PROCESSES FOR INCREASING HYDROCARBON PRODUCTION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Continuation-in-Part Application no. 17/220,470 filed on April 1, 2021. This application also related to continuation-in-part of pending U.S. Application Number 17/034,849 filed September 28, 2020 which application is a continuation of 16/780,089 filed February 3, 2020 which issued as U.S. Patent No. 10,822,933 which application was a continuation of 16/282,831 filed February 22, 2019 which issued as U.S. Patent No. 10,584,566 which application claimed priority from provisional application number 62/634,423 filed February 23, 2018. All of the aforementioned applications are incorporated herein by reference.

FIELD OF THE DISCLOSURE

[0002] The present disclosure relates to systems and methods for increasing hydrocarbon production by, for example, inducing gas lift.

BACKGROUND AND SUMMARY

[0003] Hydrocarbon production from, for example, an oil and gas well, may often consume a large amount of energy and be limited in efficiency due to equipment limitations and/or other constraints. The present application is directed to processes and systems to improve the amount of energy, e.g., reduce the power required, and/or increase the production of a given well.

[0004] In one embodiment the application is directed a process for increasing hydrocarbon production using an electrical submersible pump. The process comprises configuring an electrical submersible pump comprising a gas separator to induce a gas lift effect in a well. The well comprises a central tubing within a casing such that an annulus is formed between the central tubing and the casing. Hydrocarbons may be produced from the well with the electrical submersible pump such that reservoir fluid is produced up the central tubing and a mixture

comprising reservoir gas and reservoir fluid is produced up the annulus. The configuring step comprises suspending the electrical submersible pump from the central tubing such that velocity of a gas separated by the gas separator is above a critical velocity of reservoir fluid.

[0005] In another embodiment the application is directed to a system for increasing hydrocarbon production using an electrical submersible pump. The system comprises a well with at least a central tubing within a casing. The central tubing comprises a fluid exit opening near a surface of the well and a fluid entrance opening downhole. An electrical submersible pump may be suspended from the fluid entrance opening of the central tubing. The electrical submersible pump comprises a pump operably connected to the fluid entrance opening of the central tubing, a gas separator operably connected to the pump, and a motor operably connected to the gas separator. The system is configured to produce reservoir fluid up the central tubing and to produce a mixture comprising reservoir fluid and reservoir gas up an annulus between the central tubing and the casing. The system is also configured to induce a gas lift effect in the absence of injecting gas into the well from the surface. The system is also configured such that velocity of a gas separated by the gas separator is above a critical velocity of reservoir fluid.

[0006] These and other objects, features and advantages of the exemplary embodiments of the present disclosure will become apparent upon reading the following detailed description of the exemplary embodiments of the present disclosure, when taken in conjunction with the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Various embodiments of the present disclosure, together with further objects and advantages, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

[0008] FIG. 1A depicts an ESP installation using an annulus between the central tubing and casing as a second fluid production flow path.

WE CLAIM:

1. A process for increasing hydrocarbon production using an electrical submersible pump comprising:

configuring an electrical submersible pump comprising a gas separator to induce a gas lift effect in a well wherein the well comprises a central tubing within a casing such that an annulus is formed between the central tubing and the casing; and

producing hydrocarbons from the well with the electrical submersible pump such that reservoir fluid is produced up the central tubing and a mixture comprising reservoir gas and reservoir fluid is produced up the annulus,

wherein the configuring step comprises suspending the electrical submersible pump from the central tubing such that velocity of a gas separated by the gas separator is above a critical velocity of reservoir fluid.

2. The process of claim 1 wherein the gas lift effect is induced in the absence of injecting gas into the well from the surface.

3. The process of claim 1 wherein the configuring step comprises suspending the electrical submersible pump from the central tubing such that the central tubing within the casing comprises a clearance which is less than about 30% of the casing diameter uphole from the electrical submersible pump.

4. The process of claim 1 wherein the configuring step comprises suspending the electrical submersible pump from the central tubing such that the central tubing within the casing comprises a clearance which is less than about 20% of the casing diameter uphole from the electrical submersible pump.

5. The process of claim 1 wherein the configuring step comprises suspending the electrical submersible pump from the central tubing and employing one or more additional tubing strings into the annulus that extend at least from a surface into the well and terminate uphole from the electrical submersible pump wherein the sum of diameters of the central tubing and the one or more additional tubing strings is less than about 30% of the casing diameter uphole from the electrical submersible pump.

6. The process of claim 5 wherein the mixture comprising reservoir gas and reservoir fluid is produced up the annulus wherein at least a portion of the mixture comprising reservoir gas and reservoir fluid produced up the annulus passes through the one or more additional tubing strings.

7. The process of claim 5 wherein the one or more additional tubing strings comprise a smaller diameter than the central tubing.

8. The process of claim 1 wherein the separation efficiency of the gas separator is from about 60 to about 100%.

9. The process of claim 1 wherein the electrical submersible pump has an intake pressure below the bubble point of the reservoir.

10. The process of claim 1 wherein the hydrocarbons produced from the well are 5% to 20% more than hydrocarbons produced by a comparable process without the configuring step.

11. The process of claim 1 wherein the hydrocarbons produced from the well are about the same as or more than hydrocarbons produced by a comparable process without the configuring step, wherein the comparable process uses 6% to 29% more horsepower over the time of a given electrical submersible pump (ESP) run.

12. The process of claim 1 wherein the hydrocarbons produced from the well are 5% to 20% more than hydrocarbons produced by a comparable process without the configuring step, and wherein the hydrocarbons produced from the well are about the same as or more than hydrocarbons produced by the comparable process, wherein the comparable process uses 6% to 29% more horsepower over the time of a given electrical submersible pump (ESP) run.

13. A system for increasing hydrocarbon production using an electrical submersible pump comprising:

a well comprising a central tubing within a casing wherein the central tubing comprises a fluid exit opening near a surface of the well and a fluid entrance opening downhole;

an electrical submersible pump suspended from the fluid entrance opening of the central tubing;

wherein the electrical submersible pump comprises a pump operably connected to the fluid entrance opening of the central tubing, a gas separator operably connected to the pump, and a motor operably connected to the gas separator;

wherein the system is configured to produce reservoir fluid up the central tubing and to produce a mixture comprising reservoir fluid and reservoir gas up an annulus between the central tubing and the casing;

wherein the system is configured to induce a gas lift effect in the absence of injecting gas into the well from the surface; and

wherein the system is configured such that velocity of a gas separated by the gas separator is above a critical velocity of reservoir fluid.

14. The system of claim 13 which further comprises: one or more tubing strings uphole from the electrical submersible pump wherein the one or more tubing strings are in the annulus between the casing and the central tubing wherein the one or more tubing strings are configured to produce a mixture comprising reservoir fluid and reservoir gas up the annulus through the one or more tubing strings.

15. The system of claim 14 wherein the one or more tubing strings are smaller in cross-section than the central tubing.

16. The system of claim 13 wherein the central tubing within the casing comprises a clearance which is less than about 30% of the casing diameter uphole from the electrical submersible pump.

17. The process of claim 1 wherein critical velocity of reservoir fluid varies depending upon cross-sectional flow area, or wellhead pressure.

18. The system of claim 13 wherein critical velocity of reservoir fluid varies depending upon cross-sectional flow area, or wellhead pressure.