A tool may be used within a wellbore, the wellbore including a wall and extending in a formation with formation fluid. The tool may include a packer expandable against the wellbore wall and ports included within the packer and selectively openable to enable formation fluid to flow into the tool from the formation. The ports include a sample port to sample formation fluid from the formation, and include a guard port to guard the sample port from contamination. At least one of the ports is configurable between a sample port and a guard port.
Switching a First Port

Expanding a Packer

Receiving Fluid Through the First Port

Receiving Fluid Through a Second Port

Switching a Third Port

Receiving Fluid Through the Third Port

Measuring Formation Properties

FIG. 5
PACKER TOOL INCLUDING MULTIPLE PORTS FOR SELECTIVE GUARDING AND SAMPLING

BACKGROUND

[0001] A wellbore is generally drilled into the ground to recover natural deposits of hydrocarbons trapped in a geological formation below the Earth's surface. The wellbore is traditionally drilled to penetrate a subsurface hydrocarbon formation in the geological formation. As a result, the trapped hydrocarbons may be released and recovered from the wellbore.

[0002] A variety of packers are used in wellbores to isolate specific wellbore regions. A packer is delivered downhole on a conveyance and expanded against the surrounding wellbore wall to isolate a region of the wellbore. Often, two or more packers can be used to isolate one or more regions in a variety of well-related applications, including production applications, service applications and testing applications.

[0003] In some applications, packers are used to isolate regions for collection of formation fluids. For example, a straddle packer can be used to isolate a specific region of the wellbore to allow collection of fluids. A straddle packer uses a dual packer configuration in which fluids are collected between two separate packers. The dual packer configuration, however, may be susceptible, such as to mechanical stresses, that may limit the expansion ratio and the drawdown pressure differential that can be employed.

SUMMARY

[0004] In an embodiment, the present disclosure may relate to a tool to be used within a wellbore including a wall and extending in a formation with formation fluid. The tool includes a packer expandable against the wellbore wall and ports included within the packer and selectively operable to enable formation fluid to flow into the tool from the formation. The ports include a sample port to sample formation fluid from the formation, and include a guard port to guard the sample port from contamination. At least one of the ports is configured between a sample port and a guard port.

[0005] In another embodiment, the present disclosure may relate to a method to collect fluid within a wellbore including a wall and extending in a formation with formation fluid. The method includes switching a first port positioned on a packer between a sample port configuration and a guard port configuration, expanding the packer against the wellbore wall, receiving fluid from the formation into the tool through the first port, and receiving fluid from the formation into the tool through a second port positioned on the packer, in which the second port includes a sample port or a guard port.

[0006] In yet another embodiment, the present disclosure may relate to a tool to be used within a wellbore including a wall and extending in a formation with formation fluid. The tool includes a packer expandable against the wellbore wall, a sample flow path formed in the tool, a guard flow path formed in the tool, a first port included within the packer and in fluid communication with the sample flow path or the guard flow path to enable formation fluid to flow through the first port and into the tool from the formation, and a second port included within the packer and in selective fluid communication with the sample flow path or the guard flow path to enable formation fluid to flow through the second port and into the tool from the formation. The tool further includes one or more valves operably coupled to the second port such that the second port is in selective fluid communication with the sample flow path or the guard flow path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For a detailed description of the embodiments of the invention, reference will now be made to the accompanying drawings in which:

[0008] FIG. 1 shows a schematic view of a tool included within a wellbore formed in a formation in accordance with one or more embodiments of the present disclosure;

[0009] FIG. 2 shows a schematic view of a tool in accordance with one or more embodiments of the present disclosure;

[0010] FIG. 3 shows a schematic view of a tool in accordance with one or more embodiments of the present disclosure;

[0011] FIG. 4 shows a perspective view of a tool in accordance with one or more embodiments of the present disclosure; and

[0012] FIG. 5 shows a flow chart of a method in accordance with one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[0013] The following discussion is directed to various embodiments of the invention. The drawing figures are not necessarily to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in the interest of clarity and conciseness. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. It is to be fully recognized that the different teachings of the embodiments discussed below may be employed separately or in any suitable combination to produce desired results. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimidate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0014] Certain terms are used throughout the following description and claims to refer to particular features or components. As one skilled in the art will appreciate, different persons may refer to the same feature or component by different names. This document does not intend to distinguish between components or features that differ in name but are the same structure or function. The drawing figures are not necessarily to scale. Certain features and components herein may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in interest of clarity and conciseness.

[0015] In the following discussion and in the claims, the terms "including" and "comprising" are used in an opened-ended fashion, and thus should be interpreted to mean "including, but not limited to . . . ." Also, the term "couple" or "couples" is intended to mean either an indirect or direct connection. In addition, the terms "axial" and "axially" generally mean along or parallel to a central axis (e.g., central axis of a body or a port), while the terms "radial" and "radially" generally mean perpendicular to the central axis. For instance, an axial distance refers to a distance measured along
or parallel to the central axis, and a radial distance means a distance measured perpendicular to the central axis. The use of “top,” “bottom,” “above,” “below,” and variations of these terms is made for convenience, but does not require any particular orientation of the components.

Accordingly, disclosed herein is a tool and packer for use within a wellbore, and/or a method to collect fluid within a wellbore. The tool includes a packer expandable against the wellbore wall and ports included within the packer and selectively openable to enable formation fluid to flow into the tool from the formation. The ports include a sample port to sample formation fluid from the formation and a guard port to guard the sample port from contamination, in which at least one of the ports is configurable or switchable between a sample port and a guard port. The tool may further include a sample flow path and a guard flow path formed in the tool with the sample port in fluid communication with the sample flow path and the guard port in fluid communication with the guard flow path. Accordingly, at least one of the ports is in selective fluid communication with the guard flow path and the sample flow path. The switchable port may be configurable or switchable between the sample port and the guard port based upon a predetermined formation property, such as based upon a ratio of permeability for the formation in a first direction to permeability for the formation in a second direction.

Referring now to FIG. 1, a schematic view of a tool 100 including a packer 102 in accordance with one or more embodiments of the present disclosure is shown. The tool 100 may be used within a wellsite system, which may be located onshore or offshore, in which one or more of the present embodiments and methods for collecting one or more measurements, data, information and/or samples may be employed and/or practiced. For example, with respect to FIG. 1, a wellbore or borehole 110 (hereinafter “wellbore”) may be drilled and/or formed within a subsurface, porous reservoir, or formation 112 (hereinafter “formation”) by one or more known drilling techniques. The wellbore may be drilled into or formed within the formation to recover and/or collect deposits of hydrocarbons, water, gases, such as, for example, non-hydrocarbon gases and/or other desirable materials trapped within the formation. The wellbore may be drilled or formed to penetrate the formation that may contain the trapped hydrocarbons, and/or other desirable materials, such as, for example, gases, water, carbon dioxide, and/or the like. As a result, the trapped hydrocarbons and/or other desirable materials may be released from the formation and/or may be recovered or collected via the wellbore.

Referring back to FIG. 1, the tool 100 may include one or more packers 102, in which the packer 102 may be expandable such that the packer 102 may expand against and seal against a wall of a wellbore 110. For example, a packer in accordance with the present disclosure may include and/or form of a flexible and/or elastomeric material for squeezing, inflating, and/or otherwise expanding the packer.

The tool 100 may also include one or more ports 104 to enable fluid communication with the wellbore 110 and the formation 112. In particular, the tool 100 may include one or more ports 104 to enable formation fluid to flow into the packer 102 from the formation. As shown in FIG. 1, the first packer 102 may include one or more ports 104 positioned therein and/or formed therethrough, in which the ports 104 enable fluid flow between the tool 100 and the wellbore through the packer 102. For example, the packer 102, in addition to other packers shown and discussed within the present disclosure, may include an expandable element, such as a rubber layer, an inflatable layer, a rubber layer, and/or other similar elements. One or more of the ports 104 may be formed and/or positioned within the expandable element of the first packer 102, and/or one or more of the ports 104 may be surrounded, such as by a rubber element. When the first packer 102 then expands against the wall of the wellbore, the ports 104 may be positioned adjacent and/or partially embedded within the wall of the wellbore 110. According to certain embodiments, each of the ports 104 may extend radially around the circumference of the packer 102 to form a ring. The ports 104 may be spaced longitudinally from one another along the packer 102.

A tool in accordance with the present disclosure, and/or one or more components of the tool, may be adapted and/or configured to collect one or more measurements, data and/or samples (hereinafter “measurements”) associated with and/or based on one or more characteristics and/or properties relating to the wellbore and/or the formation (collectively known hereinafter as “properties of the formation”). Accordingly, a tool of the present disclosure may include one or more sensors to collect and measure one or more characteristics and/or properties relating to the wellbore and/or the formation. In such an embodiment, one or more sensors may be positioned on one or more of the packers of the tool, and/or may be positioned within one or more intervals of the tool. For example, a sensor may be positioned adjacent one or more of the ports of the tool, such as positioned adjacent each port of the tool to measure one or more properties of the formation.

A tool in accordance with the present disclosure, and/or one or more components thereof, may be and/or may include, for example, one or more downhole tools and/or devices that may be lowered and/or run into the wellbore. For example, the tool 100 may be a downhole formation testing tool that may be used to conduct, execute, and/or complete one or more downhole tests, such as, for example, a local production test, a build-up test, a drawdown test, an injection test, an interference test, and/or the like. The interference test may include, for example, an interval pressure transient test (hereinafter “IPTT test”) and/or a vertical interference test. It should be understood that one or more downhole tests that may be conducted by the tool 100 or components thereof may be any downhole tests as known to one of ordinary skill in the art.

A tool in accordance with the present disclosure, and/or one or more components thereof, may be conveyed into the wellbore by any known conveyance, such as drill
pipe, tubular members, coiled tubing, wireline, slickline, cable, or any other type of conveyance. For example, with respect to FIG. 1, the tool 100 may be conveyed into the wellbore via a wireline cable 116. As a result, a tool of the present disclosure may be positionable and/or locatable within the wellbore and/or adjacent to one or more wellbore walls (hereinafter “walls”) of the wellbore. In one or more embodiments, a tool of the present disclosure may be configurable to collect one or more measurements relating to the wellbore, the formation, and/or the walls of the wellbore. For example, the tool 100 may be used to collect pressure data and/or measurements relating to the wellbore and the formation. The tool 100 may be, for example, a formation testing tool configured to collect the pressure data and/or measurements relating to the wellbore and the formation. The tool 100 may be connected to and/or incorporated into, for example, a drill string, a test string, or a tool string.

In embodiments, a tool in accordance with the present disclosure, and/or one or more components thereof, may be connected to and/or incorporated into, for example, a modular formation dynamic tester (MDT™) test string. The drill string, test string, or tool string may include one or more additional downhole components (hereinafter “additional components”), such as, for example, drill pipe, one or more drill collars, a mud motor, a drill bit, a telemetry module, an additional downhole tool, and/or one or more downhole sensors. It should be understood that the drill string, test string, or tool string may include any number of and/or any type of additional downhole components as known to one of ordinary skill in the art.

Referring now to FIG. 2, a schematic view of a tool 200 in accordance with one or more embodiments of the present disclosure is shown. The tool 200 may include a packer 202 with one or more ports 204 positioned on the packer 202 to enable fluid communication with the wellbore and the formation. In accordance with one or more embodiments of the present disclosure, the ports 204 may include one or more sample ports and one or more guard ports.

A sample port may be used to sample formation fluid from the formation, and a guard port may be used to guard the sample port from contamination. For example, referring back to FIG. 1, the formation 112 may include filtrate and/or other contamination 114, such as when drilling and/or otherwise forming the wellbore 110. Sample ports of the ports 104 positioned on the packer 102 may be used to sample and receive fluid from the formation 112 and guard ports of the ports 104 positioned on the packer 102 may be used to guard and prevent the contamination 114 from entering the sample ports when sampling. Accordingly, with reference back to FIG. 2, one or more of the ports 204 may be switchable between a sample port, such as a sample port configuration, and a guard port, such as a guard port configuration.

In one or more embodiments, the guard ports may be positioned adjacent or in the vicinity of the sample ports to reduce or prevent contamination from being introduced into a sample collected by the tool 200. For example, in one or more embodiments, one or more guard ports may be positioned above and/or below one or more sample ports such that contamination may be collected by and through the guard ports for a cleaner sample to be collected by and through the sample ports. In one embodiment, the guard ports may be opened first to enable formation fluid to flow therethrough to collect contamination and filtrate, with the sample ports then opened after the guard ports such that the formation fluid collected through the sample ports includes less contamination and filtrate.

[0028] As a tool is used within a wellbore extending in a formation to perform various functions, such as receiving from and/or expelling fluid into the formation when in the wellbore, the tool may be optimized based upon one or more properties of the wellbore and formation. For example, a port configuration for the one or more ports of the tool may be optimized based upon a predetermined formation property. In one embodiment, the port configuration of the ports may be optimized based upon permeability anisotropy of the formation.

“Anisotropy” may refer to a variation of a property with the direction in which the property is measured. Rock permeability is a measure of the conductivity to fluid flow through the pore spaces of the rock. Formation and reservoir rocks often exhibit permeability anisotropy whereby conductivity to fluid depends on the direction of flow of the formation fluid. For example, when comparing permeability measured parallel or substantially parallel to the formation bed boundaries, which may be referred to as horizontal permeability, khl, and permeability measured perpendicular or substantially perpendicular to the formation bed boundaries, which may be referred to as vertical permeability, kvt, such permeability anisotropy is referred to as two-dimensional (hereinafter “2D”) anisotropy.

Further, a formation may exhibit anisotropy within the plane parallel or substantially parallel to the formation bed boundaries, such that instead of a single value of horizontal permeability, khl, separate components may be measured in orthogonal or substantially orthogonal directions, such as, for example x- and y-directions, referred to as khl and kvh, respectively. A formation that exhibits variation in permeability when measured vertically or substantially vertically, as well as, both horizontally or substantially horizontal directions may be referred to as three-dimensional (hereinafter “3D”) anisotropy. Rock that exhibits no directional variation in permeability is referred to as “isotropic”.

One or more tools, such as the tools shown above, in addition to other tools, such as formation testing tools, may be used to determine 2D and/or 3D permeability anisotropy, such as through an IPTT test. For example, during an IPTT test, a tool may be used to pump formation fluid from the formation into the wellbore. From the transient reservoir pressure response, 2D and/or 3D permeability anisotropy may be measured, estimated, and/or otherwise determined. Such tests can be performed with a single probe, multi probe, dual-pack, single packer, packer-pack combinations, and/or packer-probe combinations.

In one or more embodiments, such as when sampling, a tool may be used to obtain a fluid sample containing relatively low amounts of contamination, such as drilling fluid contamination, with the sample collected at a pressure above the saturation pressure of the fluid in a relatively short amount of time. As discussed above, a focusing effect for a tool in accordance with the present disclosure may be achieved by pumping and pulling mud filtrate from above or below the tool into guard ports, focusing clean or low contamination formation fluid to the sample ports. The efficiency of the sampling can vary significantly according to formation properties, such as a formation permeability anisotropic ratio and viscosity contrast between mud filtrate and formation fluid.
Accordingly, in one or more embodiments, one or more ports may be configurable or switchable between a sample port and a guard port based upon a predetermined formation property, such as to minimize clean-up time, the time necessary for a tool and/or a packer to obtain and collect a fluid sample that limits fluid contamination at a pressure above the saturation pressure for the fluid. The ports that are configurable or switchable between a sample port and a guard port may be switched and optimized, such as when sampling, based upon the operating conditions and formation properties when in use within a wellbore to optimize the performance of the tool when used within a wellbore. In one embodiment, one or more ports may be switched between a sample port and a guard port based upon a ratio or comparison of the permeability for the formation in a first direction with respect to the permeability for the formation in a second direction, such as 2D permeability anisotropy and/or 3D permeability anisotropy. Other properties of the formation that may determine when to switch a port between a sample port and a guard port may include the comparison of the viscosity of the drilling fluid filtrate with respect to the formation fluid, the formation thickness, the depth of invasion within the formation, the allowable pressure draw down for the formation fluid (e.g. due to saturation pressure), and/or one or more other properties of the formation. Accordingly, one or more tests may be conducted to estimate and determine one or more of the above properties, such as 2D permeability anisotropy, 3D permeability anisotropy, fluid viscosity, formation thickness, and/or depth of invasion.

One or more examples of embodiments that may incorporate a tool or a method including an optimized port configuration may include: selectively opening and/or closing ports positioned within a packer; selectively changing the shape and/or size of a port; selectively directing one or more ports to be in fluid communication with a sample flow path and/or a guard flow path, thereby selectively enabling one or more ports to be a sample port and/or a guard port; and/or other port parameters and configurations that may be varied and optimized.

Continuing with FIG. 2, as the tool 200 may include one or more ports 204 positioned on the packer 202, the ports 204 may include in this embodiment a first port 204A, a second port 204B, a third port 204C, a fourth port 204D, and a fifth port 204E. The first port 204A is shown as having a relatively central axial position on the packer 202 of the tool 200 and/or as having a relatively central position between one or more of the other ports 204. As shown, the first port 204A may be positioned relatively central between the second port 204B and the third port 204C, and/or the first port 204A may be positioned relatively central between the fourth port 204D and the fifth port 204E. Further, the second port 204B and the third port 204C may be positioned adjacent the first port 204A, with the fourth port 204D and the fifth port 204E spaced from the first port 204A, the second port 204B, and the third port 204C, and positioned closer to the ends of the packer 202 than to the first ports 204A in the center axial position. Accordingly, the position of the second port 204B and the third port 204C may be relatively symmetrical with respect to the position of the first port 204A, and/or the position of the fourth port 204D and the fifth port 204E may be relatively symmetrical with respect to the position of the first port 204A.

As discussed above, one or more of the ports within a tool in accordance with the present disclosure may switch between a sample port and a guard port. For example, with respect to FIG. 2, the first port 204A, the second port 204B, the third port 204C, the fourth port 204D, and/or the fifth port 204E may be able to switch between being used as a sample port and a guard port.

The ports may be switched between use as a sample port and use as a guard port, and/or selectively closed, based upon one or more predetermined formation properties. For example, as discussed above, the ports 204 may be switched between use as a sample port and use as a guard port based upon a ratio of permeability for the formation in a first direction to permeability for the formation in a second direction, such as a formation permeability anisotropic ratio.

In one embodiment, the first port 204A may be used as a sample port, with the second port 204B and/or the third port 204C used as guard ports to guard the first port 204A, and with the fourth port 204D and/or the fifth port 204E used as guard ports to guard the first port 204A. Further, in one or more embodiments, as vertical permeability, k_v, of a formation increases with respect to horizontal permeability, k_h, the ports of the tool may be optimized and selectively switched between use as a sample port and a guard port such that the guard ports may provide more vertical guarding for the sample ports. Thus, in such an embodiment, as the ratio of vertical permeability, k_v, to horizontal permeability, k_h, increases, the first port 204A may be used as a sample port, the second port 204B and/or the third port 204C may also be used as sample ports, with the fourth port 204D and/or the fifth port 204E used as guard ports to guard the first port 204A, the second port 204B, and/or the third port 204C.

Furthermore, in one or more embodiments, as vertical permeability, k_v, of a formation decreases with respect to horizontal permeability, k_h, the ports of the tool may be optimized and selectively switched between use as a sample port and a guard port such that the guard ports may provide less vertical guarding for the sample ports. Thus, in such an embodiment, as the ratio of vertical permeability, k_v, to horizontal permeability, k_h, decreases, the first port 204A may be used as a sample port, with the second port 204B and/or the third port 204C used as guard ports to guard the first port 204A. The fourth port 204D and/or the fifth port 204E may then be closed, as the fourth port 204D and/or the fifth port 204E may provide limited vertical guarding for the sample ports as vertical permeability, k_v, decreases.

Referring now to FIG. 3, a schematic view of a tool 300 in accordance with one or more embodiments of the present disclosure is shown. Similar to the tools above, the tool 300 may include a packer 302 with one or more ports 304 positioned on the packer 302 to enable fluid communication with the wellbore and the formation.

Those having ordinary skill in the art may appreciate that a tool in accordance with the present disclosure may include one or more ports in different configurations and positions, in which one or more of the ports may be switched between a sample port and a guard port, with the ports also selectively openable to enable fluid flow therethrough. In the embodiment in FIG. 3, the ports 304 may include a first port 304A, a second port 304B, a third port 304C, a fourth port 304D, a fifth port 304E, a sixth port 304F, and a seventh port 304G.

As with the above, the first port 304A is shown as having a relatively central axial position on the packer 302 of the tool 300 and/or as having a relatively central position between one or more of the other ports 304. The first port 304A may be positioned relatively central between the sec-
second port 304B and the third port 304C, may be positioned relatively central between the fourth port 304D and the fifth port 304E, and/or may be positioned relatively central between the sixth port 304F and the seventh port 304G.

[0043] The second port 304B and the third port 304C may be positioned adjacent the first port 304A, the fourth port 304D may be positioned adjacent the second port 304B such that the second port 304B is in between the fourth port 304D and the first port 304A, and the fifth port 304E may be positioned adjacent the third port 304C such that the third port 304C is in between the fifth port 304E and the first port 304A.

Further, in this embodiment, the sixth port 304F and the seventh port 204G may be spaced from the first port through fifth ports 304A-304E, and positioned closer to ends of the packer 302 than to the first port 304A in the center axial position. Accordingly, the position of the second port 304B and the third port 304C may be relatively symmetrical with respect to the position of the first port 304A, the position of the fourth port 304D and the fifth port 304E may be relatively symmetrical with respect to the position of the first port 304A, and/or the position of the sixth port 304F and the seventh port 304G may be relatively symmetrical with respect to the position of the first port 304A.

[0044] In one embodiment, the first port 304A may be used as a sample port, with the second port 304B and/or the third port 304C used as guard ports to guard the first port 304A. The remainder of the ports 304D-304G may then be closed, and/or may be opened and used as guard ports to guard the first port 304A. As vertical permeability, $k_v$, of a formation increases with respect to horizontal permeability, $k_h$, the ports of the tool may be optimized and selectively switched between use as a sample port and a guard port such that the guard ports may provide more vertical guarding for the sample ports. Thus, in such an embodiment, as the ratio of vertical permeability, $k_v$, to horizontal permeability, $k_h$, increases, the first port 304A may be used as a sample port, with the ports 304B-304G selectively opened and used as guard ports when moving axially outward from the first port 304A and towards the ends of the packer 302 and tool 300.

[0045] Further, as vertical permeability, $k_v$, of a formation increases with respect to horizontal permeability, $k_h$, the ports of the tool may be optimized and selectively switched between use as a sample port and a guard port such that the tool may be used as needed. In one embodiment, the first port 304A may be used as a sample port, the second port 304B and/or the third port 304C may also be used as sample ports, with the fourth port 304D and/or the fifth port 304E may be used as guard ports. In another embodiment, the first port 304A may be used as a sample port, the second port 304B and/or the third port 304C may be used as sample ports, the fourth port 304D and/or the fifth port 304E may be used as sample ports and/or guard ports, with the sixth port 304F and/or the seventh port 304G used as guard ports.

[0046] Referring now to FIG. 4, a perspective view of a tool 400 in accordance with one or more embodiments of the present disclosure is shown. Similar to the tools above, the tool 400 may include a packer 402 with one or more ports 404 positioned on the packer 402 to enable fluid communication with the wellbore and the formation. In this embodiment, the ports 404 may include a first port 404A, a second port 404B, a third port 404C, a fourth port 404D, a fifth port 404E, and a sixth port 404F.

[0047] As mentioned above, a tool in accordance with the present disclosure may include one or more ports in different configurations and positions. In one embodiment, a port configuration in accordance with the present disclosure may include an enclosed port configuration and/or a concentric port configuration, in which one or more ports may be enclosed and surrounded by one or more other ports. Accordingly, in FIG. 4, the first port 404A and the second port 404B may have an enclosed port configuration, in which the first port 404A is enclosed and surrounded by the second port 404B.

In another embodiment, a port configuration in accordance with the present disclosure may include an individual port configuration, in which one or more ports may be individually formed and spaced from one or more other ports. Accordingly, in FIG. 4, the third port 404C, the fourth port 404D, the fifth port 404E, and/or the sixth port 404F may have an individual port configuration that are spaced apart and distanced from each other. Further, in another embodiment, a port configuration in accordance with the present disclosure may include a ring port configuration, in which one or more of the ports may extend substantially about the packer of the tool. Accordingly, as shown in FIGS. 2 and 3, the ports are shown in a ring port configuration.

[0048] In FIG. 4, the first port 404A is shown as having a relatively central axial position on the packer 402 of the tool 400 and/or as having a relatively central position between one or more of the other ports 404. Further, the second port 404B is shown as also having a relatively central axial position on the packer 402 of the tool 400 and/or as having a relatively central position between one or more of the other ports 404, in which the second port 404B may be positioned adjacent and enclose the first port 404A. The first port 404A and/or the second port 404B may then be positioned relatively central between the third port 404C, the fourth port 404D, the fifth port 404E, and/or the sixth port 404F.

[0049] Further, in this embodiment, the third port 404C and the fourth port 404D may be spaced from the first port 404A and/or the second port 404B and positioned closer to one end of the packer 402 than to the first port 404A in the center axial position. Similarly, the fifth port 404E and the sixth port 404F may be spaced from the first port 404A and/or the second port 404B and positioned closer to another end of the packer 402 than to the first port 404A in the central axial position. Accordingly, the position of the third port 404C, the fourth port 404D, the fifth port 404E, and/or the sixth port 404F may be relatively symmetrical with respect to the position of the first port 404A.

[0050] In one embodiment, the first port 404A may be used as a sample port, with the second port 404B used as guard ports to guard the first port 404A. The remainder of the ports 404C-404F may then be closed, and/or may be opened and used as guard ports when moving axially outward from the first port 404A and towards the ends of the packer 402 and tool 400. Further, as vertical permeability, $k_v$, of a formation increases with respect to horizontal permeability, $k_h$, the ports of the tool may be optimized and selectively switched between use as a sample port and a guard port such that the guard ports may provide more vertical guarding for the sample ports. Thus, in such an embodiment, as the ratio of vertical permeability, $k_v$, to horizontal permeability, $k_h$, increases, the first port 404A may be used as a sample port, with the ports 404B-404F selectively opened and used as guard ports when moving axially outward from the first port 404A and towards the ends of the packer 402 and tool 400.
and a guard port such that the tool provides a larger sampling area as needed. In such an embodiment, the first port 404A and/or the second port 404B may be used as sample ports, with one to all of the remaining ports 404C-404F used as guard ports.

[0051] A tool in accordance with one or more embodiments of the present disclosure may include one or more flow paths formed therein and/or extending therethrough. For example, a tool in accordance with the present disclosure may include one or more sample flow paths and one or more guard flow paths. In such an embodiment, the sample ports may be in fluid communication with the sample flow path of the tool such that fluid received through the sample ports may be received and flow into the sample port flow path. Further, the guard ports may be in fluid communication with the guard flow path of the tool such that fluid received through the guard ports may be received and flow into the guard flow path. This configuration may enable fluid that is received into the sample ports to be fluidly isolated from the guard ports, such as to prevent contamination for the fluid received within the sample ports. Accordingly, when switching a port between a sample port configuration and/or configuring a port to be a sample port, the port may be situated within the tool to be in fluid communication with the sample flow path for the port to collect a fluid sample into the sample flow path. Further, when switching a port between a guard port configuration and/or configuring a port to be a guard port, the port may be situated within the tool to be in fluid communication with the guard flow path for the port to collect fluid into the guard flow path that would guard one or more sample ports.

[0052] Further, a tool in accordance with the present disclosure may include one or more valves, one or more gauges, and/or one or more sensors. In one or more embodiments, a tool in accordance with the present disclosure may include one or more valves operably coupled to one or more ports and/or one or more flow paths. For example, one or more valves may be operably coupled to a port, in which the valves may be selectively opened, closed, and/or otherwise moved and reoriented to switch the port between a sample port and a guard port. In one embodiment, a valve operably coupled to a port may open to enable fluid communication between the port and the sample flow path, thereby switching the port to a sample port configuration and/or configuring the port as a sample port. In another embodiment, a valve operably coupled to a port may open to enable fluid communication between the port and the guard flow path, thereby switching the port to a guard port configuration and/or configuring the port as a guard port. One or more valves may be operably coupled to a port to be able to switch the port between a sample port and a guard port. For example, a two-way valve, a three-way valve, and/or any other valve in accordance with the present disclosure may be used without departing from the scope of the present disclosure.

[0053] In an embodiment in which a tool includes one or more gauges and/or one or more sensors, the gauges and sensors may be used to measure and determine one or more formation properties. A pressure gauge and/or a sensor may be operably coupled to a port, a flow path, and/or positioned on a packer of a tool in accordance with the present disclosure. Accordingly, based upon the one or more measured properties, one or more ports within the tool may be switched between a sample port and a guard port. For example, in an embodiment in which one or more ports may be closed to not receive fluid flow therethrough, gauges and/or sensors adjacent the closed port may be used to measure one or more properties of the formation to determine if one or more ports within the tool should be switched between a sample port and a guard port.

[0054] Referring now to FIG. 5, a flow chart of a method 500 to collect fluid within a wellbore in accordance with one or more embodiments of the present disclosure is shown. The method 500 may include switching a first port (block 510), such as switching a first port positioned on a packer between a sample port configuration to sample fluid and a guard port configuration to guard from contamination. For example, one or more predetermined formation properties, such as a formation permeability anisotropic ratio, or more specifically a ratio between $k_h$ and $k_v$, may be used when determining to switch the first port between a sample port and a guard port. In another example, an expected permeability or 3D permeability anisotropy may be employed to switch a first port 510 to a desired configuration.

[0055] In certain embodiments, the predetermined formation property may be determined from historical well log data, such as data from previous downhole tool runs and/or data stored in a reservoir database. In certain embodiments, the port may be switched prior to conveying the tool within the wellbore, while in other embodiments, the port may be switched while the packer is disposed downhole. Moreover, in yet other embodiments, the predetermined formation property may be determined based on measurements made using the packer. For example, the pressure, flow rate, contamination level, oil gas ratio, density, viscosity, oil based mud level, and the like, may be measurements, and these measurements may be employed to determine the predetermined formation properties. In certain embodiments, a 2D or 3D formation permeability anisotropy may be determined based on these measurements.

[0056] The method 500 may further include expanding the packer (block 520), receiving fluid through the first port (block 530), and receiving fluid through a second port (block 540). In particular, the packer may be expanded against the wellbore wall to receive formation fluid from the formation into the tool through the first and second ports. In an embodiment in which the second port may be used as a sample port, the first port may be switched to a guard port such that the first port may guard the second port from contamination. In another embodiment in which the second port may be used as a guard port, the first port may be switched to a sample port such that the first port may be used to collect and sample formation fluid.

[0057] The method 500 may include switching a third port (block 550), such as switching a third port positioned on a packer between a sample port configuration to sample fluid and a guard port configuration to guard from contamination. For example, similar to above, one or more predetermined formation properties may be used when determining to switch the third port between a sample port and a guard port.

[0058] According to certain embodiments, the predetermined formation properties used to switch the third port (block 550) may be the same properties used to switch the first port (block 510). However, in other embodiments, the predetermined formation properties used to switch the third port (block 550) may be based on measurements made based on fluid sampled through the first port and the second port (blocks 530 and 540). For example, the fluid received through the first and second ports may be analyzed within the downhole tool, for example by measuring the pressure, flow rate,
contamination level, oil gas ratio, density, viscosity, oil based mud level, and the like, and these measurements may be employed to determine additional predetermined formation properties. In certain embodiments, a 2D or 3D formation permeability anisotropy may be determined or adjusted based on these measurements. Further, a new permeability anisotropic ratio, such as a ratio between $k_x$ and $k_y$, may be determined. Based on these predetermined formation properties, the third port may be switched from a sample port to a guard port, or vice versa.

[0059] The method 500 may then continue with receiving fluid through the third port (block 560). In an embodiment in which the first port and/or the second port may be used as a sample port, the third port may be switched to a guard port such that the third port may guard one or more other ports from contamination. In another embodiment in which the first port and/or the second port may be used as a guard port, the third port may be switched to a sample port such that the third port may be used to collect and sample formation fluid.

[0060] Furthermore, the method 500 may include measuring formation properties (block 570). For example, a tool in accordance with the present disclosure may be used to measure permeability in one or more directions of a formation, in which the ports may be selectively switched between a sample port and a guard, and/or selectively opened and closed. In another embodiment, rather than a tool of the present disclosure measuring one or more formation properties, formation properties measured with previous tools and/or measured using other methods and techniques may be used when determining to selectively switch a port between a sample port and a guard, and/or selectively opening and closing the port.

[0061] A tool in accordance with the present disclosure may have an optimized port configuration to obtain a fluid sample containing relatively low amounts of contamination, such as drilling fluid contamination, with the sample collected at a pressure above the saturation pressure of the fluid in a relatively short amount of time. As discussed above, a focusing effect for a tool in accordance with the present disclosure may be achieved by pumping and pulling mud filtrate from above or below the tool into guard ports, focusing clean or low contamination formation fluid to the sample ports. The efficiency of the sampling can vary significantly according to formation properties, such as a formation permeability anisotropic ratio and viscosity contrast between mud filtrate and formation fluid. Accordingly, in one or more embodiments, one or more ports may be switched between use as a sample port and use as a guard port, and/or selectively opened and closed, based upon a predetermined formation property, such as to minimize clean-up time, the time necessary for a tool and/or a packer to obtain and collect a fluid sample that limits fluid contamination at a pressure above the saturation pressure for the fluid.

[0062] Further, a tool in accordance with the present disclosure may enable focused sampling. As the ports may be in fluid communication with multiple flow paths, fluid may be received through one or more ports to receive filtrate therein, whereas fluid may be received through other ports to receive sample fluid. For example, a port may be used on a packer to receive sample fluid therein, in which adjacent ports, such as ports of the intervals and/or ports of the packers, may be used as guard ports to receive filtrate therein that may be undesirable for sampling.

[0063] Furthermore, a tool in accordance with the present disclosure may enable one or more ports, gauges, and/or sensors to observe and measure properties of the wellbore and formation. For example, one or more ports may be used to receive fluid therein or dispatch fluid therefrom. During this process, one or more gauges, one or more sensors, and/or one or more other ports may be used to observe properties of the wellbore and the formation, such as increases and/or decreases of fluid flow in areas of the formation affected by the fluid moving through the ports of the tool. Accordingly, the present disclosure contemplates a tool that may have a variety of functions and uses without departing from the scope of the present disclosure.

[0064] Although the present invention has been described with respect to specific details, it is not intended that such details should be regarded as limitations on the scope of the invention, except to the extent that they are included in the accompanying claims.

What is claimed is:

1. A tool to be used within a wellbore, the wellbore including a wall and extending in a formation with formation fluid, the tool comprising:
   a packer expandable against the wellbore wall; and
   ports included within the packer and selectively openable to enable formation fluid to flow into the tool from the formation;
   wherein the ports include a sample port to sample formation fluid from the formation;
   wherein the ports include a guard port to guard the sample port from contamination; and
   wherein at least one of the ports is configurable between a sample port and a guard port.

2. The tool of claim 1, further comprising:
   a sample flow path in fluid communication with the sample port; and
   a guard flow path in fluid communication with the guard port.

3. The tool of claim 2, wherein the at least one of the ports is in selective fluid communication with the guard flow path or the sample flow path.

4. The tool of claim 1, wherein the sample port comprises the at least one port configurable between the sample port and the guard port.

5. The tool of claim 1, wherein the guard port comprises the at least one port configurable between the sample port and the guard port.

6. The tool of claim 1, wherein the ports comprise a sample port, a guard port, and a port configurable between a second sample port and a second guard port.

7. The tool of claim 1, wherein the at least one of the ports is configurable between the sample port and the guard port based upon a predetermined formation property.

8. The tool of claim 7, wherein the predetermined formation property comprises a ratio of permeability for the formation in a first direction to permeability for the formation in a second direction.

9. The tool of claim 1, further comprising:
   a pressure gauge to measure pressure of formation fluid flowing through at least one of the ports; and
   a sensor positioned on the packer to measure a property of the formation fluid.

10. The tool of claim 1, wherein the ports comprise at least one of a ring port configuration, an enclosed port configuration, and an individual port configuration.
11. A method to collect fluid within a wellbore, the wellbore including a wall and extending in a formation with formation fluid, the method comprising:

- switching a first port positioned on a packer between a sample port configuration and a guard port configuration;
- expanding the packer against the wellbore wall;
- receiving fluid from the formation into the tool through the first port; and
- receiving fluid from the formation into the tool through a second port positioned on the packer, the second port comprising one of a sample port and a guard port.

12. The method of claim 11, wherein, when the second port comprises the sample port, switching the first port comprises:

- switching the first port from the sample port configuration to the guard port configuration.

13. The method of claim 12, wherein switching the first port further comprises:

- switching the first port from being in fluid communication with a sample flow path of the tool to being in fluid communication with a guard flow path of the tool; and
- communicating fluid into the tool through the first port to the guard flow path.

14. The method of claim 11, wherein, when the second port comprises the guard port, switching the first port comprises:

- switching the first port from the guard port configuration to the sample port configuration.

15. The method of claim 14, wherein switching the first port further comprises:

- switching the first port from being in fluid communication with a guard flow path of the tool to being in fluid communication with a sample flow path of the tool; and
- communicating fluid into the tool through the first port to the sample flow path.

16. The method of claim 11, wherein the tool comprises at least one valve operably coupled to the first port, the method further comprising:

- opening the at least one valve between the first port and a sample flow path of the tool to switch the first port to a sample port configuration; and
- opening the at least one valve between the first port and a guard flow path of the tool to switch the first port to a guard port configuration.

17. The method of claim 11, further comprising:

- switching a third port positioned on a packer between a second sample port configuration and a second guard port configuration; and
- receiving fluid from the formation into the tool through the first port.

18. The method of claim 11, wherein switching the first port comprises:

- measuring permeability for the formation in a first direction;
- measuring permeability for the formation in a second direction; and
- switching the first port positioned on the packer between the sample port configuration and the guard port configuration based upon a ratio of the permeability for the formation in the first direction to the permeability for the formation in the second direction.

19. The method of claim 11, further comprising:

- measuring pressure of fluid received into the tool; and
- measuring a property of fluid received into the tool.

20. A tool to be used within a wellbore, the wellbore including a wall and extending in a formation with formation fluid, the tool comprising:

- a packer expandable against the wellbore wall;
- a sample flow path formed in the tool;
- a guard flow path formed in the tool;
- a first port included within the packer and in fluid communication with one of the sample flow path and the guard flow path to enable formation fluid to flow through the first port and into the tool from the formation;
- a second port included within the packer and in selective fluid communication with the sample flow path or the guard flow path to enable formation fluid to flow through the second port and into the tool from the formation; and
- at least one valve operably coupled to the second port such that the second port is in selective fluid communication with the sample flow path or the guard flow path.