

What is claimed is:

- 5 1. A method for detecting buildup of hardened concrete in a mixer drum, comprising:
- (a) providing a rotatable concrete mixer drum having an inner wall and at least two blades mounted on the inner wall within the mixer drum, the mixer drum having 0.0-1.0 cubic yard of plastic cementitious material and material unattached to the mixer drum
10 (hereinafter described as “mixer drum having zero or negligible load”), the concrete mixer drum having zero or negligible load being rotated at a constant rotational speed by a motor driven by a hydraulic-pressure pump, the motor having two sides, a first side for charging the motor in a first direction using hydraulic fluid driven by the pump and a second side for returning the hydraulic fluid to the pump;
- 15 (b) measuring the hydraulic pressure as a function of time during at least two successive complete rotations of the mixer drum having zero or negligible load at constant rotational speed using a sensor for measuring the pressure of the hydraulic fluid at the first side, second side, or sensors on both sides to obtain a pressure/time data curve;
- (c) determining when the sensed pressure/time data curve as obtained from step (b)
20 represents eccentric behavior which meets or exceeds a stored eccentricity threshold; and, where eccentric behavior meets or exceeds a stored eccentricity threshold the stored,
- (d) providing an alarm or indication that the rotation of the concrete drum has eccentric behavior which meets or exceeds the stored threshold value.
2. The method of claim 1 wherein, in step (c), eccentricity is determined based
25 upon at least one of the following procedures:
- A. measuring the amplitude of the sensed hydraulic pressure at the charge side, at the discharge side, or at both the charge and discharge sides;

- B. comparing the hydraulic pressure over a complete drum rotation at the charge side to the hydraulic pressure over the same complete drum rotation at the discharge side; or
- C. calculating the ratio between the second moment of area about both the x and y-axes for the shape created by plotting the hydraulic pressure over a complete drum rotation at the charge side in polar coordinates where the pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate or measuring the centroid of the shape created by plotting the hydraulic pressure over a complete drum rotation at the discharge side in polar coordinates where the pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate.
3. The method of claim 2 wherein eccentricity of mixer drum behavior is determined based upon measuring the amplitude of the sensed hydraulic pressure at the charge side, at the discharge side, or sensors at both the charge and discharge sides.
4. The method of claim 3 wherein the amplitude is calculated as the absolute difference between the maximum and minimum values of the hydraulic pressure over time at the charge side or the amplitude is calculated as the absolute difference between the maximum and minimum values of the hydraulic pressure over time at the discharge side.
5. The method of claim 2 wherein eccentricity of mixer drum behavior is determined based upon comparing the hydraulic pressure over a complete drum rotation at the charge side to the hydraulic pressure over the same complete drum rotation at the discharge side.
6. The method of claim 2 wherein eccentricity of mixer drum behavior is determined by calculating the ratio between the second moment of areas about both the x and y-axes of the shape created by plotting the hydraulic pressure over a complete drum rotation at the charge side in polar coordinates where the pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate or measuring the centroid of the shape created by plotting the hydraulic pressure over a complete drum

rotation at the discharge side in polar coordinates where the pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate.

7. The method of claim 1 wherein, in step (d), the alarm or indication comprises:
(i) a visual indication or display indicating to a driver of a vehicle upon which the concrete
5 mixer drum is mounted that hardened concrete buildup is detected; (ii) a notification to the
concrete plant manager that hardened concrete buildup has exceeded a threshold limit; (iii)
a notification to the concrete quality control manager that buildup has exceeded a threshold
limit; or (iv) a combination of any of the foregoing.

8. The method of claim 2 wherein, in procedure A, the amplitude is calculated as
10 the absolute difference between the maximum and minimum values of the hydraulic pressure
over drum rotation at the charge side or the amplitude is calculated as the absolute difference
between the maximum and minimum values of the hydraulic pressure over drum rotation at
the discharge side.

9. The method of claim 2 wherein, in procedure A, the amount of buildup is
15 determined by comparing the measured amplitude to a previously stored data curve that
derived from buildup amount data and amplitude data.

10. The method of claim 2 wherein, in procedure B, the comparison between the
hydraulic pressure over a complete drum rotation at the charge and discharge sides is
quantified by the difference between hydraulic pressure over a complete drum rotation at
20 the charge and discharge sides.

11. The method of claim 2 wherein, in procedure B, the amount of hardened
concrete buildup is calculated by comparing the difference between the hydraulic pressure
at the charge side and the hydraulic pressure at the discharge side to a previously stored data
curve that contains buildup amount data and the difference between the hydraulic pressure
25 at the charge side and the hydraulic pressure at the discharge side.

12. The method of claim 2 wherein, in procedure C, the buildup is quantified by comparing the ratio between the second moment of areas about both the x and y-axes of the shape created by plotting the hydraulic pressure over a complete drum rotation at the charge port in polar coordinates where the pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate and the pole to a previously stored data curve that relates buildup amount and the ratio between the second moment of areas about both the x and y-axes of the shape created by plotting the hydraulic pressure over a complete drum rotation at the charge side in polar coordinates where hydraulic pressure represents the distance from the pole and the angle of drum rotation represents the angular coordinate.

13. The method of claim 1 wherein, in step (d), the indication is of the amount of hardened concrete buildup.

14. The method of claim 1 wherein, in step (b), the drum is rotated at a constant speed that exceeds 50% of the maximum drum rotation speed.

15. The method of claim 1 wherein, in steps (a) and (b), the drum is rotated at a constant speed that exceeds 90% of the maximum drum rotation speed.

16. The method of claim 1 further comprising introducing at least one set retarding admixture chemical into the mixer drum after plastic concrete has been removed from the drum.

17. The method of claim 1 wherein the processor is programmed to indicate on a visual display the amount of hardened concrete buildup in the mixer drum as a function of time.

18. A concrete mixer drum monitoring system comprising: a computer processor programmed to perform the method of claim 1.

25