Abstract: A method for blending a well treatment fluid at a well site, including (1) providing centrifugal pumps for pumping components of the well treatment fluid into a pipe, (2) providing valves for controlling the flow of the components of the well treatment fluid into the pipe, and (3) controlling the pumps and the valves so as to control the ratio of the components of the well treatment fluid being delivered to the pipe.
IMPROVED METHOD OF BLENDING HAZARDOUS CHEMICALS TO A WELL BORE

BACKGROUND

[0001] On-the-fly blending of well treatment fluids is not typically used for corrosive chemicals. Generally, blending corrosive chemicals, otherwise known as acids, or hazardous chemicals, is done at a location other than the well site, using batch mixing. The chemicals are mixed in a tank at a bulk chemical plant and then transported to the well site. The mixing and the transportation are costly. Specialized transports are required to transport the mix. Additionally, specially trained personnel are required. In addition to being costly, this can be undesirably time consuming. Further, any real-time change to the mix presents problems, as an entire new batch must be mixed and transported. While this occurs, the job must wait, which can be extremely costly. Further, batch mixing requires that the tank be emptied prior to changing the mix. It is difficult to anticipate the exact amount of mix that will be required for a given application. This generally leads to excess mix left in the tank at the end of a job, or at a change point. Proper disposal of this mix can be environmentally hazardous, costly, and dangerous.

SUMMARY

[0002] The present invention relates generally to blending fluids and more specifically to an improved method of blending well treatment fluids at the well site.

[0003] In one embodiment of the present invention a method for blending a well treatment fluid at a well site, comprises: providing a first centrifugal pump for pumping a first component of the well treatment fluid into a pipe; providing a first valve for controlling the flow of the first component of the well treatment fluid into the pipe; providing a second centrifugal pump for pumping a second component of the well treatment fluid into the pipe; providing a second valve for controlling the flow of the second component of the well treatment fluid into the pipe; and controlling the pumps and the valves so as to control the ratio of the first component of the well treatment fluid to the second component of the well treatment fluid being delivered to the pipe.

[0004] In another embodiment of the present invention a system for blending a well treatment fluid at a well site, comprises: a first centrifugal pump for pumping a first
component of the well treatment fluid into a pipe; a first valve for controlling the flow of the first component of the well treatment fluid into the pipe; a second centrifugal pump for pumping a second component of the well treatment fluid into the pipe; a second valve for controlling the flow of the second component of the well treatment fluid into the pipe; and means for controlling the pumps and the valves so as to control the ratio of the first component of the well treatment fluid to the second component of the well treatment fluid being delivered to the pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Figure 1 is a schematic view of a system for blending well treatment fluids at the well site.

DETAILED DESCRIPTION

[0006] Referring now to Figure 1, shown therein is an exemplary embodiment of a system for blending well treatment fluids at the well site. The system, designated generally by the numeral 100, may be mounted on a trailer or skid (not shown). The system 100 blends various components of the well treatment fluid directly into a pipe 110. This reduces or eliminates the need for standard mixing tanks or tubs. This may be accomplished using at least two centrifugal pumps 120 (shown as 120a, 120b, and 120c). The centrifugal pumps 120 may each pump a different component of the desired well treatment fluid. For example, in an acid treatment, a first centrifugal pump 120a may pump a hazardous chemical such as hydrochloric acid (HCl), a second centrifugal pump 120b may pump water, and a third centrifugal pump 120c may pump a highly corrosive chemical such as Ammonium Bi-Fluoride ("AF"). While HCl, water, and AF are disclosed, it should be understood that the chemicals may include any acid, hazardous chemical, corrosive, or other fluid.

[0007] The system 100 may also include a number of valves 140 (shown as 140a, 140b, and 140c) for controlling the flow of the various components from the centrifugal pumps 120 into the pipe 110. The valves 140 may be butterfly valves, or any other valve suitable for use with well treatment fluids.

[0008] Between the centrifugal pumps 120 and the valves 140, the system 100 may include pressure transducers 150 (shown as 150a, 150b, and 150c) that act as a pressure
controls on the centrifugal pumps 120, preventing the centrifugal pumps 120 from pushing one another off line. Feedback from pressure transducers 150 may signal pressure set points in centrifugal pumps 120, such that the centrifugal pumps 120 maintain a desirable balance.

[0009] Between the valves 140 and the pipe 110, the system 100 may additionally include flow meters 160 (shown as 160a, 160b, and 160c) and check valves 162 (shown as 162a, 162b, and 162c) to monitor and control flow rates from the pumps 140.

[0010] Liquid additives may also be introduced into the pipe 110. The additives may be stored in liquid additive storage tanks (not shown), and pumped into the pipe 110 via one or more liquid additive pumps 130. While the liquid additive pump 130 is shown as a hand pump, the liquid additive pump 130 may be any type of pump, including, but not limited to a positive displacement pump. One or more liquid additive valves (not shown) may be included to control the flow of liquid additives from the liquid additive pumps 130 into the pipe 110.

[0011] The well treatment fluid may be blended directly in the pipe 110, without the use of any tank. The flow rate and pressure of any of the components may be controlled by controlling the pumps 120, 130 and the valves 140. This allows for the ratio of the various components and additives of the well treatment fluid to be modified as necessary for the specific field conditions at any given time. This modification can take place in real-time, allowing the desired well treatment fluid mix to be pumped into the well as it is needed.

[0012] Additionally, the system 100 may have a number of additional valves (not shown), with locations suitable for controlling flow in various ways as would be readily understood by one of ordinary skill in the art. For example, these additional valves may be butterfly valves, some of which are open and some of which are closed.

[0013] A discharge flow meter 170 may be included in the system 100. This may allow for adjustments to be made to the pumps 120 and valves 140, such that the correct mix ratio is maintained without creating undesirable negative pressure in the system 100. After the mix has passed through the discharge flow meter 170, it may pass through another pump (not shown), which then pumps the mix downhole.

[0014] Computer software may be used to control the mix ratio. The computer software may include a pressure control system, a rate control system, and/or a concentration
control system. The pressure control system may control pressure by controlling the pumps 120. The rate control system may control flow rate by controlling the valves 140. The concentration control system may control the concentration by controlling the pumps 120.

[0015] The pressure control system may include a drive signal to the centrifugal pumps 120 and feedback from pressure transducers 150. Each of the centrifugal pumps 120 may maintain a separate pressure set point. These pressure set points may be based on expected rate and resultant discharge pressure. The optimal pressure set point may place the valves 140 at a predetermined percentage open for each respective expected rate.

[0016] The rate control system may include a drive signal to each valve 140 and feedback from the respective flow meter 160. The valve 140 for a first (or master) component (e.g. water) may be set to 100% open and the rate may be set by the discharge rate, as measured by the discharge flow meter 170. The rate set points for the remaining valves 140 may be set by the concentration control system. Thus as the requirements for concentrations change (even during a job), the operator has the ability to ramp up or down the concentration and/or liquid additives depending on the specific need. This may be a desirable alternative to the standard practice of mixing a new batch at the acid plant and transporting the mixture to the well site.

[0017] The concentration control system may include the rate control system and the rate feedback from the master (e.g. water) rate, which may be measured by the corresponding flow meter 160. Based on a predetermined well treatment fluid mix, the rate set points for the other components may be calculated from a concentration or parts per thousand of the master rate. As the master rate increases, the rate for the other components may also increase. The increasing rate of other components will slow the increasing master rate until the desired concentration is established.

[0018] The system 100 may optionally include additional components. For example, as shown in Figure 1, the system 100 may include a tank 180. Due to the nature of the types of chemicals used, the tank 180 may be situated on the discharge side of the system 100. The tank 180 may be used to prevent loss if something goes wrong and the job must be stopped. Additionally, the tank 180 may be useful in situations where the flow rates are very low.
The system 100 may also optionally include a discharge recirculation pump 198. The discharge recirculation pump 198 may serve two purposes. The first may be for recirculation. The second may be for discharge at very low flow rates. The recirculation pump 198 may be any type of pump for discharge recirculation (e.g. 120 HP pumps).

This system 100 may be used for acid blending for acidizing wells, otherwise known as "Acid-On-the-Fly," which involves blending two or more major hazardous chemical components into a pressurized piping system and injecting one or more liquid additives into that flow stream. This system 100 may alternatively be used for fracturing operations, in which case the treatment fluid would be a fracturing fluid. Additionally, this system 100 may be used for drilling operations, in which case the treatment fluid would be drilling mud.

The ability to blend "On-the-Fly" may reduce the amount of blended chemicals requiring disposal upon completion of the process. It may also lower exposure of hazardous chemicals to personnel and the environment. Furthermore, it may decrease the number of personnel required for the process and decrease the amount of time hazardous chemicals would be in use. Additionally, by blending the chemicals as they are pumped downhole, there may be a significant reduction of waste that must be disposed of, and cost associated with that disposal process. Further, there may be a reduction in cost for transporting the mixed chemicals, since that would no longer be a requirement. Additionally, there may be a reduction of cost for buying and maintaining the highly regulated cargo tank motor vehicles. Additionally, there may be a reduction and/or elimination of the bulk chemical plants (otherwise known as acid plants) currently being used. By eliminating bulk acid plants, transports, and the physically handling of these types of chemicals the risk of personal and environmental exposure may be significantly reduced.

Therefore, the present invention is well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that
the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present invention. In addition, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee.
CLAIMS

What is claimed is:

1. A method for blending a well treatment fluid at a well site, comprising:
   providing a first centrifugal pump for pumping a first component of the well
treatment fluid into a pipe;
   providing a first valve for controlling the flow of the first component of the
well treatment fluid into the pipe;
   providing a second centrifugal pump for pumping a second component of the
well treatment fluid into the pipe;
   providing a second valve for controlling the flow of the second component of
the well treatment fluid into the pipe; and
   controlling the pumps and the valves so as to control the ratio of the first
component of the well treatment fluid to the second component of the
well treatment fluid being delivered to the pipe.

2. The method of claim 1, further comprising:
   providing a third centrifugal pump for pumping a third component of the well
treatment fluid into the pipe; and
   providing a third valve for controlling the flow of the third component of the
well treatment fluid into the pipe;
   wherein controlling the pumps and the valves further controls the ratio of the
third component of the well treatment fluid to the other components of
the well treatment fluid being delivered to the pipe.
3. The method of claim 2, further comprising:
providing at least one liquid additive storage tank;
providing at least one liquid additive pump; and
providing at least one liquid additive valve for controlling the flow of liquid additive into the pipe:
wherein controlling the liquid additive pump and the liquid additive valve controls the ratio of the liquid additive to the other components of the well treatment fluid being delivered to the pipe.

4. The method of claim 3, further comprising
pumping the well treatment fluid from the pipe into the well.

5. The method of claim 2,
wherein the well treatment fluid is an acidizing fluid; and
wherein the first component of the well treatment fluid is water.

6. The method of claim 5,
wherein the second component of the well treatment fluid is a hazardous chemical.

7. The method of claim 6,
wherein the hazardous chemical is Ammonium Bi-Fluoride.

8. The method of claim 7,
wherein the third component of the well treatment fluid is hydrochloric acid.

9. The method of claim 2,
wherein the well treatment fluid is a fracturing fluid.
10. The method of claim 2, wherein the well treatment fluid is a drilling mud.

11. A system for blending a well treatment fluid at a well site, comprising:

   a first centrifugal pump for pumping a first component of the well treatment fluid into a pipe;

   a first valve for controlling the flow of the first component of the well treatment fluid into the pipe;

   a second centrifugal pump for pumping a second component of the well treatment fluid into the pipe:

   a second valve for controlling the flow of the second component of the well treatment fluid into the pipe; and

   means for controlling the pumps and the valves so as to control the ratio of the first component of the well treatment fluid to the second component of the well treatment fluid being delivered to the pipe.

12. The system of claim 11, further comprising:

   a third centrifugal pump for pumping a third component of the well treatment fluid into the pipe; and

   a third valve for controlling the flow of the third component of the well treatment fluid into the pipe;

   wherein the means for controlling the pumps and the valves further controls the ratio of the third component of the well treatment fluid to the other components of the well treatment fluid being delivered to the pipe.
13. The system of claim 12, further comprising:

at least one liquid additive storage tank;

at least one liquid additive pump; and

at least one liquid additive valve for controlling the flow of liquid additive into the pipe;

means for controlling the liquid additive pump and the liquid additive valve so as to control the ratio of the liquid additive to the other components of the well treatment fluid being delivered to the pipe.

14. The system of claim 13, further comprising

means for pumping the well treatment fluid from the pipe into the well.

15. The system of claim 12,

wherein the well treatment fluid is an acidizing fluid; and

wherein the first component of the well treatment fluid is water.

16. The system of claim 13,

wherein the second component of the well treatment fluid is a hazardous chemical.

17. The system of claim 16,

wherein the hazardous chemical is Ammonium Bi-Fluoride.

18. The system of claim 17,

wherein the third component of the well treatment fluid is hydrochloric acid.

19. The system of claim 12,

wherein the well treatment fluid is a fracturing fluid.
20. The system of claim 12,

wherein the well treatment fluid is a drilling mud.
# INTERNATIONAL SEARCH REPORT

**International application No**
PCT/GB2008/000450

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. B01F15/04

According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

E21B BOIF

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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Further documents are listed in the continuation of Box C

See patent family annex

**'** Special categories of cited documents

'A' document defining the general state of the art which is not considered to be of particular relevance

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'O' document referring to an oral disclosure, use, exhibition or other means

'P' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

'K' document member of the same patent family

**Date of the actual completion of the international search**

15 April 2008

**Date of mailing of the international search report**

23/04/2008

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Authorized officer

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