HALLIBURTON

Old versus New Trends in HF Chemicals

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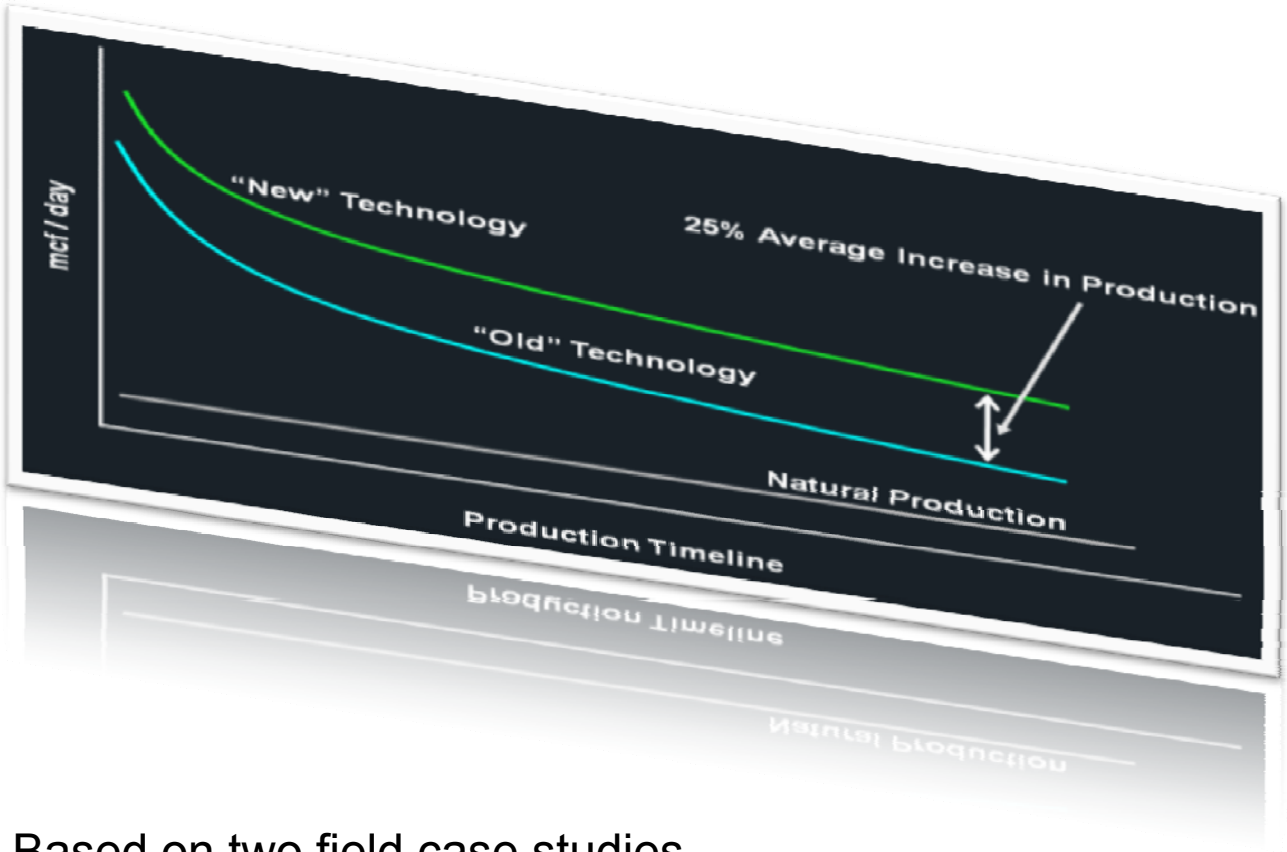
Whatever your challenge, Halliburton is there with you.

Benefits of Advanced Technology



Based on two field case studies

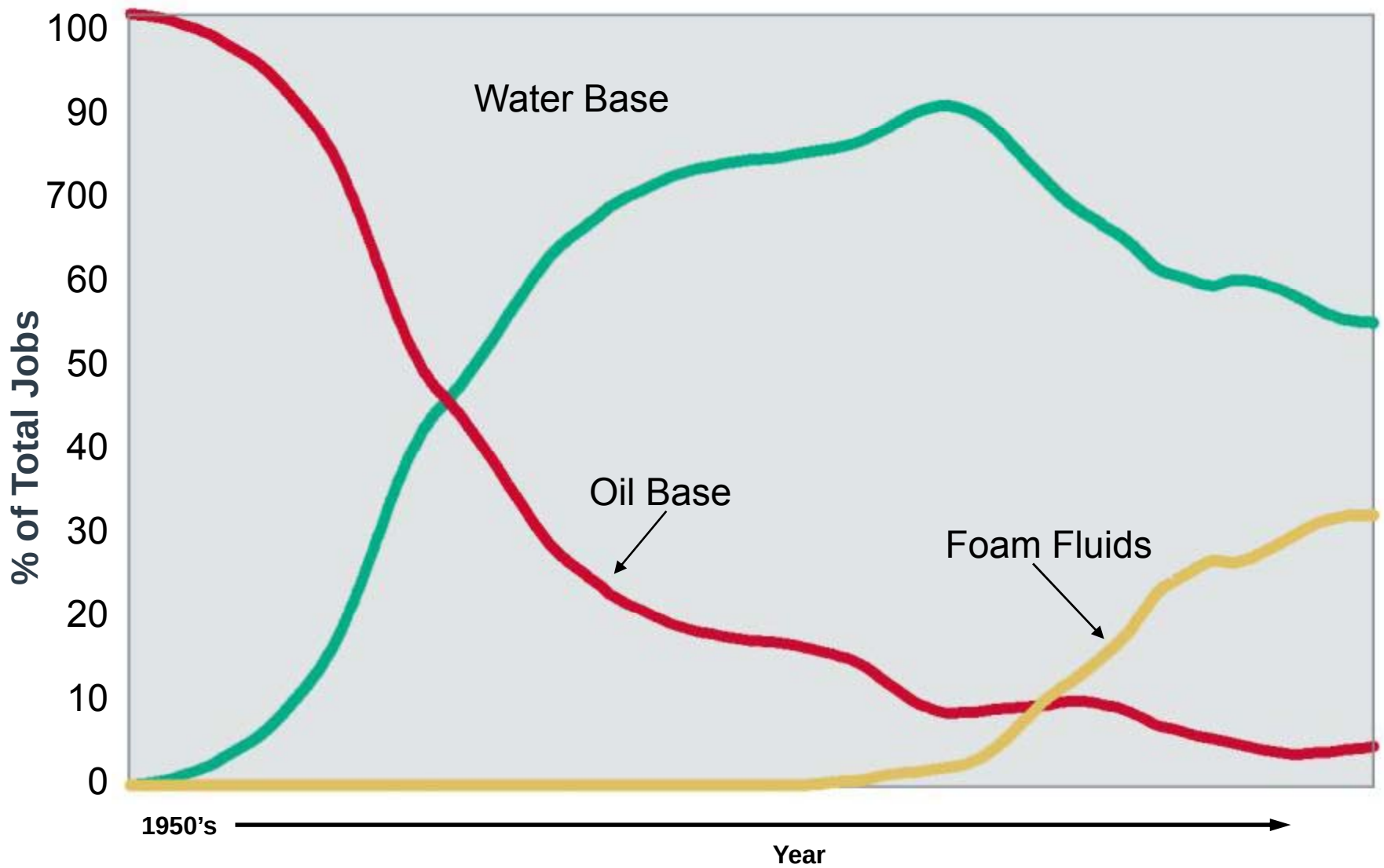
Frac Fluid Additives

- Depending on the fluid system being pumped various additives are used:

Polymers	Clay Control
Crosslinkers	Biocides
pH Control	Conductivity Enhancers
Gel Breakers	Fluid Loss Additives
Surfactants	Proppants

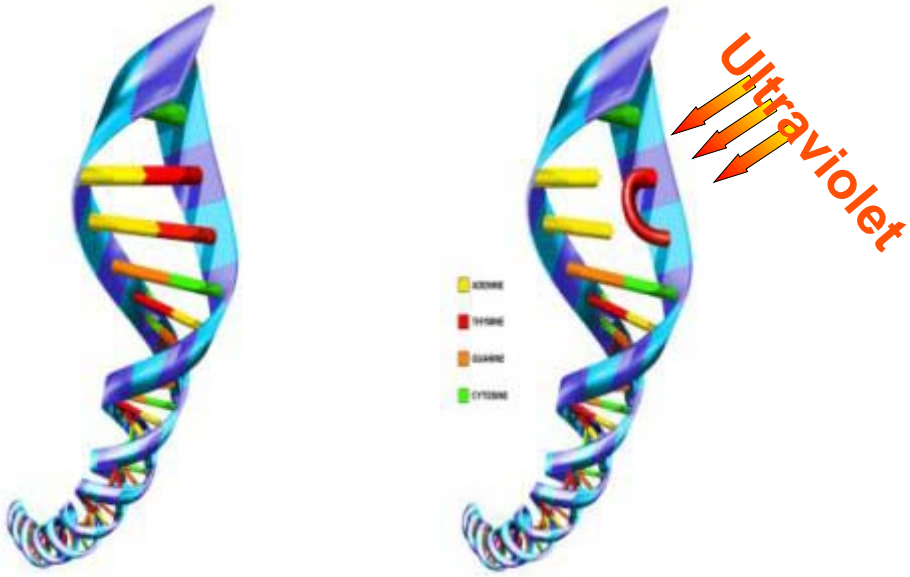
- Additives are transported in concentrated form and diluted when pumped
  - Typical blended concentrations are less than 3 gallons per 1,000 gal of base fluid
- All additive injection rates are controlled
- The purpose of any additive is to improve the overall effectiveness of the resulting hydraulic fracture
  - i.e., productivity of the well

Historical Frac Fluid Trends



Biocides

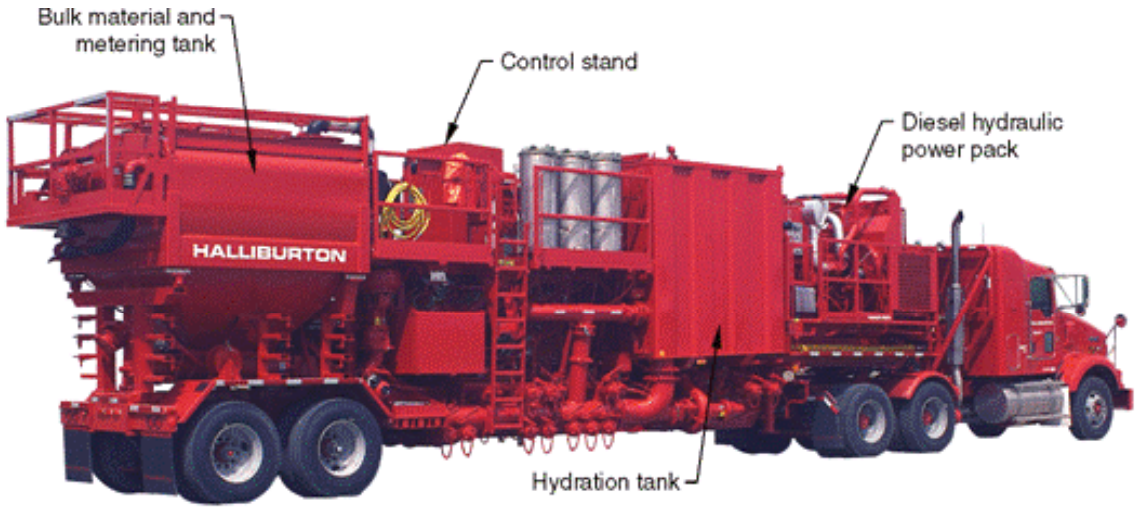
- Specialized biocides
- Chlorine
- Ozone
- Ultraviolet light



DNA before exposure **DNA after exposure**

Polymer Gels

- Sacked Gel
- Liquid Carrier Fluids
- Advanced Dry Polymer Blender



New Fluid System Performance

Applications

- Gelled fracs
- Water fracs
- Hybrid fracs

Performance

- Good results
- Wide range of parameters

All ingredients sourced from the food industry, but that comes with additional regulations and cost

Halliburton Chemistry Scoring Index

- Assesses three hazard criteria
  - Health
  - Safety
  - Environmental
- Hazards in each criterion assessed by reviewing specific categories
- Health and Safety categories based on the U.N. Globally Harmonized System for Classification and Labeling of Chemicals (GHS)
- Evaluated by third party

Halliburton Chemistry Scoring Index

Provides a solid basis for choosing more environmentally-focused chemistry while balancing the selection with overall well-completion performance

Solving challenges.™

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