

A FLEXIBLE, FILTER DEVICE TO PROTECT BARRIER VALVES**BACKGROUND**

[0001] In downhole well environments, debris tolerance of barrier valves is a major issue for those in the business of the development and production of hydrocarbon reservoirs. During development, a barrier valve is used to seal off a perforated section of production tubing to isolate a reservoir from remaining sections being developed. The barrier valves can be remotely controlled using pressure pulses. However, during development various types of debris, such as cement, can become lodged in a valve mechanism and in control ports, which sense pressures pulses. If these control ports cannot be accessed by pressure, the barrier valve cannot be opened. In this event, the valve may fail to operate and well cleaning operations must be performed which is very expensive and time consuming.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] For a more complete understanding of the features and advantages of the present disclosure, reference is now made to the detailed description along with the accompanying figures in which corresponding numerals in the different figures refer to corresponding parts and in which:

[0003] FIG. 1 is an illustration of a diagram of a wellsite utilizing a flexible, filtering device, in accordance with certain example embodiments;

[0004] FIG. 2A is an illustration of an isometric view of production tubing, barrier valve with a maneuverable component, and a flexible, filtering device, in accordance with certain example embodiments;

[0005] FIG. 2B is an illustration of an isometric view of another flexible, filtering device, according to certain example embodiments; and

[0006] FIG. 2C is an illustration of a side view of yet another flexible, filtering device, in accordance with certain example embodiments.

DETAILED DESCRIPTION

[0007] While the making and using of various embodiments of the present disclosure are discussed in detail below, it should be appreciated that the present disclosure provides many applicable inventive concepts, which can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative and do not delimit the scope of the present disclosure. In the interest of clarity, not all features of an actual implementation may be described in the present disclosure. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developer's specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming but would be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

[0008] Presented herein are devices and methods of using those devices within a downhole well environment that prevent or reduce debris buildup around a barrier valve between the time of well completion and production. A flexible, filtering device strategically placed within a section of a wellbore above a barrier valve collects debris during development and prevents or limits debris, such as cement, from affecting valve operation. Barrier valves, sometimes referred to in the industry as isolation valves, are similar to or function similar to a ball valve and used to isolate a section near a sand barrier, i.e. an accessible reservoir. The flexible, filtering device can be attached to an Internal Diameter (ID) of a section of tubing in a circumferential fashion. The filtering device can also be placed in the tubing string above a bespoke tubular tool or above a bespoke tubular tool and a barrier valve. In essence, the filtering device can be integrated with the

barrier valve. A single filtering device can be used or a plurality can be used in a production tubing string.

[0009] The flexible, filtering device includes filtering members to restrict and collect debris. The flexible, filtering device members can also be displaced or moved aside to allow for the passage of tools. The members can be made of a material that will dissolve after a period of time in response to well fluids and environmental conditions or it can be securely fixed to the device by a temporary method such as adhesives or crimped into a groove, and flowed out of the well once a barrier valve has been opened. Device members can be a metal finger type, a bristle type, meshes, pierced foils, and any combination thereof. Members can also be independent or connected to other members by a permanent, semi-permanent or temporary connector. The members can be oriented to re-direct debris to a collection area, or reservoir, in the device, valve, or tubing.

[0010] In this specification, the terms downstream and upstream refer to in the direction of a wellhead or the surface, or a location closer thereto, and in the direction of a reservoir, or a location closer thereto, respectively.

[0011] Referring now to Fig. 1, illustrated is a diagram of a well site 10 utilizing a flexible, filtering device 34, in accordance with certain example embodiments. The well site 10 includes a system controller 12, a tool string 14, a well head 16, well casing 18, production tubing section 20, 22, perforations 24 formed in the well casing 18, a barrier valve 26, and the flexible, filtering device 34. If the barrier valve 26 is in an open position, fluid may flow from the reservoir and, if in a closed position, the reservoir can be sealed off to allow for development of the production system. In a development setting before the production tubing is set and completed, the flexible, filtering device 34 can be positioned within a section of tubing near the barrier valve 26. The flexible, filtering device 34 functions to isolate the barrier

valve 26 from debris, such as rocks, gravel, and cement that can pollute the production casing and interfere with the operation of the barrier valve 26. If this interference is not prevented, it can result in added costs and delays.

[0012] Referring now to Figs. 2A, illustrated is an isometric view of production tubing 20, barrier valve 26 with maneuverable component 32, and a flexible, filtering device 34a, in accordance with certain example embodiments. In this embodiment, the maneuverable component 32 can be mechanically manipulated to open and close to either provide access to or close off a reservoir. The flexible, filtering device 34a includes a first plurality of a set of members 35a securely fixed to the side of the tubing 20 and a second plurality of a set of members 35b fixed to an opposite side. The first plurality can be positioned on the ID of the tubing 20 stacked in an axially direction. Each set of the members 35a,b at each axial position can extend around a circumferential section of the ID of the tubing 22. The section can be about a half or little more than half the circumference of the tubing 22 or can be fully circumferential.

[0013] Referring now to Fig 2B, illustrated is an isometric view of a flexible, filtering device 34b, according to certain example embodiments. In this embodiment, the filtering device 34b is a spiral ring 42 of members 35c configured into a helical shape. The spiral ring 42 can be made of a metal, wood, plastic, elastomer, a combination of plastic and elastomer, or a combination of all. The ring 42 can be securely fixed to the side of the ID of the casing 20, or at least sections can be fixed. Referring now to Fig. 2C, illustrated is a side view of a flexible, filtering device 34c, according to certain example embodiments. In this embodiment, the members 35d, e are angled downstream from the surface of the production tubing. In essence, the center points are close to the surface along the tubing, whereas the edges are

further from the surface. The production tubing 22 includes cut out sections or flow paths 52 so that collected debris can fall into reservoir 54. Each embodiment of Fig. 2A and Fig. 2B can also include flow paths and a reservoir and the flow path and reservoir of the embodiment of Fig. 2B can be optional. The members 35a, b, c, d, and e can be bristles or fingers made of a metal, metal alloy, a plastic, elastomer, or combination of plastic and elastomer. Each set of members 35a, b, c, d, and e comprise enough bristles or fingers to scale a designated section of the ID of a tubing section. The bristle can be made of a metal, metal alloy, a plastic, elastomer, or combination of plastic and elastomer. Alternatively, the members 35a, b, c, d, and e can be a wire mesh or pierced foils or any combination thereof. Fixed or coupled as mentioned in the aforementioned embodiments, can mean by way of welding, using or an epoxy or an adhesive, or a compressive force. However, the members 35a, b, c, d, and e are also flexible to a degree. In essence, the members are characterized by having enough breaking strength to with stand a certain amount of debris, such as cement, but not too much breaking strength that would prevent a tool on a tool string from breaking through.

[0014] The aforementioned filtering devices 34a, b, and c and members 35a, b, c, d, and e can be dissolvable in response to interaction with certain chemicals. A combination of fluid flow rate and temperature can also cause the members 35a,b, c, d, and e to dissolve. In one or more embodiments, any fluid comprising a suitable chemical capable of dissolving at least a portion of the filtering devices 34a, b, c, and d can be used to dissolve the filtering device members 35a, b, c, d, and e. In an embodiment, the chemical can comprise an acid, an acid generating component, a base, a base generating component, and any combination thereof. Examples of acids that may be suitable for use in the present invention include, but are not limited to organic acids (e.g., formic acids, acetic acids, carbonic acids, citric acids, glycolic acids, lactic acids,

ethylenediaminetetraacetic acid (EDTA), hydroxyethyl ethylenediamine triacetic acid (HEDTA), and the like), inorganic acids (e.g., hydrochloric acid, hydrofluoric acid, nitric acid, sulfuric acid, phosphonic acid, p-toluenesulfonic acid, and the like), and combinations thereof. Examples of acid generating compounds may include, but are not limited to, polyamines, polyamides, polyesters, and the like that are capable of hydrolyzing or otherwise degrading to produce one or more acids in solution (e.g., a carboxylic acid, etc.). Examples of suitable bases can include, but are not limited to, sodium hydroxide, potassium carbonate, potassium hydroxide, sodium carbonate, and sodium bicarbonate. In some embodiments, additional suitable chemicals can include a chelating agent, an oxidizer, or any combination thereof. One of ordinary skill in the art with the benefit of this disclosure will recognize the suitability of the chemical used with the fluid to dissolve at least a portion of the filtering device based on the composition of the filtering device and the conditions within the wellbore. However, the filtering devices can be permanent if the device does not impede flow rate.

[0015] As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. As used herein, phrases such as “between X and Y” and “between about X and Y” should be interpreted to include X and Y. As used herein, phrases such as “between about X and Y” mean “between about X and about Y.” As used herein, phrases such as “from about X to Y” mean “from about X to about Y.”

[0016] The above-disclosed embodiments have been presented for purposes of illustration and to enable one of ordinary skill in the art to practice the disclosure, but the disclosure is not intended to be exhaustive or limited to the forms disclosed. Many insubstantial modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the disclosure. The scope of the claims is intended to broadly cover the disclosed embodiments and any such modification. Further, the following clauses represent additional embodiments of the disclosure and should be considered within the scope of the disclosure:

[0017] Clause 1, a system for isolating a portion of a downhole well, the system comprising: an isolation valve; and a filter having members configured to filter debris, the filter coupled to a downstream side of the isolation valve;

[0018] Clause 2, the system of clause 1 wherein the filter comprises: a first set of members securely positioned along a first circumferential surface of the isolation valve; and a second set of members securely positioned along a second circumferential surface of the isolation valve; wherein the first set and the second set of members extend radially;

[0019] Clause 3, the system of clause 2 wherein the members are angled in a downstream direction;

[0020] Clause 4, the system of clause 2 wherein the first set of members and the second set of members are offset axially to one another;

[0021] Clause 5, the system of clause 2 wherein the isolation valve comprises: at least one flow hole positioned near the bristles; and a debris collection chamber;

[0022] Clause 6, the system of clause 1 wherein the filter comprises a set of members helically positioned along a circumferential surface of the isolation valve;

[0023] Clause 7, the system of clause 1 wherein the filter is at least one of dissolvable, displaceable, and removable;

[0024] Clause 8, a debris barrier for isolating a portion of a downhole well, the debris barrier comprising: a filter having members configured to filter debris, the filter securely positioned within a production tubing section; wherein the production tubing section is couple-able with an isolation valve downstream of the isolation valve;

[0025] Clause 9, the debris barrier of clause 8 wherein the filter comprises; a first set of members securely positioned along a first circumferential surface of the production tubing section; and a second set of members securely positioned along a second circumferential surface of the production tubing section; wherein the first set and the second set of members extend radially;

[0026] Clause 10, the debris barrier of clause 9 wherein the members are angled in a downstream direction;

[0027] Clause 11, the debris barrier of clause 9 wherein the first set of members and the second set of members are offset axially to one another;

[0028] Clause 12, the debris barrier of clause 9 wherein the production tubing section comprises: at least one flow hole positioned near the bristles; and a debris collection chamber;

[0029] Clause 13, the debris barrier of clause 8 wherein the filter comprises a set of members helically positioned along a circumferential surface of the production tubing section;

[0030] Clause 14, the debris barrier of clause 8 wherein the filter is at least one of dissolvable, displaceable, and removable;

[0031] Clause 15, a method for isolating a portion of a downhole well, the method comprising: positioning a filter within a production tubing section of the downhole well environment; wherein the production tubing section is coupled with an isolation valve downstream of the isolation valve;

[0032] Clause 16, the method of clause 15 wherein the filter comprises: a first set of members securely positioned along a first circumferential surface of the production tubing section; and a second set of members securely positioned along a second circumferential surface of the production tubing section; wherein the first set and the second set of members extend radially;

[0033] Clause 17, the method of clause 16 wherein the members are angled in a downstream direction;

[0034] Clause 18, the method of clause 16 wherein the production tubing section comprises: at least one flow hole positioned near the bristles; and a debris collection chamber;

[0035] Clause 19, the method of clause 15 wherein the filter comprises a set of members helically positioned along a circumferential surface of the production tubing section; and

[0036] Clause 20, the method of clause 15 wherein the filter is at least one of dissolvable, displaceable, and removable.