It is claimed:

1. A method for mixing a cementitious material, comprising:

providing a mixing drum having an inner drum wall and at least one mixing blade mounted on said inner drum wall, said mixing drum containing components for making a hydratable cementitious material;

rotating said mixing drum at constant speed S^{C1} in the range of 1-25 revolutions per minute;

providing a first sequence of values over time corresponding to the energy required to rotate the mixing drum, said first sequence of values being monitored at a frequency of at least 10 times constant speed S^{C1};

calculating a second sequence of two or more values describing the variation in the first sequence of values and optionally the average of the first sequence of values, with said first sequence of values represented in the time domain, frequency domain, or both;

comparing the first or second sequence of values with a corresponding sequence of values previously stored in data memory storage location; and

adjusting rheology or other property of the cementitious material contained in said mixing drum by introducing a liquid or other cementitious material component into the mixing drum.

2. The method of claim 1 wherein said rotatable mixing drum has at least two mixing blades mounted on an inner drum wall.

3. The method of claim 1 wherein said first sequence of values corresponds to hydraulic pressure.

4. The method of claim 1 wherein said first and second sequences of values are stored in a computer-accessible data memory storage location.

5. The method of claim 1 wherein said components for said hydratable cementitious material are mixed in said mixing drum until a uniform consistency is obtained.

6. The method of claim 1 wherein, in said step of comparing the provided first or second sequence of values with a sequence of values previously stored in data memory storage location, said sequence of values is correlated with at least one of the cementitious material mixing parameters selected from (a) load weight, (b) load volume, (c) concrete density, (d) concrete air content, (e) concrete slump, (f) concrete slump flow, (g) concrete flow table value, (h) concrete rheology (e.g., yield stress, viscosity, thixotropy), (i) segregation of concrete components, (j) concrete setting, (k) inclination of the mixing drum, (l) size and configuration of the internal drum structure, and (m) build-up of concrete in the drum.

7. The method of claim 6 wherein said first or second sequence of values stored in data memory storage location corresponds with slump or slump flow.

8. The method of claim 6 wherein said provided sequence of values is displayed graphically on a visual display or chart as a waveform.

9. The method of claim 6 wherein said provided sequence of values is analyzed as a waveform pattern and said waveform is correlated to at least one of said parameters (a) through (m), and said sequence of values analyzed as a waveform pattern is stored in a computer-accessible memory location, displayed on a monitor, printed on paper, or combination thereof.

10. The method of claim 1 wherein said liquid is water, at least one chemical admixture, or mixture thereof.

11. The method of claim 1 wherein said provided sequence of values is converted into the frequency-domain to obtain a second data set.

12. The method of claim 11 wherein the conversion is accomplished using an algorithm selected from Fast Fourier Transform and Discrete Fourier Transform, and variations thereof.

13. The method of claim 1 comprising: rotating a mixing drum containing a cementitious mixture at a constant speed in the range of 1-25 revolutions per minute; providing a sequence of time-domain values corresponding to the amount of energy required to rotate said mixing drum; converting said sequence of time-domain values into frequency-domain values; comparing said converted frequency-domain values to stored frequency-domain values; and introducing a liquid into said mixing drum in response to said comparison.

14. The method of claim 13 wherein, in converting said sequence of time-domain values into frequency-domain values, the method further comprising correlating said frequency-domain values with at least one of the cementitious material mixing parameters selected from (a) load weight, (b) load volume, (c) concrete density, (d) concrete air content, (e) concrete slump, (f) concrete slump flow, (g) concrete flow table value, (h) concrete rheology (e.g., yield stress, viscosity, thixotropy), (i) segregation of concrete components, (j) concrete setting, (k) inclination of the mixing drum, (l) size and configuration of the internal drum structure; and (m) build-up of concrete in the drum.

15. The method of claim 1, further comprising: determining, storing, and reporting the progress of mixing based on a comparison of said provided sequence of values with said previously stored sequence of values, said comparison involve values corresponding to features of "M" or "W" shaped time-domain waveform, variation in non-averaged hydraulic pressure, stabilization of averaged hydraulic pressure, or a combination thereof when hydraulic pressure data is graphically depicted in as a function of time or frequency to rotate the mixing drum containing the hydratable cementitious material.

16. A mixing system comprising:

a mixing drum having an inner drum wall and at least one mixing blade mounted on said inner drum wall, said mixing drum containing components for making a hydratable cementitious material;

a motor operative to rotate said mixing drum at constant speed S^{C1} in the range of 1-25 revolutions per minute;

a sensor operative to provide a first sequence of values over time corresponding to the energy required to rotate the mixing drum;

a computer processing unit for

monitoring first sequence of values provided by the energy sensor corresponding to the amount of energy required by the hydraulic drive,

representing first sequence of values in the time domain, frequency domain, or both,

and calculating a second sequence of two or more values describing the variation in the first sequence of values and optionally the average of the first sequence of values;

a data memory storage location for storing a second sequence of values corresponding to first sequence of values over time corresponding to the energy required to rotate the mixing drum containing a first hydratable cementitious material, said first sequence of values being monitored at a frequency of at least 10 times constant speed S^{C1};

said computer processing unit being further operative for receiving a said first and second sequences of values over time corresponding to the energy required to rotate the mixing drum containing a second hydratable cementitious material, said first sequence of values for second hydratable cementitious material being monitored at a frequency of at least 10 times constant speed S^{C1};

said computer processing unit being further operative for comparing said first or second sequence of values for second hydratable cementitious material with said first or second sequence of values for first hydratable cementitious material, and adjusting rheology or other property of said second hydratable cementitious material by introducing a liquid or other cementitious material component into said mixing drum based on said comparison.

17. The mixing system of claim 16 wherein said computer processing unit is operative (a) to convert said first and second sequence of values, corresponding to energy required to rotate the mixing drum containing cementitious material, into the frequency-domain; (b) to compare said first and second sequence of values after conversion into the frequency-domain, and (c) to adjust the rheology of cementitious material contained in said mixing drum by addition of liquid based on said comparison.

IT IS CLAIMED:

1. A mixing system, comprising:

a rotatable mixing drum having an inner drum wall and at least two mixing blades mounted on the inner drum wall for mixing a provided concrete contained within the rotatable mixing drum;

a drive means for rotating the rotatable mixing drum containing the provided concrete at constant speed S^{C1} in the range of 1-25 revolutions per minute;

a sensor for providing a sequence of values over time corresponding to the energy required by the drive means to rotate the mixing drum, the provided sequence of values enabling a computer processing unit to detect shape transitioning in the waveform data corresponding to concrete flowing over the at least two blades mounted in the drum within one rotational cycle of the mixing drum;

a data memory storage location having waveform data derived from a previously stored sequence of values over time corresponding to the energy required to rotate a mixing drum containing a previous concrete as monitored by a sensor during rotation of the mixing drum at a frequency of at least 10 times constant speed S^{C1} of mixing drum rotation, the stored waveform data enabling a computer processing unit to detect shape transitioning in the waveform data corresponding to concrete flowing over the at least two blades mounted in the drum within one rotational cycle of the mixing drum; and

a computer processing unit which performs the following functions:

monitors at a frequency of at least 10 times constant speed S^{C1} of mixing drum rotation the sequence of values provided by the energy sensor to obtain waveform data containing shape transitioning in waveform data corresponding to concrete flowing over at least two blades mounted in the drum within one rotational cycle of the mixing drum rotation, and corresponding to the amount of energy required by the drive means to rotate the mixing drum containing the provided concrete,

analyzes the provided sequence of values in the time domain, the frequency domain, or in both the time domain and frequency domain, for variations in waveform data within one rotational cycle of the mixing drum,

compares waveform data variations within the waveform data provided by the sensed sequence of values to waveform data variations within the previously stored sequence of values, and

adjusts the slump, slump flow, or other property of the provided concrete by introducing a liquid into the rotatable mixing drum containing the provided concrete based on the comparison of waveform data variations in provided and previously stored sequences of values.

2. The mixing system of claim 1 wherein the waveform data variations are correlated with at least one property or condition of the concrete or mixing drum selected from (a) load weight, (b) load volume, (c) concrete density, (d) concrete air content, (e) concrete slump, (f) concrete slump flow, (g) concrete flow table value, (h) concrete rheology selected from yield stress, viscosity, and thixotropy, (i) segregation of concrete components, (j) concrete setting, (k) inclination of the mixing drum, (l) size and configuration of the internal drum structure; and (m) build-up of concrete in the drum.

3. The mixing system of claim 2 wherein the waveform data variations are correlated with concrete air content and concrete slump.

4. The mixing system of claim 1 wherein the computer processing unit further compares the waveform data variations which were derived from provided and previously stored sequences of values corresponding with concrete slump flow.

5. The mixing system of claim 1 wherein a sequence of values and waveform data variations is displayed graphically on a visual display or chart as a waveform.

6. The mixing system of claim 1 wherein the system provides a sequence of values and waveform data variations therein as a waveform pattern and the waveform is correlated to at least one of the parameters and the sequence of values and waveform data variations therein are analyzed as waveform patterns stored in a computer-accessible memory location, displayed on a monitor, printed on paper, or a combination thereof.

7. The mixing system of claim 1 wherein the liquid is water, at least one chemical admixture, or a mixture thereof.

8. The mixing system of claim 1 wherein the determination, storing, and reporting of mixing progress involves the computer processing unit comparing the provided sequence of values with the previously stored sequence of values, and the comparison involves values corresponding to features of "M" or "W" shaped time-domain waveform, waveform data variations corresponding to non-averaged hydraulic pressure, stabilization of averaged hydraulic pressure, or a combination thereof when hydraulic pressure data, corresponding to the energy required to rotate the mixing drum containing concrete, is graphically depicted as a function of time or frequency.

9. The mixing system of claim 1 wherein the drive means is a hydraulic drive.

10. The mixing system of claim 1 wherein the waveform data variations compared by the computer processing unit comprise changes in peak amplitude and phase shift in the frequency domain.