SLIPER Suitable for Use on Construction Sites?

The SLIPER requires only a 6.2-liter concrete sample, runs on battery power, and transmits data wirelessly to a smartphone. Its compact, robust design makes it portable enough for on-site quality control. Operators can test a sample and review the p-Q diagram within minutes, enabling real-time decisions about mix adjustments before pumping begins.

How Does Mix Design Affect the p-Q Curve?

Every mix parameter shifts the pressure-flow rate curve. Increasing water-to-binder ratio generally reduces pumping pressure but may compromise strength. Adding superplasticizer lowers yield stress and flattens the curve. Higher fine aggregate content thickens the lubricating layer and improves pumpability. The SLIPER quantifies these effects so that engineers can optimize mix designs for both structural performance and pumping efficiency.

TECHNICAL SPECIFICATIONS

Sliding Pipe Rheometer - SLIPER Technical Specifications:

Sample Volume	6.2 liters
Speed Range	0 ... 4 m/s
Pressure Range	1 ... 1000 mbar
Weights	Approximately 1.6 kg and 4.8 kg

For delivery, you will receive:

- SLIPER (Sliding Pipe Rheometer)
- 2x NiMH batteries including charger
- 3x weights approximately 1.6 kg each
- 3x weights approximately 4.8 kg each
- Android smartphone with pre-installed software app
- Operating instructions

This comprehensive package ensures you have all the necessary components and instructions to effectively utilize SLIPER for your applications.

Order information:

Product Code	Product Description
QT-B0200	SLIPER – Sliding Pipe Rheometer
QT-B0206	Replacement tubes
QT-B0202	Replacement sealing
QT-B1174	Additional weight approx. 1.6 kg
QT-B1175	Additional weight approx. 4.8 kg

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