

# Produced Water

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Tom Tschanz, Senior Consultant  
Robert W. McIlvaine, President  
McIlvaine Company  
Northfield, IL USA  
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# What is produced water?

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- ❑ Produced water is water that is trapped underground and brought to the surface during oil & gas production.
- ❑ Constituents of produced water include:
  - Suspended solids (sand, silt, clay), and oils
  - Dissolved salts
  - Scale from precipitated dissolved solids
  - Bacterial contamination
  - Organic and inorganic compounds
  - Corrosive dissolved gases including  $\text{CO}_2$ ,  $\text{H}_2\text{S}$ , and  $\text{O}_2$
  - Naturally occurring radioactive material, e.g., radium



# Generation of produced water

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- ❑ Produced water is by far the largest byproduct of oil & gas production
- ❑ The US generates more than 18-billion barrels of produced water per year
- ❑ The world generates more than 77-billion barrels of produced water each year
- ❑ The water-to-oil ratio increases over the life of a conventional oil or gas well
- ❑ The US averages 7 barrels of water/barrel of oil vs. 3 barrels elsewhere in the world



# Managing produced water

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- Minimization
  - Mechanical or chemical blocking of return water
  - Down hole oil/water separators
- Reuse and re-cycle
  - Underground re-injection for well enhancement
  - Irrigation
  - Livestock and habitat watering
  - Industrial utilization (vehicle washing, dust control, power plant makeup water, fire control, etc)
- Disposal (discharge to environment)
  - Most off-shore produced water is discharged
  - Most on-shore produced water is re-cycled



# Treatment of produced water

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## **From Siemens website**

**“Clean water is important to the oil and gas industry, especially when it comes to cleaning oily produced water before reinjection or discharge to the environment.**

Produced water treatment for water injection or reinjection improves the recoverable reserves from a reservoir by establishing an external water drive and by maintaining reservoir pressure. This process can often double the recoverable reserves. To achieve this level of production performance, special attention must be given to the injection water quality. The injection water must be devoid of oxygen that will cause corrosion of the injection well piping, and particles that will cause plugging of the reservoir.”



# Mechanical Treatment

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## Solids Separation

Solid/Liquid Hydrocyclones

## Primary Produced Water Separation

Corrugated Plate Separators (CPS)

API Separators

Solid/Liquid Hydrocyclones

Liquid/Liquid Hydrocyclones

## Secondary Produced Water Separation

Induced Air/Gas Flotation Separators

Dissolved Air/Gas Flotation Separators

## Tertiary Produced Water Separation

Walnut Shell Filters

Media Filters

Activated Carbon Filters



# Chemical treatment

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- ❑ Corrosion inhibitors and oxygen scavengers
- ❑ Scale inhibitors to limit mineral scale
- ❑ Biocides to mitigate bacterial fouling
- ❑ Emulsifiers and clarifiers
- ❑ Coagulants
- ❑ Solvents



# The Result of Treatment

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- Utilization of a valuable resource
  - Produced water becomes a resource for well enhancement, not simply a waste product
- Preservation of surface-water resources
  - Without produced water treatment and re-use, valuable surface water would be required for re-injection
- More efficient well operation
- Extended well life and oil & gas recovery
- Reduced environmental impact of oil & gas operations