

completions, such as long horizontal completions having numerous production intervals, it may be desirable to independently control the inflow of production fluids into each of the production intervals. Further, in some completions, it would be desirable to adjust the flow control characteristics of the flow control sections without the requirement for well intervention.

[0006] Accordingly, a need has arisen for a flow control screen that is operable to control the inflow of formation fluids in a completion requiring sand control. A need has also arisen for flow control screens that are operable to independently control the inflow of production fluids from multiple production intervals. Further, a need has arisen for such flow control screens that are operable to control the inflow of production fluids without the requirement for well intervention as the composition of the fluids produced into specific intervals changes over time.

SUMMARY

[0006a] According to a first aspect of the present invention, there is provided a downhole fluid flow control system comprising: a flow control assembly having a fluid flow path for a flowing fluid; a first flow control component disposed in the fluid flow path having a positive flowrate response to decreasing fluid viscosity; a second flow control component disposed in the fluid flow path in parallel with the first flow control component having a negative flowrate response to decreasing fluid viscosity; and a valve disposed in the fluid flow path in series with and downstream of the first and second flow control components, the valve having a first inlet path for fluid from the first flow control component and a second inlet path for fluid from the second flow control component, wherein, decreasing the fluid viscosity of the flowing fluid increases a ratio of the flowrate through the first control component to the flowrate through the second flow control component; and wherein, when the ratio reaches a predetermined level, the valve autonomously shifts from an open position to a closed position.

[0006b] According to a second aspect of the present invention, there is provided a flow control screen comprising: a base pipe with an internal passageway; a filter medium positioned around the base pipe; a housing positioned around the base pipe defining a fluid passageway between the filter medium and the internal passageway; a flow control assembly positioned in the fluid passageway, the flow control assembly having a fluid flow path for a flowing fluid; a first flow control component disposed in the fluid flow path having a positive flowrate response to decreasing fluid viscosity; a second flow control component disposed in

the fluid flow path in parallel with the first flow control component having a negative flowrate response to decreasing fluid viscosity; and a valve disposed in the fluid flow path in series with and downstream of the first and second flow control components, the valve having a first inlet path for fluid from the first flow control component and a second inlet path for fluid from the second flow control component, wherein, decreasing the fluid viscosity of the flowing fluid increases a ratio of the flowrate through the first control component to the flowrate through the second flow control component; and wherein, when the ratio reaches a predetermined level, the valve autonomously shifts from an open position to a closed position.

[0006c] According to a third aspect of the present invention, there is provided a downhole fluid flow control method comprising: positioning a fluid flow control system at a target location downhole, the fluid flow control system including a flow control assembly having a fluid flow path for a flowing fluid, first and second flow control components disposed in parallel in the fluid flow path, the first flow control component having a positive flowrate response to decreasing fluid viscosity and the second flow control component having a negative flowrate response to decreasing fluid viscosity and a valve disposed in the fluid flow path in series with and downstream of the first and second flow control components, the valve having first and second inlet paths for fluid from the first and second flow control components, respectively; flowing fluid through the fluid flow path of the flow control assembly through the first and second flow control components and the valve; decreasing the fluid viscosity of the flowing fluid; increasing a ratio of the flowrate through the first control component to the flowrate through the second flow control component; reaching a predetermined ratio of the flowrates; and autonomously shifting the valve from an open position to a closed position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] 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:

[0008] Figure 1 is a schematic illustration of a well system operating a plurality of flow control screens according to an embodiment of the present disclosure;

[0009] Figures 2A-2B are quarter sectional views of successive axial sections of a downhole fluid flow control system embodied in a flow control screen according to an embodiment of the present disclosure;

[0010] Figure 3 is a top view of a downhole fluid flow control system according to an embodiment of the present disclosure;

[0011] Figures 4A-4C are schematic illustration of various embodiments of flow control components having positive flowrate response to decreasing fluid viscosity for use in a downhole fluid flow control system according to an embodiment of the present disclosure;

[0012] Figures 5A-5C are schematic illustration of various embodiments of flow control components having negative flowrate response to decreasing fluid viscosity for use in a downhole fluid flow control system according to an embodiment of the present disclosure;

[0013] Figures 6A-6B are cross sectional views of an autonomous closure mechanism for use in a downhole fluid flow control system according to an embodiment of the present disclosure in its open and closed configurations, respectively; and