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United States Patent	12383939
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Baranko; Glenn

Oilfield tubing cleaning

Abstract

In a method of removing scale deposits from a used oilfield tube having first and second threaded ends, a coupling collar is unscrewed one or more rotations from a first threaded end about a longitudinal axis of the oilfield tube without detaching the coupling collar from the first threaded end. A spray of water is discharged through a spray tip of a lance. The spray tip is fed along the longitudinal axis from the collar to the second threaded end using a lance feeder, wherein the spray tip travels through a bore of the collar and the interior of the oilfield tube. Scale deposits are removed from the bore of the collar and the interior of the oilfield tube using the spray of water during the feeding of the lance.

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Appl. No.: **18/171879**

Filed: **February 21, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240278294 A1	Aug. 22, 2024

Publication Classification

Int. Cl.: **B08B9/032** (20060101)

U.S. Cl.:

CPC **B08B9/0321** (20130101); B08B2209/027 (20130101)

Field of Classification Search

CPC: B08B (3/021)

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Background/Summary

FIELD

(1) Embodiments of the present disclosure generally relate to systems and methods for cleaning and decontaminating used oilfield tubes and, more specifically, to oilfield tube cleaning systems and methods utilizing jetted water.

BACKGROUND

(2) Oil and gas extraction and processing operations use sucker rods to join surface and downhole components of a reciprocating piston pump installed in an oil well. Sucker rods are rigid rods that typically extend between 25-30 feet in length through oilfield tubing within a bore of a well and are used to lift fluid and materials out of the well.

(3) The oilfield tubing generally lines the casing of the wellbore. The oilfield tubes may be joined together to extend to a desired length, such as using couplings that attach to threaded ends of the oilfield tubes.

(4) During use, the oilfield tubing and sucker rods accumulate scale and other deposits (hereinafter "scale deposits"). The scale deposits may include naturally occurring radioactive material at concentrations above normal in by-product waste streams. Because the extraction process concentrates the naturally occurring radionuclides and exposes them to the surface environment and human contact, these scale deposits are classified as Technologically Enhanced Naturally Occurring Radioactive Material (TENORM).

(5) The primary radionuclides of concern in oil and gas TENORM are radium-226 and radium-228. These isotopes are the decay products of uranium and thorium isotopes that are present in subsurface formations from which hydrocarbons are produced. The source for most oil and gas TENORM is dissolved radium that is transported to the surface in a water waste stream. The

dissolved radium remains in solution in the produced water, coprecipitates with barium, strontium, or calcium to form a hard sulfate deposit. These radioactive scale deposits lead to disposal problems when the equipment is taken off-line for repair or replacement.

(6) It is desirable to remove such scale deposits from used oilfield tubing and sucker rods prior to reusing or disposing of the components. Exemplary conventional techniques for cleaning oilfield tubing and sucker rods include scraping, brushing, applying chemical compounds, media blasting, and other processes. U.S. Pat. No. 11,524,320, which issued to Baranko Environmental LLC, discloses a sucker rod cleaning technique involving inductive heating of the sucker rod.

SUMMARY

(7) Embodiments of the present disclosure are directed to methods and systems for cleaning used oilfield tubing to remove scale deposits. Each used oilfield tube has first and second threaded ends and a hollow interior. A coupling collar having a threaded bore is screwed onto the first threaded end.

(8) In one embodiment of the method, the coupling collar is unscrewed one or more rotations from the first threaded end about a longitudinal axis of the oilfield tube without detaching the coupling collar from the first threaded end. A wet decontamination operation is performed, which includes: discharging a spray of water through a spray tip of a lance; feeding the spray tip of the lance along the longitudinal axis from the collar to the second threaded end using a lance feeder during the discharging of the spray of water, wherein the spray tip travels through the bore of the collar and the interior of the oilfield tube; and removing scale deposits from the bore of the collar and the interior of the oilfield tube using the spray of water during the feeding of the lance.

(9) One embodiment of the system includes a bucking unit, a pressurized water source, a lance, a lance feeder and a controller. The bucking unit is configured to unscrew a coupling collar connected to a threaded end of a used oilfield tube. The pressurized water source is configured to generate a flow of pressurized water. The lance is configured to receive the flow of pressurized water at a proximal end and discharge a spray of the water through a spray tip at a distal end. The lance feeder is configured to move the lance along a longitudinal axis. The controller is configured to control the pressurized water source and the lance feeder.

(10) This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. The claimed subject matter is not limited to implementations that solve any or all disadvantages noted in the Background.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a simplified drawing of an oilfield tube cleaning system that is configured to clean an oilfield tube, in accordance with embodiments of the present disclosure.

(2) FIG. **2** is a simplified diagram of an example of the controller, in accordance with embodiments of the present disclosure.

(3) FIG. **3** is a simplified cross-sectional view of an example of an end of a used sucker rod, in accordance with embodiments of the present disclosure.

(4) FIG. **4** is a flowchart illustrating a method of cleaning a used sucker rod, in accordance with embodiments of the present disclosure.

(5) FIG. **5** is a simplified cross-sectional view of an example of the end of the used sucker rod of FIG. **4** after the collar has been unscrewed, in accordance with embodiments of the present disclosure.

(6) FIGS. **6**A-D are simplified side views of various stages of an oilfield tube cleaning or wet

decontamination process, in accordance with embodiments of the present disclosure.
(7) FIG. **7** is a simplified side cross-sectional view of the collar and threaded end of the oilfield tube during a wet decontamination process, in accordance with embodiments of the method.
(8) FIG. **8** is a simplified cross-sectional view taken generally along line **8-8** of FIG. **7**.
DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS
(9) Embodiments of the present disclosure are described more fully hereinafter with reference to the accompanying drawings. Elements that are identified using the same or similar reference characters refer to the same or similar elements. The various embodiments of the present disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present disclosure to those skilled in the art.
(10) Embodiments of the present disclosure include systems and methods for cleaning used oilfield tubes that operate to join surface and downhole or borehole components of an oil or gas extraction system, such as components of a reciprocating piston pump, for example. FIG. **1** is a simplified drawing of an oilfield tube cleaning system **100** that is configured to clean a used oilfield tube **102**, in accordance with embodiments of the present disclosure.
(11) The used oilfield tube **102** may be in accordance with conventional oilfield tubes, which are typically formed of iron or steel. The oilfield tube **102** is generally a hollow cylinder having a longitudinal axis **104**, and may have a diameter of approximately 2.375-4.5 inches, threaded ends **106** and **108**, and a length of approximately 18-45 feet. A coupling collar **110** that is used to join the ends of a pair of oilfield tubes together, may be screwed onto one of the ends of the oilfield tube, such as the end **106** as shown in FIG. **1**.
(12) Embodiments of the system **100** may also include a bucking unit **112**, a pressurized water source **114**, one or more rigid lances **116**, a lance feeder **118**, and a controller **120**. The bucking unit or make-break unit **112** is a conventional device used to screw or unscrew connected items using an electric motor or a hydraulic actuator. As discussed below in greater detail, the bucking unit **112** is configured to rotate the collar **110** about the axis **104** relative to the oilfield tube **102** to unscrew the collar **110** a few rotations from the end **106** of the oilfield tube **102** prior to cleaning the interior of the oilfield tube **102**.
(13) The pressurized water source **114** is configured to generate a flow of pressurized water **122**, and may comprise a supply of water **124**, a pump **126** (e.g., three-quarter horsepower pump) used to transport water from the supply **124**, and/or a high pressure pump **128** (e.g., waterjet system pump) that receives water **127** from the pump **126** and pressurizes the water **127** to form the flow **122** for the oilfield tube cleaning or wet decontamination operation. The flow of pressurized water **122** supplied by the high pressure pump **128** may have a pressure of greater than 10 kilo-pounds per-square-inch (kpsi), greater than 30 kpsi, or greater than 50 kpsi. In one embodiment, the pressurized water source utilizes a 55 kpsi waterjet pump. The water flow **122** may be controlled using one or more valves, such as valves **130** and **132**, for example.
(14) The pressurized water source **114** may also include suitable connectors, manifolds, tumble boxes, and/or other components for generating and delivering the pressurized water flow **122** to a proximal end **134** of one or more of the lances **116**, such as two or three lances. When multiple lances **116** are utilized, the cleaning operation may be performed simultaneously on the corresponding number of oilfield tubes **102**.
(15) The pressurization of the water generally heats the water. In some embodiments, the pressurized water source **114** may include supplemental heaters for further heating the water flow **122** to enhance the cleaning or decontaminating power of the flow **122**.
(16) Suitable water capture components and tanks may be used to collect the discharged wastewater flowing from the oilfield tube, such as at the end **108**. The wastewater may be processed (e.g., filtered, cooled, etc.) for containment and disposal, or reuse.

(17) The lance feeder **118** is configured to feed one or more of the lances **116** relative to the oilfield tubes **102** being cleaned during a cleaning or decontamination operation, as indicated by arrow **135**. The lance feeder **118** may take on any suitable form. In one example, the lance feeder **118** supports one or more of the lances **116** on a carrier that is driven along the longitudinal axis **104** to feed each lance **116** through the interior of the corresponding oilfield tube **102**, as the oilfield tube is supported in a fixed position. Alternatively, a similar feed mechanism may be used to feed the oilfield tubes **102** relative to the lances **118**.
(18) Each lance **116** may be a rigid unit having a spray tip **136** at a distal end **138**, through which the flow of pressurized water **122** is discharged as a high velocity water spray or jetted water **140**. The spray tip **136** may comprise one or more nozzles or openings for directing the spray **140** against the interior of the oilfield tube, such as in a direction that is transverse to the longitudinal axis **104**, as indicated in FIG. **1**.
(19) In some embodiments, the controller **120** may be used to control components of the system **100** to perform an oilfield tube cleaning or wet decontamination operation. Thus, the controller **120** may be configured to control the bucking unit **112** to screw or unscrew the collar **110**, the pressurized water source (e.g., the pumps, valves, etc.) **114** to generate the flow of pressurized water **122**, the lance feeder **118** to feed one or more lances **116**, and/or other functions described herein to perform an oilfield tube cleaning or wet decontamination operation.
(20) FIG. **2** is a simplified diagram of an example of the controller **120**, in accordance with embodiments of the present disclosure. The controller **120** may include one or more processors **144** configured to perform various functions of the described herein, in response to their execution of instructions contained in memory **146**. The one or more processors **144** may be components of one or more computer-based systems, and may include one or more control circuits, microprocessor-based engine control systems, and/or one or more programmable hardware components, such as a field programmable gate array (FPGA). The memory **146** represents local and/or remote memory or computer readable media. Such memory **146** comprises any suitable patent subject matter eligible computer readable media and does not include transitory waves or signals. Examples of the memory **146** include conventional data storage devices, such as hard disks, CD-ROMs, optical storage devices, magnetic storage devices and/or other suitable data storage devices. The controller **120** may include circuitry **148** for use by the one or more processors **144** to receive input signals **150**, and issue control signals **152**, such as signals that control the bucking unit **112**, the pump **126**, the pump **128**, the valve **130**, the valve **132**, and/or other components of the system **100** to perform a wet decontamination operation in accordance with embodiments of the present disclosure. The circuitry **148** may also be used to communicate data **154**, such as in response to the execution of the instructions stored in the memory **146** by the one or more processors **144**.
(21) FIG. **3** is a simplified cross-sectional view of an example of the threaded end **106** of the used oilfield tube **102**, to which the coupling collar **110** is connected. The coupling collar includes a threaded bore **156** that is screwed onto the end **106**. The oilfield tube **102** and threaded bore **156** of the coupling collar **110** include a hollow interior **158**. Scale deposits **160** are attached to the interior wall of the oilfield tube **102** and the threaded bore **156**.
(22) Embodiments of the present disclosure relate to methods of cleaning or decontaminating the used oilfield tube **102** and coupling collar **110** to remove the deposits **160** and prepare the oilfield tube **102** for reuse. FIG. **4** is a flowchart illustrating the method, in accordance with embodiments of the present disclosure.
(23) At **170** of the method, the coupling collar **110** is unscrewed from the threaded end **106**. In some embodiments, this involves rotating the collar **110** about the longitudinal axis **104** relative to the oilfield tube **102** without detaching the collar **110** from the threaded end **106** of the oilfield tube **102**, as illustrated in the simplified side cross-sectional view of FIG. **5**. Thus, in one embodiment of step **170**, the threaded bore **156** of the collar **110** remains in threaded engagement with the threaded end **106**.

(24) In some embodiments, the collar **110** is unscrewed in step **170** by rotating the collar **110** two or more rotations, such as 2-5 rotations, about the longitudinal axis **104** relative to the oilfield tube **102**. This displaces the collar **110** a distance **172** relative to the oilfield tube **102** along the axis **104**, as indicated in FIG. **5**. In some embodiments, the distance **172** is approximately 0.25-1.5 inches.

(25) In some embodiments, the coupling collar **110** is unscrewed in step **170** using the bucking unit **112**. After collar **110** is initially unscrewed using the bucking unit **112**, the collar **110** may be further rotated in step **170** relative to the oilfield tube **102** by hand until the collar **110** is unscrewed the desired distance **172** relative to the oilfield tube **102**.

(26) A cleaning or wet decontamination operation is then performed to clean the bore **156** of the collar and the interior **158** of the oilfield tube **102**. Steps of the wet decontamination operation are illustrated in the simplified side views of FIGS. **6**A-D.

(27) At **174** of the method, a spray **140** of water is discharged through the spray tip **136** of the lance **116**, as shown in FIG. **6**A. As discussed above, this is implemented using the pressurized water source **114** that drives the flow of pressurized water **122** through the lance **116**. The spray tip **136** may be positioned outside the collar **110** at the start of the discharging step **174**, as indicated in FIG. **6**A.

(28) At **176** of the method, the spray tip **136** is fed along the longitudinal axis **104** by the lance feeder **118** toward the collar **110** and threaded end **106** of the oilfield tube **102** as indicated by arrow **176** in FIG. **6**A, and advanced into the threaded bore **156** of the collar **110** and the interior **158** of the oilfield tube **102**, as indicated in FIG. **6**B, during the discharging step **174**. This ensures that the full interior of the threaded bore **156** receives the spray **140**. The spray tip **136** may continue to be fed during step **176** through the interior **158** (FIG. **6**C) and through the end (FIG. **6**D) while discharging the spray **140**. It is understood that this process may be performed on an oilfield tube that has an orientation that is the reverse of that illustrated in FIGS. **1** and **6**A-B, such that the threaded end **108** initially receives the spray tip **136** during the feeding step **176**.

(29) FIG. **7** is a simplified side cross-sectional view of the collar **110** and the threaded end **106** of the oilfield tube **102** during the feeding step **176** of the method. FIG. **8** is a simplified cross-sectional view taken generally along line **8-8** of FIG. **7**. As shown in FIGS. **7** and **8**, the spray tip **136** includes one or more nozzles or openings **178** that discharge the high-velocity spray **140** in a transverse direction relative to the longitudinal axis **104**, such as 45-90 degrees relative to the longitudinal axis **104**. The velocity of the water in the spray **140** may be approximately 300-700 miles per hour. It is understood that while the spray tip is illustrated as comprising several individual nozzles or openings **178**, any suitable nozzle tip may be used, such as a single nozzle tip that is configured to discharge the spray at approximately 360 degrees around the longitudinal axis **104**, for example.

(30) As the spray tip **136** is fed along the axis **104** through the collar **110** and the oilfield tube **102** (FIGS. **6**A-D), scale deposits **160** attached to the bore **156** of the collar **110** and the interior wall of the oilfield tube **102** are dislodged and removed by the spray **140**, as indicated at step **180** of the method, and illustrated in FIG. **7**. The dislodged deposits **160** are driven out of the oilfield tube **102** by a flow of wastewater **182** (FIG. **7**) through the oilfield tube **102** generated by the spray **140**. The wastewater **182** may be collected and processed by the system **100** as discussed above.

(31) In some embodiments, the feeding step **176** of the wet decontamination operation involves multiple passes of the spray tip **136** through the collar **110** and oilfield tube **102** while discharging the spray of water (step **174**). Thus, the feeding step **176** may include feeding the lance **116** and the spray tip **136** along the longitudinal axis **104** in the opposite direction indicated by arrow **176** in FIGS. **6**A-D using the lance feeder **118** while continuing to discharge the spray **140**. This movement of the lance **116** may be repeated as necessary to completely or substantially remove the deposits **160** (step **180**).

(32) The inventors have discovered that the unscrewing step **170** improves the removal (step **180**) of the deposits **160** during the discharging step **174** and the feeding step **176**, particularly on the

end face **182** of the threaded end **106** of the oilfield tube **102** and the threaded bore **156** that was initially located adjacent to the end face **182** prior to the unscrewing step **170**. This may be due to an increase in the exposure of the deposits **160** at those locations.

(33) The wet decontamination process may be terminated by stopping the flow of pressurized water **122** by deactivating the pump **126**, deactivating the pump **128**, closing the valve **130**, and/or closing the valve **132** using the controller **120**, for example. Additionally, the lance **116** may be removed from the oilfield tube **102** back to the position shown in FIGS. **1** and **6**A using the lance feeder **118**. The cleaned and decontaminated oilfield tube **102** and attached coupling collar **110** may then be moved to a collection area for inspection.

(34) In one embodiment, the bucking unit **112** is used to tighten the coupling collar **110** onto the threaded end **106** of the decontaminated oilfield tube **102**. This prepares the sucker rod **102** for reuse in the field.

(35) Although the embodiments of the present disclosure have been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the present disclosure.

Claims

1. A method of removing scale deposits from a used oilfield tube having a hollow interior, first and second threaded ends, and a coupling collar having a threaded bore screwed over the first threaded end, the method comprising: unscrewing the coupling collar one or more rotations from the first threaded end about a longitudinal axis of the oilfield tube without detaching the coupling collar from the first threaded end; and performing a wet decontamination operation on the threaded bore and the interior of the oilfield tube comprising: discharging a spray of water through a spray tip of a lance; feeding the spray tip of the lance along the longitudinal axis from the collar to the second threaded end using a lance feeder during the discharging of the spray of water, wherein the spray tip travels through the bore of the collar and the interior of the oilfield tube; and removing scale deposits from the bore of the collar and the interior of the oilfield tube using the spray of water during the feeding of the lance.
2. The method of claim 1, wherein discharging the spray of water comprises pumping the water through the lance using a pump.
3. The method of claim 2, wherein pumping the water through the lance comprises delivering a flow of water to the lance that is pressurized to greater than 30 kpsi using a high pressure pump.
4. The method of claim 1, wherein unscrewing the coupling collar comprises unscrewing the coupling collar using a bucking unit.
5. The method of claim 4, wherein unscrewing the coupling collar comprises rotating the collar 2-5 rotations about the longitudinal axis relative to the oilfield tube.
6. The method of claim 5, comprising screwing the collar one or more rotations onto the first threaded end about the longitudinal axis after performing the wet decontamination operation.
7. The method of claim 6, wherein screwing the collar one or more rotations onto the first threaded end comprises screwing the collar using a bucking unit.
8. An oilfield tube cleaning system comprising: a bucking unit configured to unscrew a coupling collar connected to a threaded end of a used oilfield tube; a pressurized water source configured to generate a flow of pressurized water; a lance configured to receive the flow of pressurized water at a proximal end and discharge a spray of the water through a spray tip at a distal end; a lance feeder configured to move the lance along a longitudinal axis; and a controller configured to control the pressurized water source and the lance feeder.
9. The oilfield tube cleaning system of claim 8, wherein the pressurized water source comprises: a supply of water; and a high pressure pump configured to receive a flow of water from the supply and discharge the flow of pressurized water.

10. The system of claim 9, wherein the high pressure pump is configured to discharge the flow of pressurized water having a pressure of greater than 30 kpsi.