Jason: Hello. I’m Jason your host for Halliburton’s RedTech podcasts, part of the technology learning series featured on www-dot-halliburton-dot-com-slash-redtech. This series of podcasts has been designed to highlight particularly significant products that Halliburton has recently brought to market. These technologies represent innovations that deliver reliability by simplifying complex completions, optimizing hydrocarbon recovery or economically optimizing production.

Jason: Joining us today is Randy. He is Halliburton’s product manager for sand control screens. Hi, Randy!

Randy: Hi Jason.
Sand Control / Sand Management

Problems Caused by Sand:
• Plugs perforation tunnels
• Screen erosion
• Erodes downhole and surface equipment
• Accumulates in surface equipment

Solutions:
• Packing material consisting of gravel or material coated with epoxy or resin
• Halliburton’s sand control products

Shale failure can cause massive plugging.

Halliburton’s N-Flow™ breaker permeates gravel pack, then releases acid for cleanup.

Jason: Randy, what are some of the challenges that Halliburton’s sand screen technology overcomes?
Randy: Well Jason, in many parts of the world, uncased or openhole well bores in loosely arranged sandstone reservoirs – we call those unconsolidated formations – produce sand along with the reservoir fluids. If not controlled, these sands can plug perforation tunnels, erode screen, accumulate in surface equipment, and possibly erode the downhole and surface equipment.

Jason: Those are all issues that affect both safety and the long-term productive life of the well. So, what can be done about unwanted sand?
Randy: There are a variety of solutions including packing material consisting of gravel or material coated with epoxy or resin. You know, essentially gluing the packing material together in a manner that still allows hydrocarbon to pass through while keeping the sand from entering the wellbore.
Jason: Yet, isn’t the most widely used sand control solution the installation of one or more sand control screens during well completion?

Randy: Absolutely. Sand screens are devices that filter or “screen” the flow of hydrocarbons as they enter the wellbore, allowing the oil or gas to easily pass into the production tubulars while denying the sand to access the production string. Today’s sand screens are very advanced and have gone through quite a technical evolution including the development of screens to address specific sand-control tasks unique to each well.
Inflow Control Technology

Benefits:

- Helps reduce water and gas production association with
  - Heel-toe effects
  - Breakthrough of water/gas
  - Permeability differences
  - High oil viscosity wells
- Helps increase productivity and recovery
- Delays water and gas breakthrough

Jason: I understand that certain well completions benefit from having a flow control device in the well.
Randy: Yes, flow control devices are useful especially in balancing production from horizontal intervals and for preventing water production.
Jason: Now, water coning is a phenomenon that can greatly reduce or completely displace the produced oil, leaving the company man with only produced water.
Randy: (ha) Yes, that’s right. It is completely undesirable. At high production rates, water propagates upwards until the oil–water interface reaches the well. At this stage, the well begins to produce water and oil simultaneously, leading to reduced production of oil.
Inflow Control Devices (ICD)

- Horizontal wells enables greater contact with the production layer
- Higher production than vertical wells with lower drawdown
- Frictional forces in the tubular can be significant
  - Early water and/or gas breakthrough in the heel

**Without ICD**

**With ICD**

**Time**

**Heel**

**Toe**

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**Jason:** Another challenge Halliburton is addressing is the uneven inflow from the reservoir resulting in highly productive sections of the well producing more than others.

**Randy:** A situation like that can eventually lead to water or gas breakthrough which, again, reduces the well’s recovery. By utilizing an ICD – you know, an inflow control device – as part of the completion string, production from the high productivity sections is managed to a reduced rate and the low productivity sections are “stimulated”. The ICD includes a filter medium and inflow ports and thus results in a better sweep efficiency and lower overall water or gas production. The filter material of the screen is sized to allow fluid to pass, yet prevent sand particles from passing through.

**Jason:** So, ICDs help delay the unwanted water or gas production by equalizing the pressure drop and flow rate along horizontal and deviated openhole wells.

**Randy:** That’s correct. But, they can also be used for remediation in cased holes – going back in to correct or remedy the situation.
Jason: Randy, let me give our listeners a little background. Recently, Halliburton introduced several new innovative sand control screen and inflow control technology solutions to improve the capabilities and economics of the completions. These new technologies include the EquiFlow™ inflow control device, EquiFlow™ Oil Selector™ valve and PetroGuard™ screen. Will you tell us something about each one?

Randy: Sure. The EquiFlow™ inflow control device (ICD) is designed to improve completion performance and efficiency by balancing inflow throughout the length of the completion. Typical applications include wells experiencing breakthrough of water/gas, permeability differences, water challenges in highly viscous oil reservoirs, Jason: So, in wells with inconsistent permeability or high-viscosity oil … ?

Randy: The EquiFlow ICD helps delay water or gas breakthrough and better equalize the inflow from the reservoirs, managing the velocity of highly productive zone while stimulating low productivity zone. The EquiFlow ICD also addresses the flow distribution challenges from “heel-toe” effects in horizontal wells where the "heel" is the beginning of the horizontal wellbore and the "toe" is the end of the horizontal wellbore.
In unconsolidated sands, the EquiFlow ICD is placed at the end of screen.

1. Production through screen
2. Into inlet tube
3. Across tube chamber
4. Into outlet tube
5. Into base pipe to surface

Jason: And what this means for operators is they increase productivity and the long-term reservoir recovery – in other words, they are not leaving valuable reserves in the ground. Tell us about some unique innovations in the EquiFlow ICD that enable these achievements.

Randy: The EquiFlow ICD consists of an annular chamber on a standard oilfield tubular. If a screen is required, the reservoir fluid is produced from the formation through the sand screen and into the flow chamber. The flow continues through a set of tubes which creates a pressure drop, and then proceeds into the pipe through a set of ports. Tube length and inside diameter are designed to produce the differential pressure needed for optimum completion efficiency. It requires no control lines and no specialist installation time. Simulations run prior to installation determine optimum configuration.
Jason: Now, Halliburton has another technology in the EquiFlow family developed for reservoir challenges such as undesirable water or gas coning, highly permeable intervals or natural fractures.

Randy: Yes, the EquiFlow Oil Selector valve is an autonomous valve that automatically reduces water or gas production.
**EquiFlow™ Oil Selector™ Valve**

**Flow Chambers:**
- Active chamber
  - Containing floatation balls
- Bypass chamber
  - Containing the bypass nozzles to balance the system

_Jason:_ As I understand it, the particularly innovative aspect of this valve is based on the principle of buoyancy and takes advantage of the varying densities of the produced fluids to control inflows.

_Randy:_ The EquiFlow Oil Selector valve is an autonomous and gradual inflow control system and yes, it employs the simple principle of buoyancy. In operation, reservoir fluid is produced from the formation through the screen and into a flow chamber where the fluids are separated by gravity through one of the two sets of nozzles. After separation, the fluids proceed into the screen base pipe. The flow chamber where the fluids are separated consists of two areas: 1) an active chamber containing floatation balls and a set of active nozzles, and 2) a bypass chamber which contains the bypass nozzles required to balance the system.
Jason: And so the valve can be configured to restrict either water or gas with the difference being in relation to the ball densities then?

Randy: Correct. If the valve has been configured to restrict water, the floatation balls, which will float in water but not oil, will float to seal off the production nozzles if water is present. Likewise, if the valve has been configured to restrict gas, floatation balls with a density less than oil are installed in the chamber. If gas is produced, the balls will sink and close the production nozzles. Each valve is an independent system and doesn’t require connection to the surface.
Solutions:

• Superior oilfield filtration technology
• Provides the highest solids retention and plugging resistance possible
• Development testing confirmed better performance when compared with wire-wrapped screens and other premium metal mesh screens

Jason: Another new sand screen control solution introduced by Halliburton was developed to improve on the short comings of current stand alone screen – and these inadequacies show up particularly in unconsolidated sands and heavy oil simply because they have a tendency to plug up in reservoirs with high fines content.

Randy: Yes. We have designed a system with multi-layered construction for superior oilfield filtration technology. Our PetroGuard™ Advanced Mesh screen is designed to provide the highest solids retention and plugging resistance possible. In fact, our development testing has confirmed that the more poorly sorted the sand, the better the relative performance of the screen when compared with wire-wrapped screen and other premium metal mesh screen products.
Jason: That is quite a breakthrough!
Randy: It is nothing short of that. Unlike older depth filtration technology, our PetroGuard Advanced mesh screen is formed from a series of surface filter layers. Using graduated filtration layers, the screen filters progressively smaller particles from the production stream as flow moves toward the base pipe. This allows the final filtration layer to be challenged by fewer solid particles. Each screen is designed specifically for a project's unique sand sample resulting in a custom-designed sand screen—a significant improvement over traditional screen sizing methods. This means precise pore size control and no tortuous flow paths. This also enables the screen to be cleaned by backflushing.
Jason: Is it fair to say that the PetroGuard Advanced Mesh screen technology allows operators to use bare screen sand control techniques in completions where typically a pumped sand control solution is required?
Randy: Absolutely. Conceived for fines-prone heavy oil reservoirs, operators benefit from this new sand screen technology for standalone screen type completions and in gravel-pack completion.
**Jason:** Randy, thank you for allowing us to phone you today. Is there anything else you would like for us to know about these innovative technologies that increase well safety and productivity by preventing the migration of formation sands from the reservoir into the wellbore?

**Randy:** Well, as a summary Jason, Halliburton has developed three technologies that greatly improve the performance and economics of complex sand control completions by resolving issues with sand production and inflow control. The new sand control screen and inflow control solutions are the EquiFlow™ inflow control device, the EquiFlow™ Oil Selector™ valve and the PetroGuard™ Advanced Mesh screen. By increasing long-term production and on-going well safety, these screens can provide operators with a significant drop in cost per barrel produced – and that is simply better, business – bottom line.
Jason: Again, thank you Randy. To our listeners, thank you for joining us today. For additional learning materials, please visit our RedTech Learning Series at www-dot-halliburton-dot-com-slash-redtech. We will continue to add podcasts and papers to the RedTech Learning Series site.