medium is adapted to acquire the gas lift well parameter data form the form sensors in the gas lift well and provides them to the computer program product for executing the gas lift well performance evaluating methods.

[0017a] According to a first aspect, there is provided a computer implemented method for evaluating the performance of a gas lift well, the method comprising:
injecting a tracer into an annulus formed between a well casing and a production tubing of the gas lift well, the annulus including a lift gas, the gas lift well including one or more points of communication between the annulus and the production tubing, wherein each of the one or more points of communication corresponds to a valve position;
measuring, over a period of time, a concentration of the tracer present in a substance retrieved from the gas lift well;
adjusting the measured concentration of the tracer upon the condition that a pattern present in:

(1) a plot of a baseline tracer concentration comprises substantial instability; or

(2) a plot of a plurality of collected real time key well parameter data comprises substantial instability, wherein each of the key well parameters comprises at least one of: (i) a plurality of pressures in the production tubing, each of the plurality of pressures corresponding to a plurality of ranges of well depth, (ii) a flow rate of the lift gas in the production tubing, (iii) a temperature in the production tubing, (iv) a parameter that represents a frictional force opposing flow in the production tubing, (v) a parameter that represents an effect of gravity on flow in the production tubing, (vi) a ratio of a gaseous phase to a non-gaseous phase in the substance retrieved from the gas lift well, (vii) a flow rate of one or more gases present in the substance retrieved from the gas lift well, (viii) a flow rate of one of more liquids present in the substance retrieved from the gas lift well, (ix) a well head pressure, and (x) a separator pressure; and generating one or more fractals by graphically representing the adjusted tracer concentration and the collected key well parameter data in a multi-dimensional time dependent plot for diagnosing an abnormal condition in the gas lift well.

CLAIMS

1. A computer implemented method for evaluating the performance of a gas lift well, the method comprising:

injecting a tracer into an annulus formed between a well casing and a production tubing of the gas lift well, the annulus including a lift gas, the gas lift well including one or more points of communication between the annulus and the production tubing, wherein each of the one or more points of communication corresponds to a valve position;

measuring, over a period of time, a concentration of the tracer present in a substance retrieved from the gas lift well;

adjusting the measured concentration of the tracer upon the condition that a pattern present in:

(1) a plot of a baseline tracer concentration comprises substantial instability; or

(2) a plot of a plurality of collected real time key well parameter data comprises substantial instability, wherein each of the key well parameters comprises at least one of: (i) a plurality of pressures in the production tubing, each of the plurality of pressures corresponding to a plurality of ranges of well depth, (ii) a flow rate of the lift gas in the production tubing, (iii) a temperature in the production tubing, (iv) a parameter that represents a frictional force opposing flow in the production tubing, (v) a parameter that represents an effect of gravity on flow in the production tubing, (vi) a ratio of a gaseous phase to a non-gaseous phase in the substance retrieved from the gas lift well, (vii) a flow rate of one or more gases present in the substance retrieved from the gas lift well, (viii) a flow rate of one of more liquids present in the substance retrieved from the gas lift well, (ix) a well head pressure, and (x) a separator pressure; and

generating one or more fractals by graphically representing the adjusted tracer concentration and the collected key well parameter data in a multi-dimensional time dependent plot for diagnosing an abnormal condition in the gas lift well.

2. The method of claim 1, further comprising:

determining one or more actual travel times of the tracer based on a deviation of the concentration of the tracer measured over the period of time from the pattern present in a

displaying a graphical representation on an output device the concentration of the tracer measured over the period of time, wherein the graphical representation indicates the travel time of the tracer calculated for each of the one or more points of communication between the annulus and the production tubing, and wherein upon the condition that the graphical representation includes one or more peaks in the concentration of the tracer measured over the period of time, each of the one of more peaks corresponding to one of the one or more actual travel times, one of the one or more points of entry of the lift gas into the production tubing, and one of the one or more lift gas loss parameters, the one or more lift gas loss parameters being determined by:

(i) determining an area under each of the one or more peaks;

(ii) summing each area determined for each of the one or more peaks to obtain a total area; and (iii) determining, for each of the one or more peaks, a ratio of the area under the each of the one or more peaks to the total area, the ratio representing the lift gas loss parameter corresponding to the each of the one or more peaks.

6. The method of claim 3, further comprising: comparing the one or more determined points of entry of the lift gas to the one or more points of communication in order to determine, for each of the one or more determined points of entry of the lift gas, whether the point of entry corresponds to a leak of the lift gas into the production tubing or entry of the lift gas into the production tubing through a valve.

7. The method of claim 2, further comprising: separating a gaseous phase from the substance retrieved from the gas lift well; and measuring, over a period of time, a concentration of the tracer present in the gaseous phase.

8. The method of claim 2, wherein a velocity of the lift gas in the annulus for a second range of the plurality of ranges of well depth is calculated further based on a temperature in the annulus and a pressure in the annulus that correspond to a first range of the plurality of ranges of well depth.

9. The method of claim 2, wherein the velocity of the lift gas in the production tubing is calculated using a dynamic multi-phase flow pressure simulator, and wherein the performance of