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(54) FRAC WATER BLENDING SYSTEM

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(57) ABSTRACT

A water blending system and associated method for a gas shale well is provided, which includes a first inlet pipeline that receives water from a freshwater source. The first inlet pipeline has a first valve. A second inlet pipeline receives flow back water and has a second control valve. A third pipeline receives water flow from the first and second pipelines. The first pipeline has a salination level detector, the third pipeline flowing water into a tank; wherein the water flow of the first and second inlet pipelines is adjusted based on a salination level detected by the salination level detector.

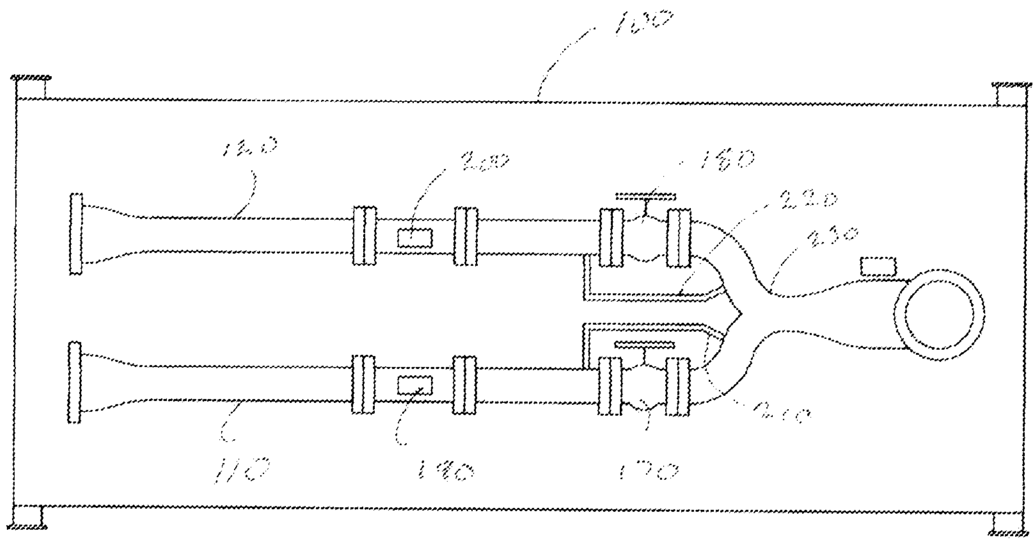
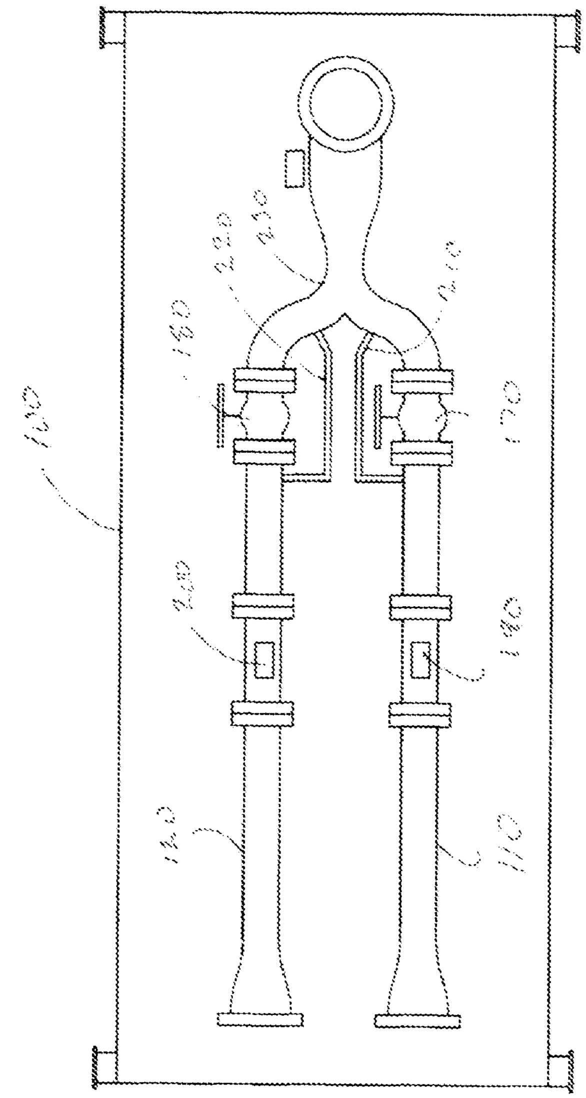


FIG. 1



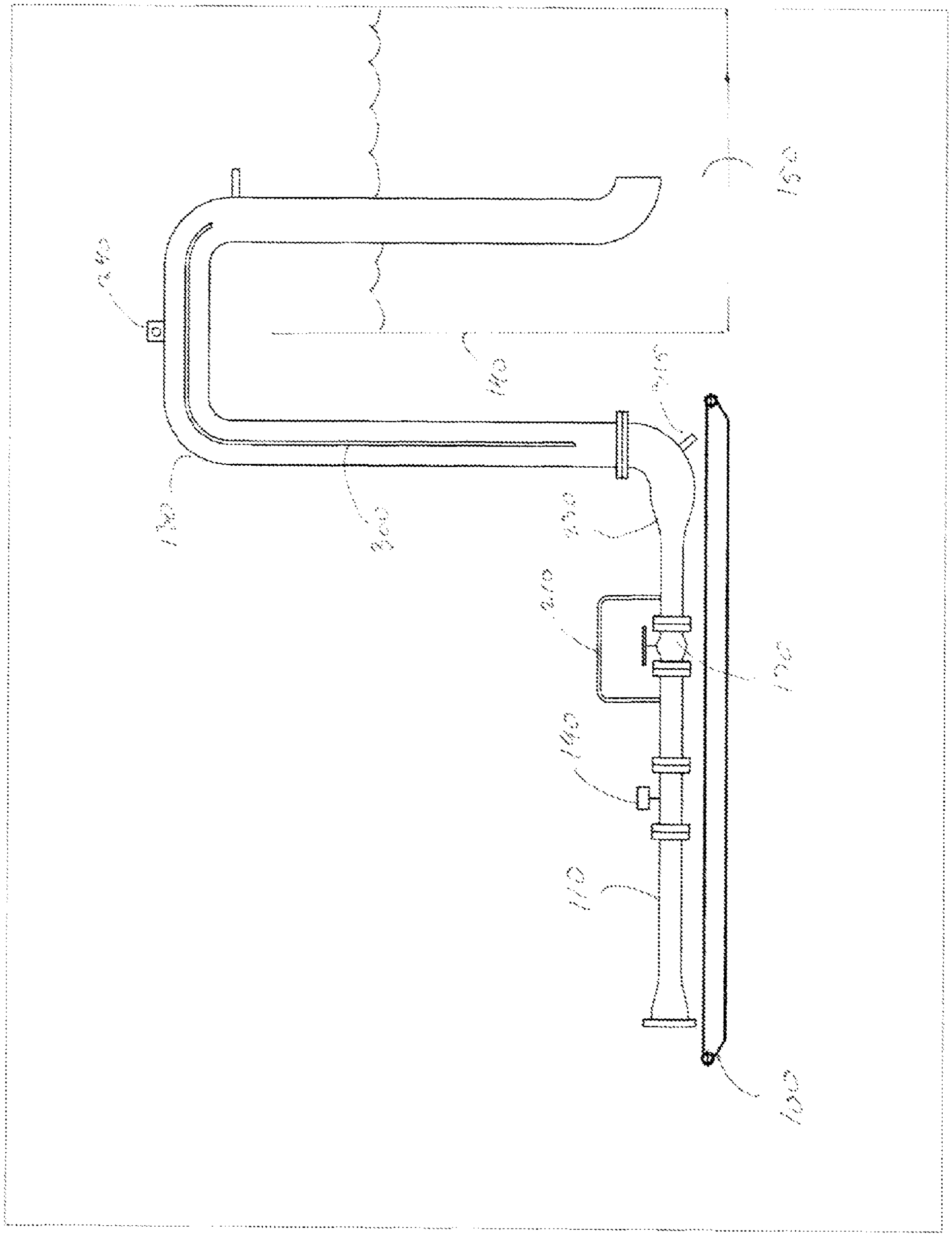


FIG. 2

FIG. 3

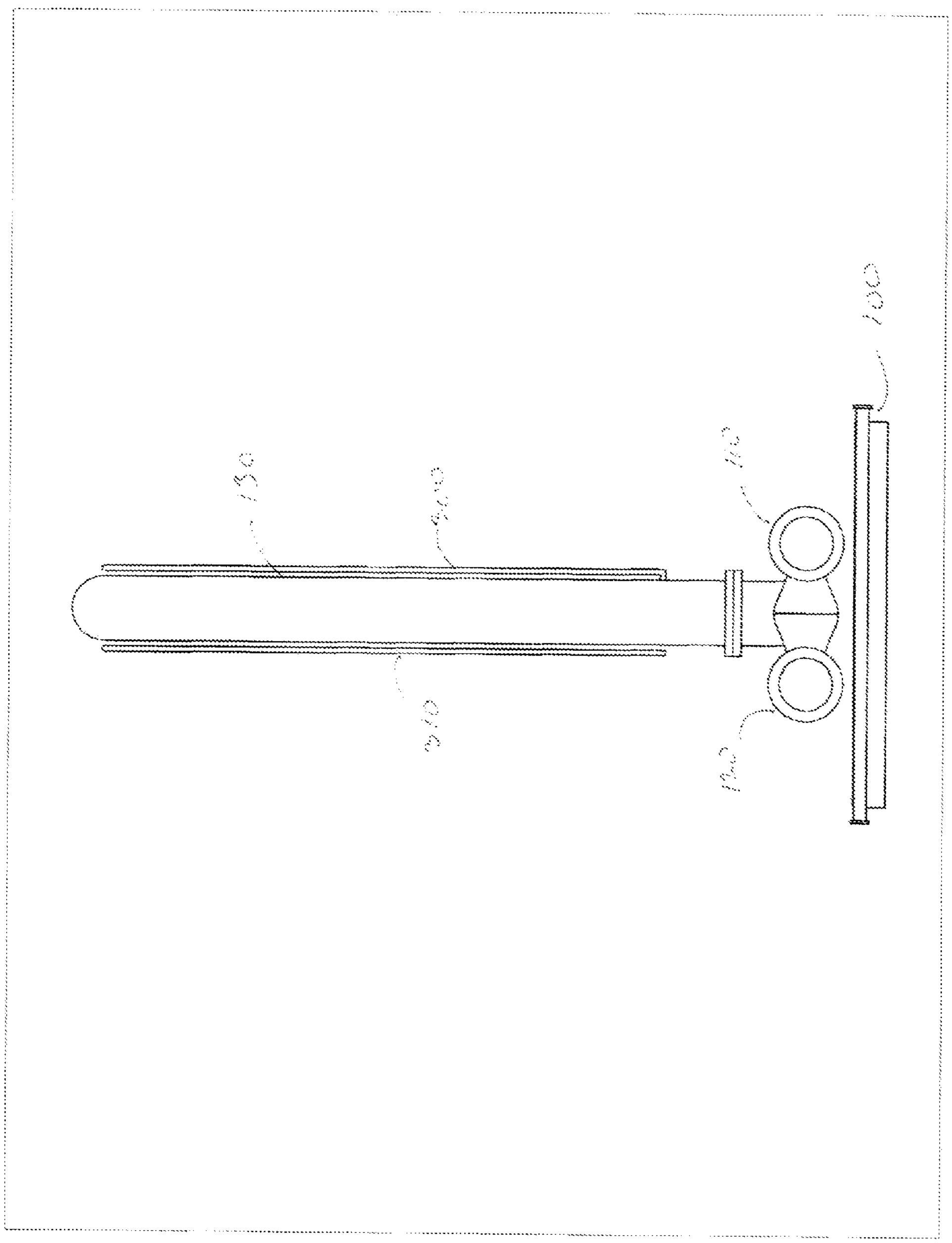
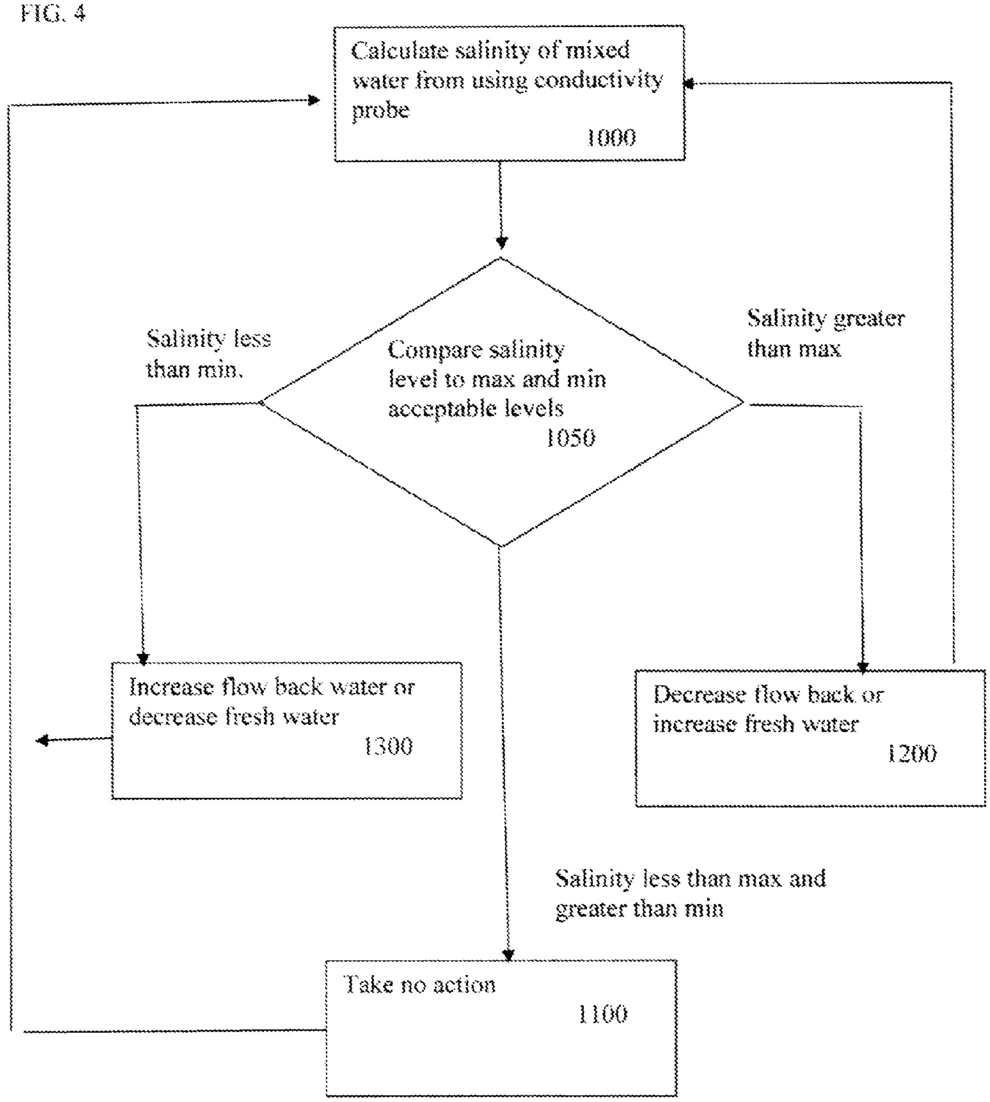


FIG. 4


Calculate salinity of mixed water from using conductivity probe
1000
Compare salinity level to max and min acceptable levels
1050
Salinity less than min.
Salinity greater than max
Increase flow back water or decrease fresh water
1300
Decrease flow back or increase fresh water
1200
Salinity less than max and greater than min
Take no action
1100

FRAC WATER BLENDING SYSTEM

STATEMENT OF RELATED APPLICATION

[0001] The present application claims the benefit of priority under 35 U.S.C. 119(b) to Canadian Patent Application Serial No. 2750776 filed Aug. 26, 2011, in the name of inventor David J. Elliot, entitled "Frac Water Blending System", all commonly owned herewith.

FIELD

[0002] This invention relates to the provision of water for use with gas shale wells, and more particularly for provision of frac water therefor.

BACKGROUND

[0003] Hydraulic stimulation (fracture) is used in shale gas wells by using frac water to stimulate, or fracture the shale. Frac water includes either fresh water, or a blend of fresh and 'flow back' water. Flow back water is water that has previously been pumped into the shale formation, and is returned to the surface during testing and production periods. The flow back water generally contains dissolved solids, typically with high concentrations of dissolved salts. Flow back water can be generally reused if the salinity level, as measured in parts per million (ppm) is below a certain threshold. Generally, this threshold is in the range of 30,000-90,000 ppm, and in some applications may be even higher. Higher salinity levels mean higher fluid friction, making the water more difficult to pump at high pressures.

[0004] It is difficult to accurately and easily blend two streams of water (fresh and flow back) into an output stream with a consistent desired salinity level. Previous solutions have been to pump individual streams of fresh and flow back water into a frac water tank (such as a Westeel™ c-ring), circulate the water, and constantly sample the water for salinity. The challenge is that fresh and salt water tend to stratify due to the difference in density, and they tend to separate with the heavier salty water sinking to the bottom of the tank. This makes getting a true water sample difficult as the water may not have blended well. It is also typically a manual operation, with many inaccuracies, and is also not energy efficient due to the increased pumping power needed for agitation (mixing) of the water.

SUMMARY

[0005] The invention provides a means to maximize the flow back water that is reused, and maintain the maximum salinity allowed, in order to minimize the use of fresh water, use less energy than in previous methods and provide a more consistent blending of both streams of water.

[0006] The system according to the invention blends the flow back water and fresh water prior to entering the tank, and discharges water with the correct salinity into the tank. The system includes an intake pipe for fresh water, an intake pipe for flow back water, with control valves on each pipe, a junction of the two streams and a long mixing pipeline which mixes the water either by making use of the turbulent flow regime of the individual streams of water from each intake pipe, or the mixing pipeline can be configured with agitation plates for mixing the incoming streams of water (useful if the flow is laminar), as well as a conductivity meter that measures the salinity levels of the mixed stream of water. The input water streams can be throttled with the valves to achieve the desired salinity (or conductivity) as displayed on the meter.

[0007] There are several ways of adjusting the intake pipelines. As an example, two different modes may either provide for maximum flow back water flow or maximum fresh water flow. If the maximum water flow is desired, then typically the fresh water pipeline valve will stay at maximum open and the flow back water pipeline valve will be throttled to provide the maximum salinity permitted; and if the maximum reuse of flow back water is desired, then the flow back water pipeline valve is open to its maximum and if the resultant salinity is higher than the maximum permitted, the fresh water pipeline valve is gradually closed to achieve the permitted salinity. Therefore, the mixing of the flow back water and fresh water depends on the flows of the two pipelines, the flow back water salinity and the resultant salinity permitted. An operator may have confidence that the frac water being used for fracture stimulation is indeed at the correct salinity level, and maximum reuse of the flow back water is achieved, which is best for the environment, and for longevity of the industry.

[0008] The system according to the invention is portable and can be installed quickly, and it allows a large flow rate while under high pressure. The control valves can be automated with a simple algorithm, or can be manually controlled. Flow meters are used to track values of fresh and flow back water used for reporting purposes. The system is compatible with commonly used open top tank systems currently being used in the industry, with a small modification of the discharge/blending tube to discharge into a manifold or directly into a closed top tank.

[0009] A water blending system for a gas shale well is provided, including: a first inlet pipeline receiving water from a freshwater source, the first inlet pipeline having a first valve; a second inlet pipeline receiving flow back water, the second inlet pipeline having a second control valve; and a third pipeline, receiving water flow from the first and second pipelines, the first pipelines having a salination level detector, the third pipeline flowing water into a tank; wherein the water flow of the first and second inlet pipelines is adjusted based on a salination level detected by the salination level detector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a top view of a blending pipe system according to the invention;

[0011] FIG. **2** is a side view thereof;

[0012] FIG. **3** is a rear view thereof; and

[0013] FIG. **4** is a flow chart showing a control process using the system.

DETAILED DESCRIPTION

[0014] The system, as shown in FIGS. **1** through **3**, includes support skid **100** which structurally supports the system, and provides contact with the ground surface. Skid **100** provides stability, and may be an oilfield skid with features such as winching ears and lifting points, allowing skid **100** to be moved easily.

[0015] Fresh water intake pipeline **110** and flow back water intake pipeline **120** lead into discharge pipeline **130**. Fresh water intake pipeline **110** receives water from a fresh water source. Flow back water intake pipeline **120** receives water that had previously been pumped into the shale formation, and has been reclaimed. Discharge pipeline **130** is configured to run the mixed water flow over wall **140** of tank **150** to allow the mixed water to enter tank **150** for use as frac water.

[0016] Fresh water intake pipeline **110** and flow back water intake pipeline **120** are configured according to the incoming water system parameters, such as flow rates. In general, the water should enter pipelines **110**, **120** via approximately **10**" pipelines. Pipelines **110**, **120** and **130** may be made from high-density polyethylene (HDPE) or stainless steel and may be internally coated with steel to resist the corrosiveness of the flow back water. The pipe diameter reduces along pipelines **110**, **120** as they approach junction **230** to increase the velocity of the water therein and provide a full pipe cross sectional flow as may be required by flow meters **190**, **200**. Control valves **170**, **180** are positioned downstream of flow meters **190**, **200**. By-pass tubes **210**, **220** may be placed to relieve pressure on pipelines **110**, **120**, if required.

[0017] Pipelines **110**, **120** join and form a single discharge pipeline **130** at junction **230** wherein the fresh water and flow back water mix. Discharge pipeline **130** may include agitation plates (not shown) to assist in mixing the two incoming water streams. The mixed water is directed up and over the wall **140** of tank **150** by discharge pipeline **130**. Conductivity probe **240** is positioned near the top of discharge pipeline **130** (above the high water level) and several pipe diameters downstream of junction **230** to ensure that the water is well mixed. The mixed water is horizontally discharged into the depths of tank **150** to provide for mixing of the water within tank **150**.

[0018] Siphon tubes **300**, **310** may be used to break the continuity of the water flow between tank **150** and discharge pipeline **130** in case remedial work is necessary or should pipeline **130** be disconnected. Siphon tubes **300**, **310** allow water to be easily emptied from discharge pipeline **130**. Drain port **315** is also present to drain discharge pipeline **130** easily.

[0019] Flow meters **190**, **200** may be magnetic flow meters, which require no moving parts, and are not susceptible to fouling from harsh water conditions. Meters **190**, **200** are used to track total and instantaneous flows of the two input water streams from pipelines **110**, **120** and can serve as part of the automated system for control of the water streams. Conductivity probe or salinity meter **240** measures the conductivity of the output mixed water stream in pipeline **130**. The conductivity level is displayed in a convenient location, and water conductivity can be converted to a salinity level. Meter **240** can be configured to display salinity in PPM or uS/cm (micro Siemens/Centimetre).

[0020] Flow meters **190**, **200** and conductivity probe **240** and display may be powered by a solar panel and/or a 24V battery system built into skid **100** or by a power system located at a control center nearby.

[0021] As shown in FIG. **4**, in use, the system, either manually or automatically, first determines the salinity level of the mixed water flow in discharge pipeline **130** (step **1000**). If the sanity level is at an acceptable level between predetermined maximum and minimum salinity levels (step **1050**), no action is taken (step **1100**).

[0022] If the salinity level is greater than the acceptable maximum salinity level (step **1050**), then either the freshwater intake pipeline flow is increased and/or the flow back water intake pipeline flow is decreased using control valves **170**, **180** (step **1200**). Then the salinity level is determined again (return to step **1000**).

[0023] If the salinity level is less than the acceptable minimum salinity level (step **1050**), then either the freshwater intake pipeline flow is decreased and/or the flow back water intake pipeline flow is increased using control valves **170**, **180** (step **1300**) depending on whether maximum flow or maximum flow back water reuse is desired. Then the salinity level is determined again (return to step **1000**). Flow rates are considered in determining either the maximum flow rate or the maximum reuse of flow back water, which depends on the flow of the fresh and flow back water streams and the incoming water salinity.

[0024] Alternatively, if the salinity level is greater than the maximum wanted, then the flow back water flow is decreased or the fresh water flow is increased (step **1200**). Again the end goal of the user, be it to maximize the overall flow rate, or maximize the use of flow back water, will affect the determination.

[0025] For example, two desired modes of operation my be to achieve maximum flow of water to tank **150** or the maximum reuse of flow back water, depending on the volume of water needed for frac purposes, and while maintaining the desired salinity levels between and maximum and a minimum. In the first mode, to obtain maximum flow of water to tank **150**, the fresh water valve **170** remains at the maximum open position and the flow back water valve **180** is adjusted to the maximum level at which the maximum salinity level permitted is reached. In the second mode, the maximum reuse of flow back water, the flow back water valve **180** remains at the maximum open position and if the resultant salinity is higher than the maximum level permitted, then the fresh water valve **170** is gradually adjusted to achieve the desired salinity. The valve adjustments thus depend on the flows of the individual streams, the flow back water salinity level and the resultant salinity permitted

[0026] The system can also be configured to mix the water in tank **150** to further reduce salinity levels by having pipeline **120** receive water from a bypass pipeline drawing water from tank **150**.

[0027] The above-described embodiments have been provided as examples, for clarity in understanding the invention. A person with skill in the art will recognize that alterations, modifications and variations may be effected to the embodiments described above while remaining within the scope of the invention as defined by claims appended hereto.

I claim:

1. A water blending system for a gas shale well, comprising:

a first inlet pipeline receiving water from a freshwater source, the first inlet pipeline having a first valve;

a second inlet pipeline receiving flow back water, the second inlet pipeline having a second control valve;

a third pipeline, receiving water flow from the first and second pipelines, the first pipeline having a salination level detector, the third pipeline flowing water into a tank.

2. The water bending system of claim **1** wherein the water flow of the first and second inlet pipelines is adjusted based on a salination level detected by the salination level detector

3. The water blending system of claim **2** wherein the first and second inlet pipes meet the third pipeline at a junction.

4. The water blending system of claim **3** wherein the third pipeline has a siphon tube exterior thereto.

5. The water blending system of claim **4** wherein the first and second valves may be bypassed through respective first and second bypass lines.

6. The water blending system of claim **5** wherein the third pipeline has a plurality of agitation plates.

7. The water blending system of claim **6** wherein the first and second pipelines have respective first and second flow meters.

8. The water blending system of claim **7** wherein the first and second flow meters are magnetic flow meters.

9. A method of providing frac water to a tank, comprising:

receiving a flow of fresh water from a first pipeline, the first pipeline having a first control valve;

receiving a flow of flow back water from a second pipeline, the second pipeline having a second control valve;

combining the flow of fresh water from the first pipeline and flow back water from the second pipeline into a third water flow;

determining the salination level of the combined water flow, and:

if the salination level is above a maximum level, then increasing the first pipeline flow or decreasing the second pipeline flow; or

if the salination level is below a minimum level, increasing the second pipeline flow or decreasing the first pipeline flow.

10. The method of claim **9** wherein the first pipeline flow is set at a maximum level, and if the salination level is greater than the maximum level, the second pipeline flow is reduced.

11. The method of claim **10** wherein the second pipeline flow is set at a maximum level and if the salination level is greater than the maximum level, the first pipeline flow is increased.

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