Claims

1. A method for determining volume of a concrete load contained within a rotatable mixer drum, comprising:

(A) rotating a concrete load contained within a rotatable mixer drum having an inner wall, having a non-vertical axis of rotation, and having at least one sensor probe mounted on or along the inner wall and configured to transmit in-and-out signal data from the at least one sensor probe when the at least one sensor probe is rotated through the contained concrete load within the rotatable mixer drum, the in-and-out signal data comprising sensor probe submergence and non-submergence intervals and sensor probe entry angle and exit angle, and transmitting the sensor probe in-and-out signal data to a processor configured to receive the in-and-out signal data and to calculate a value corresponding to volume of the concrete load contained within the rotatable mixer drum;

(B) the processor performing the volume value calculation by accessing a database having stored values of concrete load volumes as correlated with in-and-out signal data previously obtained from sensor probes used in calculating load volumes of prior concrete loads previously contained within a rotatable mixer drum; and

(C) performing, based on the volume value calculation, at least one function chosen from (i) administering a dosage of water or admixture into the concrete load, (ii) expelling a volume of concrete from the rotatable mixer drum, (iii) providing an indication of the administered dosage of water or admixture into the concrete load, expelled volume of concrete, or both; and (iv) performing a combination of any of the foregoing functions (i)-(iii); and the method further comprising

(D) monitoring rheology of the concrete load contained in the rotatable mixer drum, monitoring tilt angle of the rotatable mixer drum, and calculating the volume value by accessing a database having stored values of previous concrete load volume values as correlated with in-and-out signal data previously obtained from sensor

probes at various drum rotation speeds, at various rheological conditions, and at various rotatable mixer drum tilt angles.

2. The method of claim **1** wherein, in step (A), the calculation of the volume value of the concrete load contained in the rotatable mixer drum comprises adjustment of a concrete load volume value as included in or on a batch ticket issued by a batch plant.

3. The method of claim **1** wherein the rotatable mixer drum is mounted on a ready-mix concrete delivery truck.

4. The method of claim **1** wherein the slump value of a current concrete load contained in the rotatable mixer drum is monitored by an automatic slump monitoring system wherein the slump value is derived using a force sensor, hydraulic pressure sensor, or combination thereof.

5. The method of claim **1** wherein the at least one sensor probe is a contact switch.

6. The method of claim **1** further comprising providing at least one hydraulic pressure sensor for monitoring hydraulic pressure required to rotate the rotatable mixer drum at a given mixer drum rotation speed and obtaining an indication of slump, slump flow, or other rheology characteristic of the current concrete load contained in the rotatable mixer drum; and employing the at least one sensor probe mounted on or along the inner wall of the rotatable mixer drum and configured to transmit in-and-out signal data corresponding to the current concrete load contained in the rotatable mixer drum and to calculate a volume value for a given drum rotation speed, and comparing the indication of slump, slump flow, or other rheology characteristic of the current concrete load to historic signal data in which in-and-out signal data was stored in correlation with calculated slump, slump flow, or other rheology characteristic at various mixer drum rotation speeds as derived from prior concrete mix loads.

7. The method of claim **1** wherein said at least one sensor probe comprises a force probe and a contact switch, both of which are mounted on a rotatable mixer drum hatch door.

8. The method of claim **7** wherein both the force probe and the contact switch can provide in-and-out signal data to the processor and be compared to ascertain whether the force probe may have inaccuracies due to variations in the length of the force probe which affect calculations of its points of entry into and exit from the surface of the concrete load.

9. The method of claim **1** wherein the in-and-out signal data obtained from the current concrete load contained in the rotatable mixer drum is used by the processor only after (i) a predetermined amount of mixer drum rotations have occurred or (ii) an automated slump monitoring system has confirmed that the current concrete load has attained homogeneity or uniformity.

10. The method of claim **1** further comprising obtaining an in-and-out sensor probe signal which comprises data sets of sensor probe entry point, sensor probe exit point, mixer drum rotation speed, and slump values, and further wherein the processor compares these data sets from a current concrete load in the rotatable mixer drum and compares to historic data of past concrete loads previously contained within a rotatable mixer drum.

11. The method of claim **1** further comprising obtaining in-and-out sensor probe data signals which comprise data sets comprising probe entry point, probe exit point, mixer drum rotation speed, and slump values; wherein the processor compares these data sets obtained from a current concrete load in the rotatable mixer drum, to stored data of past concrete loads previously contained within a rotatable mixer drum, and wherein the processor further compares mix design number and tilt angle of the current concrete load with past concrete load stored data.

12. The method of claim **1** wherein the processor selects historic in-and-out sensor probe data stored in memory based on rotatable mixer drum type.

13. The method of claim **1** further comprising monitoring slump and tilt angle of the concrete load contained in the rotatable mixer drum, and performing the calculation of the volume value calculation by accessing a database having stored values of concrete load volumes as correlated with in-and-out signal data previously obtained from sensor probes at various rotatable mixer drum rotation speeds, at various rheological conditions, and various rotatable mixer drum tilt angles, the processor being further configured to store data into the database relative to monitored in-and-out signal data, speed of rotatable mixer drum rotation, slump, tilt angle, and calculated values of concrete load volume.

14. The method of claim **1** further comprising monitoring slump and tilt angle of the concrete load contained in the rotatable mixer drum, and calculating volume value by accessing a database having stored values of concrete load volumes as correlated with in-and-out signal data previously obtained from sensor probes at various rotatable mixer drum rotation speeds, at various rheological conditions, and rotatable mixer drum tilt angles, the processor being further configured to store data into the database relative to monitored in-and-out signal data, speed of rotatable mixer drum rotation, slump, tilt angle, and calculated values of concrete load volume; and further wherein rotatable mixer drum rotation speed is within the range of 1-22 rotations per minute; wherein slump or slump flow is within the range of 0.5-20 inches; and wherein the rotatable mixer drum is mounted on a delivery truck and the non-vertical axis of rotation of the rotatable mixer drum has a tilt angle between (−)10 degrees to (+)10 degrees departure on account of the delivery truck driving along sloping roadway.

15. A system comprising at least one sensor probe configured to transmit in-and-out signal data when rotated through a concrete load contained in a rotatable mixer drum according to step (A) of claim **1**, the at least one sensor probe in communication with a processor programmed to perform steps (B) through (D) of claim **1**.