Rashid Shaibu  
IVC/ICD/AICD...any difference amongst them  
ICV: inflow control valve that can be regulated at the surface. The most typical one is a sliding sleeve valve. ICD: inflow control device working on creating frictional pressure drop to reduce flow rate (see presentation). AICD: autonomous inflow control device working on viscosity difference of the fluids (see the presentation).

Ali Gul  
How much PERM is important in SAGD Reservoirs where we have average PERM is 5D?  
Permeability is very important parameter in ICD design, especially when the perm is high. For relative homogeneous reservoir, avoid to drill the well too long so you will not have production problem. For heterogeneous reservoir, understanding the perm distribution and adding ICDs along the well will help to optimize production/injection.

Rashid Shaibu  
What is the cost of installing ICD? if the installing it will not increase oil production to offset its cost of installation then I think it’s not worth it. Maybe its cost can be compared to conventional work over techniques  
In general the cost depends on the design and service companies. ICD is relatively cheap and simple (no moving parts downhole) compared with other completion hardware. Because of the simplicity the hardware has limited function on production control and optimization.

Nithin John  
Why did use of ICD reduce oil production in heterogeneous formations?  
It does reduce the oil production when installed at wrong place. Notice that ICD only add additional pressure drop to the completion string, which will reduce flow rate in general no matter it is oil or water. So if installed at the location that does not produce water, but produce oil, then it add restriction to oil flow rate.

Raj Rajan  
A horizontal well is in practice neither horizontal nor straight - more wavy depending on the formation. Then, one wonders about the reliability of the reservoir permeability information - the above concern is more in unconsolidated formations  
Good point. The ICD design for reservoir heterogeneity problem depends on the understanding of permeability distribution, which is one of the hardest information to obtain when design completion. The presentation tried to point out...
that evenly distribute ICD is not a good idea to improve well performance. One needs to understand the reservoir for ICD design.

Ruslan AKHMADIEV

Could you please advise on the kind of ICD that shows better performance in terms of reliability and production optimization (nozzle type, channel type, orifice type)? And area of application of each type. Thank you.

The original ICD is channel type, it restricts higher viscosity fluid more than lower viscosity fluid. So if oil has higher viscosity than water or if gas is the problem, channel ICD does not work well. That is why people are using AICD today for heavy oil reservoirs, which is on purposely restricting low viscosity fluid. If oil viscosity is close to water viscosity or lower, channel type would be OK.

Nithin John

Which is the most effective or most used type of ICD? Is it Channel Type, Nozzle, Orifice or Fiber?

As mentioned before, the original one is the channel one. My limited personal information would be nozzle and orifice are more applied today because of the viscosity issue.

Abdusamed Artan

Can use dry gas injection wells?

It depends on the problem involved. If the wellbore pressure distribution in the injector is a problem, then ICD can be installed on the injector. If the reservoir heterogeneity is the problem, then distributing flow over the injector does not help to solve the problem effectively. Once the fluid gets into the formation, it will pick the high perm channel and short-cut to the producer. In such a case, ICD should be placed on the producer.

Adrian Slayter

Has there been any testing to assess if ICD provide secondary sand control in case of the sand screen failing?

No as I know for channel, nozzle or orifice ICDs. Because when sand control fail, the first place the completion gets stuck with sand would be the ICDs because of the flow restriction. For fiber ICD, it does provide additional sand control.

Rashid Shaibu

how is the performance of ICD's in oil wet and water wet reservoirs

The hardware controls the flow at the wellbore, it does not alter the reservoir properties and I cannot see how ICD can affect or be affected by wettability of the reservoir.

Nithin John

Is there a particular reason that ICDs are not effective in low permeability zones?

Because the device is designed based on frictional pressure drop, high rate creates high pressure drop. This is not a linear relationship. When the perm is low, the rate is low, than the additional pressure drop is low or may not be significant to change the flow distribution.
Some ICD's are described as "Reynolds number" controlled, so they also have a rate-dependence. How does that rate dependence influence the model results? All ICD should be rate depends, with channel type more sensitive than other types. If look at the equations for ICD design provided by manufactures, it all have q or \( q^2 \) in the equation. The higher the velocity (flow rate) the higher the pressure drop. That is how an ICD “tells” when to acting on flow. Instead of using velocity, many also use Reynolds number to describe flow rate and viscosity.

Please which boundary condition it is better to use to control the well in case of ICD design study ... BHP, ORAT?
Since this is more for a longer term production problems, is will depends on the strategy of production. It is not so much a transient problem. Drive mechanism (water flooding, gas injection, natural depletion and so on) determines the boundary condition. In general pressure constrain is more common that rate constrain.

If there are field cases of ICD in cased hole completions?
No as I know.

can be modelled analytically? How?
Simple description as 1. Divide the horizontal well into several sections, 2. on each section use an inflow equation (Babu and Odel equation for example) to calculate flow rate, 3 use the flow rate to calculate additional pressure drop using the ICD equations provided by the manufacturers, and 4 use the skin equation (Hawkin’s approach) to convert the pressure drop to a skin factor and add this skin factor to the completion skin factor.
We understand that production from a low permeability reservoir like shale oil/gas is made possible only after being fractured. Is ICD/AICD applicable in this case - I mean after fracturing? I would not recommend it. For low-perm formation, flow is limited and that is the reason we fracture the well. We would not want to fracture the well to create flow path and then go in to restrict flow from it. Principle speaking, that is a wrong idea.