Quality Control and Robustness of SCC, Part 2
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IBB Probe

IBB PROBE & SYSTEM

By Dr. Denis Beaupre

IBB Probe - Contents

- IBB & Vision
- Rheology of Concrete
- What is the IBB Probe
- Measurements
- Precision
- Performance

IBB Probe - Vision

IBB Vision is:
“by 2020, all new ready-mix trucks will be have an IBB Rheological probe as a standard equipment”

IBB Probe - Rheology

- Rheology is the science of flow
- For fresh concrete, it measures Yield Stress (somewhat related to the slump) and the Viscosity

Denis Beaupre, Managing Director, IBB
Rheology, Quebec, QC, Canada
Change in composition will affect the rheological properties.
Since no rheometer uses the same dimension/principle, no agreement has been found on fundamental units.

**IBB Units:**
- Yield Stress = kPa
- Viscosity = kPa/s

For each application, there is a workability box that can be drawn.
The viscosity is an important parameter for special concrete.

The IBB Probe is a sensor that allows to assess some concrete properties (Slump, Temperature) inside the drum of a ready-mix truck, automatically, without sampling and on a continuous basis.
Properly used, it also gives rheological properties.

IBB Probe - Measurements
- Angle, Speed and direction of the drum
- Load on probe when in concrete displayed as pressure (kPa)
- Rheological properties: Yield and Viscosity (kPa, kPa/s)
- Voltage of the probe's batteries (V)
- Concrete Slump estimation (mm or inches)
- Temperature of the concrete (°C or °F)
- Volume estimation (Vl or m³)
- Probe is fully calibrated for speed, load, pressure, temperature and slump at the factory.
IBB Probe – Basic System

- System goes to sleep when speed too low
- Probe detects when it is concrete
- Measures temperature
- Measures load and speed for two speed values
- Calculates Viscosity and Yield
- Estimates slump from Yield
- Calculates volume inside the drum
- Sends data to Display by radio every turn or 10 seconds

IBB Probe – System Manager (in development)

- A System Manager can be installed at the batching plant
- It allows two ways communication between the Probe, the Display and the Plant Operator.

IBB Probe – Temperature

- Two probes were installed on the same truck in UAE

IBB Probe – Retempering Test

IBB Probe – SCC Mixes: Tow Point Test (Low speed)

IBB Probe – SCC Mixes: Aging
**IBB Probe – Other Concrete Producer**

Slump Comparison (using pressure @ 1.5 rpm) (IBB Probe System vs Manual Slump Test)

- Israel Producer
- UAE Producer

**IBB Probe – Precision of Manual vs. Probe Testing**

- The relationship between the manual slump and the IBB Slump depends on:
  - Precision of the slump test itself
  - Precision of the probe itself
  - Calibration between the probe and the slump test
  - Operational mode of both tests
- Best way to look at precision is to calculate the coefficient of variation (CV)

**IBB Probe – Variation of Manual vs. Probe Testing**

- Check Variation
- On 12 mixes
- Compare to
- ASTM, BS, BSEN allowance

**IBB Probe – Variation of the Slump Test**

- 12 mixtures were tested by 5 experienced Technicians at Unibeton Plant in Abu Dhabi, in February 2012

**IBB Probe – Variation of the Probe Test**

- In February 2012, A truck with two probes was used to evaluate the reproducibility of the probe on same 12 mixtures

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<th>PROBE 1</th>
<th>PROBE 2</th>
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**CV**

- ASTM: 15.2
- BS: 9.3
- Probe: 5.4

**Standard Deviation**

- ASTM: 10.6
- BS: 5.5
- Probe: 4.2
IBB Probe — Data from Display Log (Sequence from Feb 2012 test at UB)

- To evaluate the probe precision, it is best to look at the pressure variation from turn to turn with time. The calibration with the slump is independent of this.
- From turn to turn, the pressure measurement is quite constant, increasing slowly; as expected...

IBB Probe — All Data Available so far (all with initial UB Calibration)

• Using new calibration with Yield (to compensate if speed not exactly 1.5 rpm)
  Will improve the correlation

IBB Probe — Correlation Between Slump and Probe

- Calibration is done at a given speed when using pressure
- If speed is not exactly what is has been calibrated with, it will cause some error
- The use of the yield will eliminate the need to be exactly at the calibrated speed
- The new software will use this concept

IBB Probe — Performance

- The Probe stay general clean inside the drum
- Wear measurement indicate a potential life of 30-50 thousand cubic meter

IBB Probe — Conclusions

- After 3 years of development and many versions of the IBB probe, the system is a good tool to evaluate automatically and continuously the fresh properties inside a ready-mix truck
- The system is easy to install, gives direct measurements and does not depend on the amount of concrete inside the truck
- A good thing to install on all new trucks