Mobile Mixers: History, Performance & Use

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Concrete

Most widely used material in construction the world.

- 3000BC – Egyptian Pyramids
- 1824 – Portland Cement Invented
Concrete

- 1891 – First Concrete Street
- Bellefontaine, OH
- 1923 – Ready Mix
Ready Mix – Barrel Delivery

- Certified plant – keeps mix consistent
- Specifications written around ready mix
- Offload concrete quickly
- Simple operation

- Ready mix delivery model used for 100 years
- Is one tool a fit for all projects?
Project Needs

• What if projects require:

  ✓ Multiple mix designs
  ✓ Specialty mixes such as latex, polymers or fast-setting
  ✓ Several pour locations
  ✓ Flexibility in the schedule
  ✓ On demand concrete
  ✓ Night or weekend work with various amounts and/or mixes
  ✓ Remote work sites with limited access
How it Works

- Cement Bin
- Sand and Stone Aggregate Bin
- Water Tank
- Admixtures
- Mix Auger
- Sand and Stone Gate Dials
- Dual Auger Cement Bin +/- 1% accuracy
How it Works

Sand and Stone Gate Dials
Pump Master Auger

- 278 - 280 RPM
- 10 - 15 seconds of mix time
- 30° Angle
Weight vs Volume

ASTM C94

VS

ASTM C685
Calibration Process - Tools

- Containers
- Scale
- Stop watch
- Clipboard
Calibration Process

Typical Order of Calibration:

1. Cement
2. Sand
3. Stone

While the unit is empty of sand or stone, cement is discharged into the container, timed and weighed.
Calibration Process - Cement

• 3-5 trials is recommended

Recorded Information:
1. Record Discharge Time - seconds
2. Counts - number
3. Weight of material - lbs

• The goal is to verify +/-1% accuracy between the 3-5 trials
Calibration Process - Sand

- Discharge a specified number of sand counts into the bin

Recorded information
1. Counts: number
2. Weight of material: lbs

- No need to time the sand or stone, timing is based off the cement discharge
Calibration Process – Stone

• 3-5 trials is recommended

• Empty sand & load rock

• Repeat process
Calibration Process – Mix Design

Volumetric Concrete Dispenser Mix Design Worksheet

<table>
<thead>
<tr>
<th>Description</th>
<th>4000 PSI</th>
<th>Total</th>
<th>518 Counts / Cubic Yard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>1.09 lbs./ Count</td>
<td>Dial Setting</td>
<td>Oz/Min</td>
</tr>
<tr>
<td>Aggregate 1</td>
<td>2.75 lbs./ Count</td>
<td>ERROR</td>
<td>0.0</td>
</tr>
<tr>
<td>Aggregate 2</td>
<td>3.13 lbs./ Count</td>
<td>Admix # 1</td>
<td>ERROR</td>
</tr>
<tr>
<td>Water</td>
<td>0.00 lbs./ Count</td>
<td>Admix # 2</td>
<td>ERROR</td>
</tr>
<tr>
<td>Aggregate 1 Gate</td>
<td>5.0</td>
<td>Admix # 3</td>
<td>ERROR</td>
</tr>
<tr>
<td>Aggregate 2 Gate</td>
<td>6.5</td>
<td>Color</td>
<td>#DIV/0!</td>
</tr>
<tr>
<td>Water Meter</td>
<td>Fiber Chopper</td>
<td></td>
<td>#DIV/0!</td>
</tr>
</tbody>
</table>

1. Determine the count per cubic yard.
2. AGGREGATE 1: Divide the lbs. of fine aggregate per cubic yard by the count per cubic yard.
3. AGGREGATE 2: Divide the lbs. of coarse aggregate per cubic yard by the count per cubic yard.

Example:
- GATE SETTING (from graph) 5.0
- GATE SETTING (from graph) 6.5
Calibration Process – Verify

• Verify the mix design by running yield tests

• Slump and air testing can also be used to verify the quality of the mix
Calibration Process – Digital

• Digital Calibration simplifies the process
• Eliminates stop watch and clip board

• Sand, stone, cement, admixtures, water, fiber and color calibrations are all stored
Calibration Process – Mix Design

- Digital mix designs are also stored on the computer
- Automated gates used during calibration and mix design process
  - Accurate to 1/16”
  - Less human error
Barrel vs Mobile Mixers
Myth #1: Volumetric Concrete mixing is a new and unproven technology

- 1965 – Patent granted for the Concrete-Mobile
- Over 2,500 Concrete-Mobiles were produced by 1980
- Over 10,000 Volumetric Mixers produced by 2000
- In use in every state in the United States and 60 countries
- Used by the U.S. Military, state DOT and cities
- City of Des Moines has been operating a mixer for 15 years
Myth #2: Volumetric mixers cannot match the accuracy and consistency of a batch plant

- Specification ASTM C94 vs. ASTM C685
- Same tolerances on all materials
- More restrictions on ready mix as water-cement contact occurs at the plant, not at the job site
- ACI 304.6R “Guide for the Use of Volumetric-Measuring..”
- VMMB (NRMCA) approval and specification
- AASHTO M241
3rd Party Test Results

Concrete Comparative Testing – VMMB – 12/5/13

Table 4. Average* Concrete Compressive Strength (psi) Test Results, (ASTM C 39)

<table>
<thead>
<tr>
<th>Age</th>
<th>Drum Mixed</th>
<th>Volumetric w/o WR</th>
<th>Mixed</th>
<th>Volumetric Mixed w/ WR¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Day</td>
<td>2943</td>
<td>3338</td>
<td></td>
<td>3296</td>
</tr>
<tr>
<td>28 Day</td>
<td>4085**</td>
<td>4201**</td>
<td></td>
<td>4365</td>
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<tr>
<td>56 Day</td>
<td>4563</td>
<td>4647</td>
<td></td>
<td>4679</td>
</tr>
</tbody>
</table>

¹ Additional Test

*This is an average of the compressive strength test results of specimens of all the four batches at the respective test age.

Air content, slump, unit weight testing
Myth #3: Volumetric mixers don’t produce “good concrete” (e.g. not enough mix time)

Many examples of quality concrete:
- Bridge deck overlays – Virginia
- Street replacement/repair - Texas
- Airport runway repairs – Oregon, Australia
- Structural elements
- Pool builders, Soil retention - Florida
- Pervious concrete – California
- Light weight concrete by foam and lightweight aggregates
Myth #4: Volumetric mixers cannot handle large production pours or projects

- A single piece of equipment can be reloaded at the jobsite – No time or fuel wasted in transit
- Volumetric equipment is capable of production rates in excess of 90 cubic yards per hour
- Many examples of large scale projects done with volumetrics
  
  - Fermi Labs – 28,000 CY of concrete in 1 month with 1 machine
  - Common volumetric model on the market today will produce 1 CY of concrete per minute
Myth #5: Volumetric mixers are too complex to operate and have too long a learning curve

• Like other jobsite equipment, proper training of operators is a must
• An operator of a volumetric mixer must have more training than a typical barrel mixer operator – “batch plant on wheels”
• We offer extensive training in the operation, maintenance and calibration of their equipment
• Typical “day-to-day” operation is straight-forward and repeatable
Automated Units

- Electronic controls
- Simple Operation
- CAN wiring – simplifying maintenance
- Technology based infrastructure
- Pre-programmed mix designs
- Automated gate system
- Printable batch ticket with each pour
DOT Approved

• Arizona
• California – CalTrans
• Maryland
• North Carolina
• Illinois
• Iowa
• Louisiana
• Texas

• Florida
• Minnesota
• New Mexico
• Alabama
• Washington
• Oklahoma
• Georgia
Benefits

• Fresh, on-demand concrete
  • Stop and start as needed
• Multiple mix designs from a single load
• Not limited by travel time or distance
• Reduced clean out time, water, materials
• Specialty concrete – latex, fast-setting, etc.