CLAIMS

We claim:

1. A method for wellhead measurement of at least one well using a Coriolis flowmeter, the method comprising:

determining an entrained gas severity of the at least one well, where the entrained gas severity is based on the amount of entrained gas exceeding a determined drive gain threshold, wherein determining the drive gain threshold comprises: storing at least one factory baseline drive gain values set during meter calibration, computing at least one time period where a measured drive gain is low and steady, and setting the drive gain threshold based on the measured drive gain correlating to the at least one time intervals;

outputting at least one variable based on the determined entrained gas severity; and

outputting a respective confidence indicator correlating to the at least one variable.

2. The method of claim 1, wherein the at least one variable includes at least one of: flow variables, diagnostic information, and user alerts.

3. The method of claim 2, wherein flow variables include at least one of: mass flow, volume flow, density, water cut, and net oil.

4. The method of claim 2, wherein the diagnostic information include at least one of: temperature; detection of multiphase conditions; time durations within measurement time intervals where the entrained gas is above the determined drive gain threshold; and information of multiphase conditions, the information of multiphase conditions including at least one of: gas void fraction, continuous entrainment, and slugging gas entrainment.

5. The method of claim 1, wherein the outputting the at least one variable includes continually averaging the at least one variable over a predetermined time interval and outputting a respective single averaged data value of the at least one variable.

6. The method of claim 5, wherein the predetermined time interval is determined by one of a user and flow conditions, the flow conditions including one of intermittent slugging and continuous entrainment.

7. The method of claim 5, wherein the predetermined time interval is one of uniform and non-uniform in duration.

8. The method of claim 5, wherein the at least one continually averaged variable includes at least one of: flow variables, diagnostic information, and user alerts if the entrained gas severity is below the determined drive gain threshold.

9. The method of claim 5, wherein the at least one continually averaged variable includes at least one of: diagnostic information and user alerts if the entrained gas severity is above the determined drive gain threshold.

10. The method of claim 1, wherein the outputting the at least one variable includes outputting at least one instantaneous variable at predetermined and uniform time intervals.

11. The method of claim 10, wherein the outputting the at least one instantaneous variable includes at least one of: flow variables, diagnostic information, and user alerts if the entrained gas severity is below the determined drive gain threshold.

12. The method of claim 10, wherein the outputting the at least one instantaneous variable include at least one of: diagnostic information and user alerts if the entrained gas severity is above the determined drive gain threshold.

13. The method of claim 12, wherein the outputting the at least one instantaneous variable further includes holding a last data value of flow variables and outputting the held last data value correlating to the predetermined and uniform time intervals.

14. The method of claim 1, wherein the respective confidence indicator is based on a time duration within a measurement time interval where gas entrainment is detected.

15. The method of claim 1, wherein the respective confidence indicator is based on a computed comparison of a portion of one of mass or volume flow occurring with gas entrainment and one of a total mass and total volume flow during a measurement time interval.

16. The method of claim 1, wherein the respective confidence indicator is based on a computation of flow conditions, the flow conditions including one of intermittent slugging and continuous entrainment.

17. The method of claim 5, wherein the respective confidence indicator is based on at least one of: a percentage of mass during the predetermined time interval where the entrained gas severity is above the determined drive gain threshold, a percentage of time where the entrained gas severity is above the determined drive gain threshold, and total volume flow.

18. The method of claim 10, wherein the respective confidence indicator is based on at least one of: a cumulative moving average of a percentage of time the entrained gas severity is above the determined drive gain threshold, a percentage of mass flow where the entrained gas severity is above the determined drive gain threshold, a quantity of time durations where entrained gas severity is below the determined drive gain threshold, and total volume flow.

19. The method of claim 1, wherein the at least one well includes electric submersible pumps.

20. The method of clam 1, wherein determining the drive gain threshold includes determining if flow conditions include at least one of: gas void fraction, continuous entrainment, and slugging gas entrainment.

21. The method of claim 1, including:

correcting the drive gain threshold based on a measured water cut and increases in viscosity.

22. Meter electronics (20) for a wellhead measurement device (5), the meter electronics (20) comprising an interface (201) configured to communicate with a Coriolis flowmeter assembly of the wellhead measurement device (5), and receive a vibrational response, and a processing system (203) coupled to the interface (201) and configured to:

determine an entrained gas severity of an at least one well, where the entrained gas severity is based on the amount of entrained gas exceeding a determined drive gain threshold wherein determining the drive gain threshold includes:

storing at least one factory baseline drive gain values set during meter calibration;

computing at least one time period where a measured drive gain is low and steady; and

setting the drive gain threshold based on the measured drive gain correlating to the at least one time intervals;

output the least one variable based on the determined entrained gas severity; and

output a respective confidence indicator correlating to the at least one variable.

23. A Coriolis wellhead measurement device (5) comprising:

a Coriolis flowmeter assembly (10) to generate a vibrational response; and

meter electronics (20) connected to the flowmeter assembly configured to receive and process the vibrational response to generate at least one variable; the meter electronics further configured to:

determine an entrained gas severity of an at least one well, where the entrained gas severity is based on the amount of entrained gas exceeding a determined drive gain threshold, wherein determining the drive gain threshold includes:

storing at least one factory baseline drive gain values set during meter calibration;

computing at least one time period where a measured drive gain is low and steady; and

setting the drive gain threshold based on the measured drive gain correlating to the at least one time intervals;

output the least one variable based on the determined entrained gas severity; and

output a respective confidence indicator correlating to the at least one variable.