

The Management of Process & Produced Water

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The Management of Process & Produced Water

- Presentation overview;
 - An overview of methods and technologies used for the treatment, disposal and reinjection of produced and associated process waters and for the control of excess produced water

The Management of Process & Produced Water

- Treatment of process & produced water
 - Typically uses a combination of mechanical and chemical treatment methods
 - Required to meet either environmental and/or reservoir integrity requirements

- Control of excess produced water
 - The use of mechanical or chemical methods to reduce the amount of water produced
 - Reduces the amounts of water requiring mechanical/chemical treatment, but mechanical/chemical treatment still required

The Management of Process & Produced Water

- Treatment strategies for produced and process water
 - Mechanical
 - Chemical & Mechanical

- Control strategies for excess produced water
 - Mechanical
 - Cementing
 - Gels/Gelants
 - RPMs

Treatment Strategies for Produced & Process Water



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Treatment Strategies for Produced and Process Water

- Treatment strategy will depend on whether the water is for disposal or reinjection
 - Treatment strategy will also depend on method of disposal
- Disposal
 - Environmental requirements for disposal
 - Various standards
 - Typically 40ppm max or less



The Management of Process & Produced Water

- Reinjection
 - Increasing levels of environmental legislation
 - Increasing trend for reinjection
 - Injection into disposal zones
 - Reinjection as part of a reservoir pressure maintenance program
 - Threat to reservoir integrity
 - » Oil/solids blocking
 - » Bacterial contamination
 - » Scale formation
 - Potential additional Capex required
 - Drilling of injection/disposal wells
 - Injection pumps

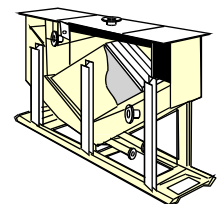
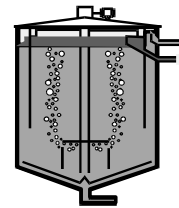
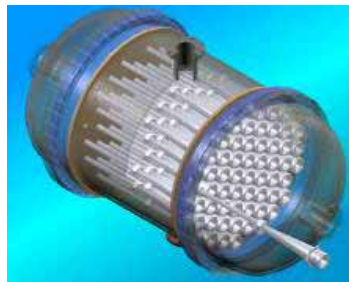


Treatment Strategies for Produced and Process Water

- Mechanical Treatment

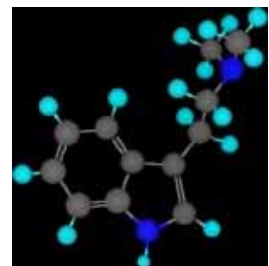
- Various equipment packages utilised
- Typically used in conjunction with a chemical treatment program

- Flotation cells
 - Dispersed gas
 - Induced air
- Hydrocyclones
- Skim Tanks
- TPIs/CPIs
- API/Skim pits



Treatment Strategies for Produced and Process Water

- Chemical Treatment
 - Typically used in conjunction with mechanical methods
 - Oil & solids removal
 - Water clarifiers and flocculants (deoilers)
 - Bacteria control
 - Traditional biocides
 - Calcium nitrate
 - Scale control
 - Scale inhibitors
 - Scale removers
 - Corrosion control
 - Oxygen removal



Control Strategies for Excess Produced Water



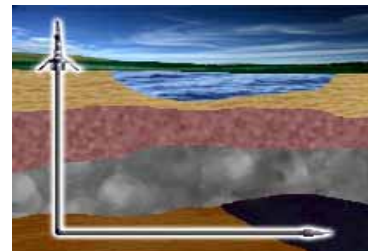
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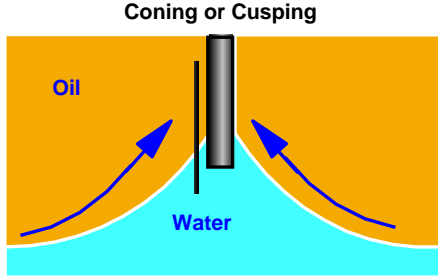
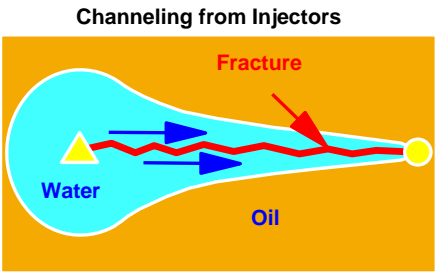
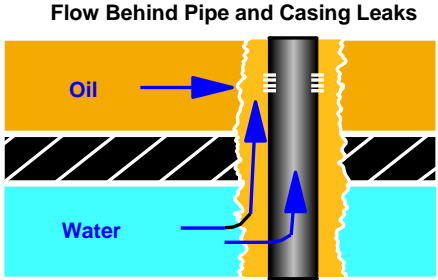
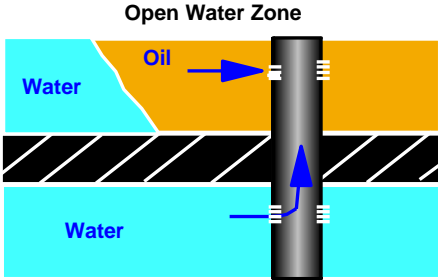
Control Strategies for Excess Produced Water

- Mechanical
 - Bridge plugs
 - Packers
 - Straddle assemblies
 - Intelligent well completions
- Physical/chemical
 - Cement
 - Sand
 - Gels/gelants
 - Relative Permeability Modifiers (RPMs)
- Horizontal drilling



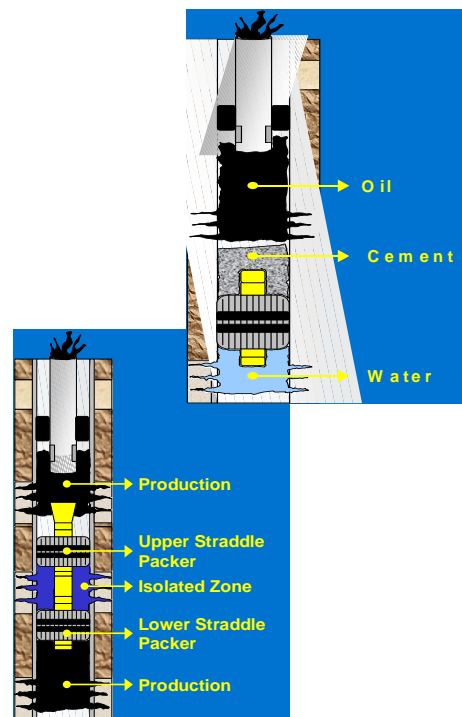
Control Strategies for Excess Produced Water

- Causes of excess water production



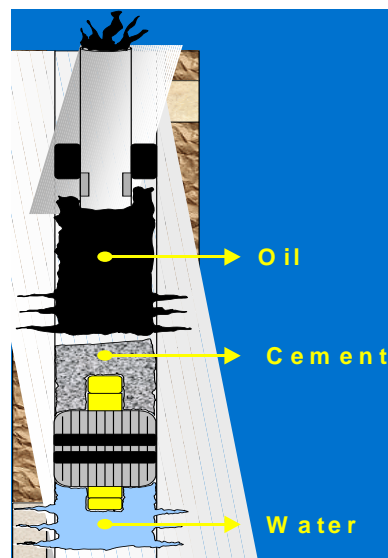
Control Strategies for Excess Produced Water

- Mechanical control
 - Bridge Plugs
 - Permanent bridge plugs
 - » Drillable
 - » Inflatable
 - Retrievable bridge plugs
 - » Inflatable
 - Packers
 - Permanent
 - Retrievable
 - Straddle assemblies



Control Strategies for Excess Produced Water

- Lower zone water shut-off utilizing an inflatable permanent bridge plug
 - Through tubing application

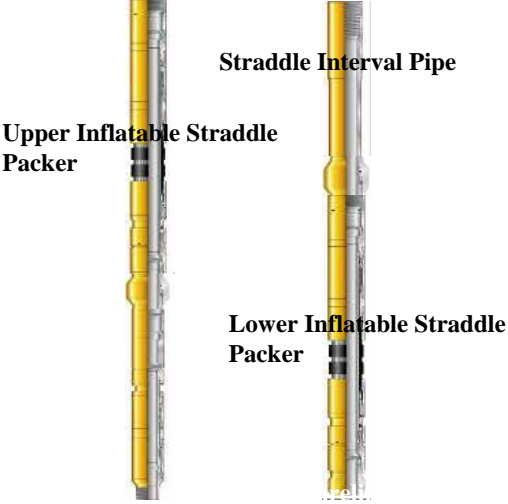
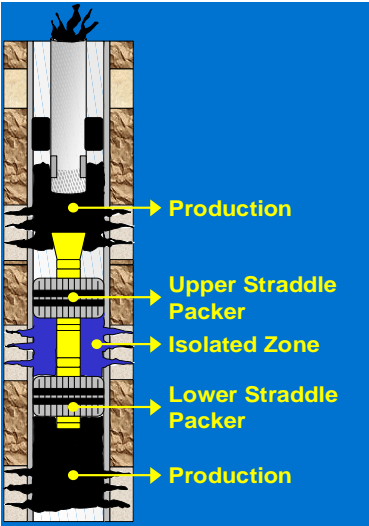


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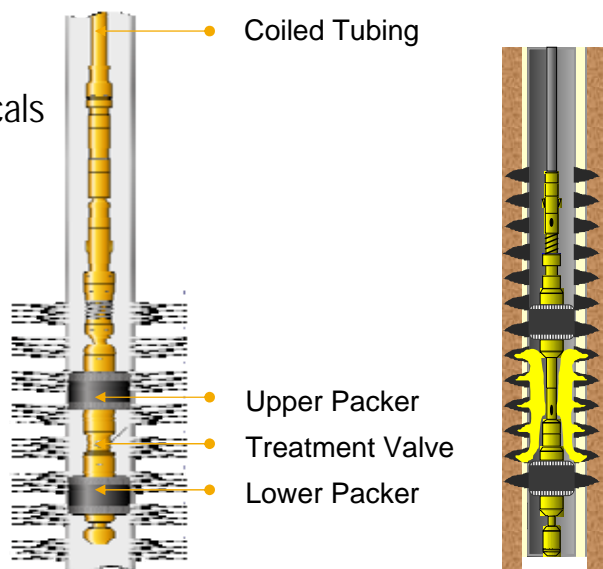
Control Strategies for Excess Produced Water

- Intermediate zonal isolation utilizing inflatable straddle system
 - Through tubing application



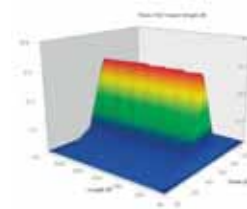
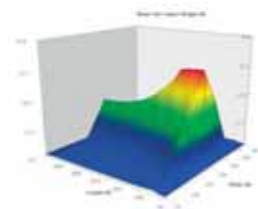
Control Strategies for Excess Produced Water

- Through tubing inflatable straddle acidising packer (ISAP) system
 - Potential use of polymers/chemicals for water control management



Control Strategies for Excess Produced Water

- EQUALIZER™ production management system
 - An innovative reservoir depletion system that is designed to delay water or gas coning in long, high-rate horizontal wells.
 - The system balances, or equalizes, longitudinal inflow along the entire length of the wellbore to ensure a uniform production profile.
 - An inflow control device (ICD) uses a helical channel as a restrictive element to impose a pressure distribution from the formation to the basepipe and control the local production rate at any point along the wellbore.



Control Strategies for Excess Produced Water

- Intelligent well completions
 - Multiple choke sizes can be achieved from surface without intervention
 - Allows isolation or reduction of production from a selected zone without intervention



Control Strategies for Excess Produced Water

- Physical/chemical
 - Cementing versus gels/gelants
 - Cementing best utilised for;
 - Relatively large casing leaks
 - Flow behind pipe (not narrow or micro annuli)
 - Gels/gelants best utilised for;
 - Pin hole casing leaks
 - Flow behind pipe involving narrow channels or micro annuli
 - Water channelling through fractures and faults

Reference: SPE70067 – A Strategy for Attacking Excess Water Production – R. S. Seright, R. H. Lane, R. D. Sydansk

Control Strategies for Excess Produced Water

- Gels

- Applicable for all mineralogies and lithologies

- Low molecular weight gels

- Near wellbore applications;

- » Chemical liner for open hole completions
 - » Zone abandonments
 - » Behind pipe channels
 - » Casing leak repairs
 - » Zone shut-off during drilling operations



- High molecular weight gels

- Far wellbore and fracture applications

- » Improving sweep of injection wells in naturally fractured or vuggy reservoirs
 - » Reducing water production in producing wells in naturally fractured or vuggy reservoirs

Control Strategies for Excess Produced Water

- Physical/Chemical

- Gels

- Mixed molecular weight gel treatments

- Applications;

- » High temperature, high strength 'cap' at the end of high molecular weight treatments
 - » Usage up to 120°C (250°F+)
 - » Zone shut-off during drilling operations
 - » Water shut-off in shales



Control Strategies for Excess Produced Water

- Relative Permeability Modifiers (RPMs)
 - Typically applied via squeeze treatments
 - Designed to block water production due to radial coning or cusping
 - Some successes
 - Applications appear to be reservoir specific
 - » Not one chemical treats all



Muchas Gracias

Muito Obrigado

Many Thanks



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