

CLAIMS

What is claimed is.

1. A method of producing fluid from a subsea wellbore 26 comprising:
 - a. obtaining an amount of fluid produced from the wellbore 26 that defines an amount of sampled fluid 50;

characterized by,
 - b. isolating the amount of sampled fluid 50 in a container 51 disposed adjacent the wellbore 26;
 - c. sensing the sampled fluid 50 at vertically spaced locations over a period of time; and
 - d. identifying a constituent of the sampled fluid 50 based on the step of sensing.
2. The method of claim 1, further characterized by identifying stratification of the sampled fluid 50 into phases based on the step of sensing.
3. The method of claims 1 or 2, characterized in that the container 51 is mechanically coupled to a production tree 22 mounted over the subsea wellbore 26.
4. The method of any of claims 1-3, characterized in that the fluid produced from the wellbore 26 flows through a flowmeter 74, the method further comprising adjusting a value of a measurement obtained using the flowmeter 74 based on step (d).
5. The method of claim 4, characterized in that step (d) comprises identifying an amount of water in the sampled fluid 50 and the flowmeter 74 is a multi-phase flowmeter.
6. The method of any of claims 1-5, further characterized by estimating a percentage an identified constituent makes up of the total sampled fluid 50.

7. The method of any of claims 1-6, characterized in that steps (a) and (b) comprise flowing the amount of fluid into a sample flow line having valves 46, 48 and closing the valves 46, 48 to isolate the sampled fluid 50 between the valves 46, 48 in the sample flow line.

8. The method of any of claims 1-7, characterized in that step (c) comprises measuring a property of a discrete portion of the sampled fluid 50 with a sensor 56 disposed at each of the vertically spaced locations.

9. The method of any of claims 1-8, further characterized by releasing the amount of sampled fluid 50 from the container 51 and into a production flow line 34 that transmits fluid produced from the wellbore 26.

10. A subsea wellhead assembly 20 comprising:

a wellhead housing 24 mounted over a subsea wellbore 26;

a production tree 22 coupled to the wellhead housing 24;

a production flow line 34 in fluid communication with the production tree 22; and

characterized by,

a sample circuit 44 comprising a container 51 that is selectively in fluid communication with the production flow line 34; and

a sensor system comprising fluid sensors 56 that are in communication with vertically spaced points along an inside of the container 51.

11. The wellhead assembly of claim 10, characterized in that the sample circuit 44 further comprises an inlet 45 in fluid communication with the production flow line 34, an outlet 47 in

fluid communication with the production flow line 34, an inlet valve 46 in fluid communication with the inlet 45, and an outlet valve 48 in fluid communication with the outlet 47, and wherein the container 51 is defined between the inlet valve 46 and the outlet valve 48.

12. The wellhead assembly 20 of claim 10, wherein a value characterizing flow through the production flow line 34 is measured with a flowmeter 74 and wherein the value is adjusted based on an output of the sensor system.

13. The wellhead assembly 20 of claim 12, characterized in that the sensor system is in communication with the flowmeter 74 through a control module 68 provided on the production tree 22.

14. A method of producing fluid from a subsea well 26 comprising:

- a. retaining an amount of fluid produced from the well 26 in a sealed environment that is subsea and proximate the subsea well 26;

characterized by,

- b. sensing a characteristic of the fluid at discrete vertically spaced apart locations in the sealed environment;
- c. measuring a rate of flow of fluid produced from the well 26; and
- d. adjusting the measured rate of flow based on a result from step (b).

15. The method of claim 14, characterized in that a multi-phase flowmeter is used to measure a rate of flow of fluid and wherein step (d) comprises calibrating the multi-phase flowmeter.

16. The method of claims 14 or 15, characterized in that step (b) occurs at a time ranging from about the same time as step (a) up to at least about 10 hours after step (a).

17. The method of any of claims 14-16, characterized in that step (b) is repeated until water and hydrocarbon liquid in the fluid being retained has substantially stratified.

18. The method of any of claims 14-17, characterized in that the characteristic of the fluid is selected from the group consisting of fluid density, fluid composition, fluid pressure, fluid viscosity, and fluid temperature.

CLAIMS

1. A method of producing fluid from a subsea wellbore through a subsea production tree mounted over the subsea wellbore and out a production flow line extending from the tree, comprising:

a. connecting an inlet of a sampling conduit into the flow line and an outlet of the sampling conduit into the flow line at a location downstream from the inlet;

b. providing the sampling conduit with an inlet valve and an outlet valve downstream from the inlet valve, defining a container between the inlet valve and the outlet valve that has sensors at vertically spaced apart locations inside the container;

c. opening the inlet and outlet valves, thereby diverting some of the fluid flowing through the flow line into the sampling conduit, then closing the inlet and outlet valves, thereby isolating an amount of sampled fluid in the container from the fluid flowing through the flow line;

d. sensing the sampled fluid with the sensors over a period of time;

e. identifying a constituent of the sampled fluid based on the step of sensing;
then

f. opening the inlet and outlet valves to allow the sampled fluid to flow through the outlet valve into the flow line.

2. The method of claim 1, wherein step (e) further comprising identifying stratification of the sampled fluid into phases.

3. The method of claim 1, wherein the flow line has a choke through which the well fluid flows, and wherein step (a) comprises placing the outlet of the sampling conduit upstream from the choke.

4. The method of claim 1, wherein the fluid flowing through the flow line flows through a flowmeter, the method further comprising adjusting a value of a measurement obtained with the flowmeter based on the constituents identified in step (e).

5. The method of claim 4, wherein step (e) comprise identifying an amount of water in the sampled fluid and calibrating the flowmeter based on the amount of water identified in the sampled fluid.

6. The method of claim 1, wherein step (e) further comprises estimating a percentage that the identified constituent makes up of the total sampled fluid.

7. The method of claim 1, wherein step (e) comprises identifying whether the sampled fluid contains water, oil and gas.

8. The method of claim 1, wherein step (d) further comprises communicating data signals from the sensors to a controller, which performs step (e).

9. The method of claim 8, wherein the subsea production tree further comprises a service control module mounted to the subsea production tree; and

the controller provides data signals resulting from step (e) to the service control module.

10. A subsea wellhead assembly comprising:

a wellhead housing mounted over a subsea wellbore;

a subsea production tree coupled to the wellhead housing;

a production flow line in fluid communication with the production tree;

a sample conduit having an inlet connected into the production flow line and an outlet connected into the production flow line downstream from the inlet, defining a container between the inlet and the outlet ;

an inlet valve at the inlet of the sample conduit and an outlet valve at the outlet of the sample conduit;

the inlet and outlet valves having an open position that selectively diverts some of the well fluid flowing through the production line into the container and from the container back into the production flow line;

the inlet and outlet valves having a closed position that isolates a sample of the well fluid in the container from the well fluid flowing through the production flow line; and

a sensor system comprising fluid sensors in the container at vertically spaced apart locations and that are in communication with vertically spaced points along an inside of the container, the sensors being configured to identify constituents of the sample of the well fluid.

11. The wellhead assembly of claim 10, wherein the fluid sensors are configured to identify stratification of the sample of the well fluid that occurs when the inlet and outlet valves are in the closed position over a selected period of time.

12. The wellhead assembly of claim 10, further comprising:

a flow meter located in the production flow line that provides a value characterizing flow rate through the production flow line; and

means for adjusting the value based on an output of the sensor system.

13. The wellhead assembly of claim 10, wherein the sensor system further comprises a controller that receives signals from the sensors.

14. A method of producing well fluid from a subsea well through a subsea production tree and out a production flow line extending from the tree, comprising:

a. connecting an inlet of a sampling conduit into the flow line and an outlet of the sampling conduit into the flow line at a located downstream from the inlet;

b. diverting a portion of the well fluid flowing through the flow line into the inlet of the sampling conduit; then

c. trapping a sample of the well fluid within the conduit and allowing the sample to stratify over a period of time; then

d. sensing a characteristic of the sample at discrete vertically spaced apart locations and determining whether the sample contains oil, water and gas occurring in stratified layers within the sampling conduit;

- e. measuring a rate of flow of the well fluid flowing through the flow line;
- f. adjusting the measured rate of flow based on the determination from the step(d); and
- g. flowing the sample trapped in step (c) from the sampling conduit through the outlet back into the flow line.

15. The method of claim 14, wherein a multi-phase flowmeter is used to measure a rate of flow in step (e), and wherein step (f) comprises calibrating the flowmeter.

16. The method of claim 14, wherein the period of time in step (c) may be up to 10 hours.

17. The method of claim 14, wherein step (c) comprises isolating the sample from contact with the well fluid flowing through the flow line.

18. The method of claim 14, wherein the characteristic of the sample sensed is selected from the group consisting of fluid density, fluid composition, fluid pressure, fluid viscosity, and fluid temperature.