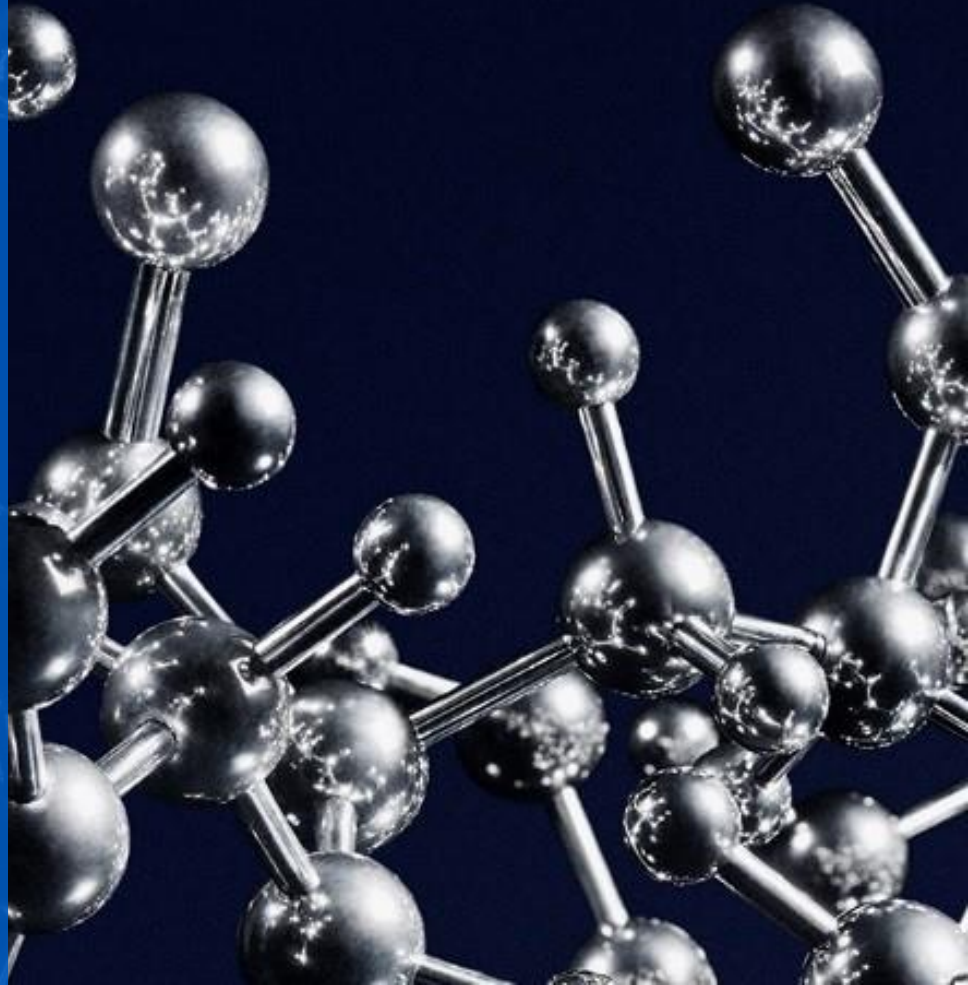


Randy Prater & Michael Hurd

Kemira webinar

Conformance Control for Advanced Secondary Recovery Techniques

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Conformance Control for Advanced
Secondary Recovery Techniques

Introduction

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The first choice in chemistry for water intensive industries

Expertise, application know-how and chemicals that improve customers' resource efficiency and product quality.

REVENUE
EUR 2.4 billion (2015)
(11% growth)

EMPLOYEES
4,685 (2015)

INVESTING IN
GROWTH

CAPEX & R&D:
EUR 340 million (2015)

PULP & PAPER 60%

Leading global chemical supplier
#1-2 in all regions

OIL & MINING 15%

Growing chemical and service provider
#2 in global polyacrylamide production

MUNICIPAL & INDUSTRIAL 25%

Market leader in raw and waste water treatment chemicals
#1 in Europe and North America

Kemira shares are listed on the NASDAQ OMX Helsinki stock exchange.



Randy Prater

Oil & Gas

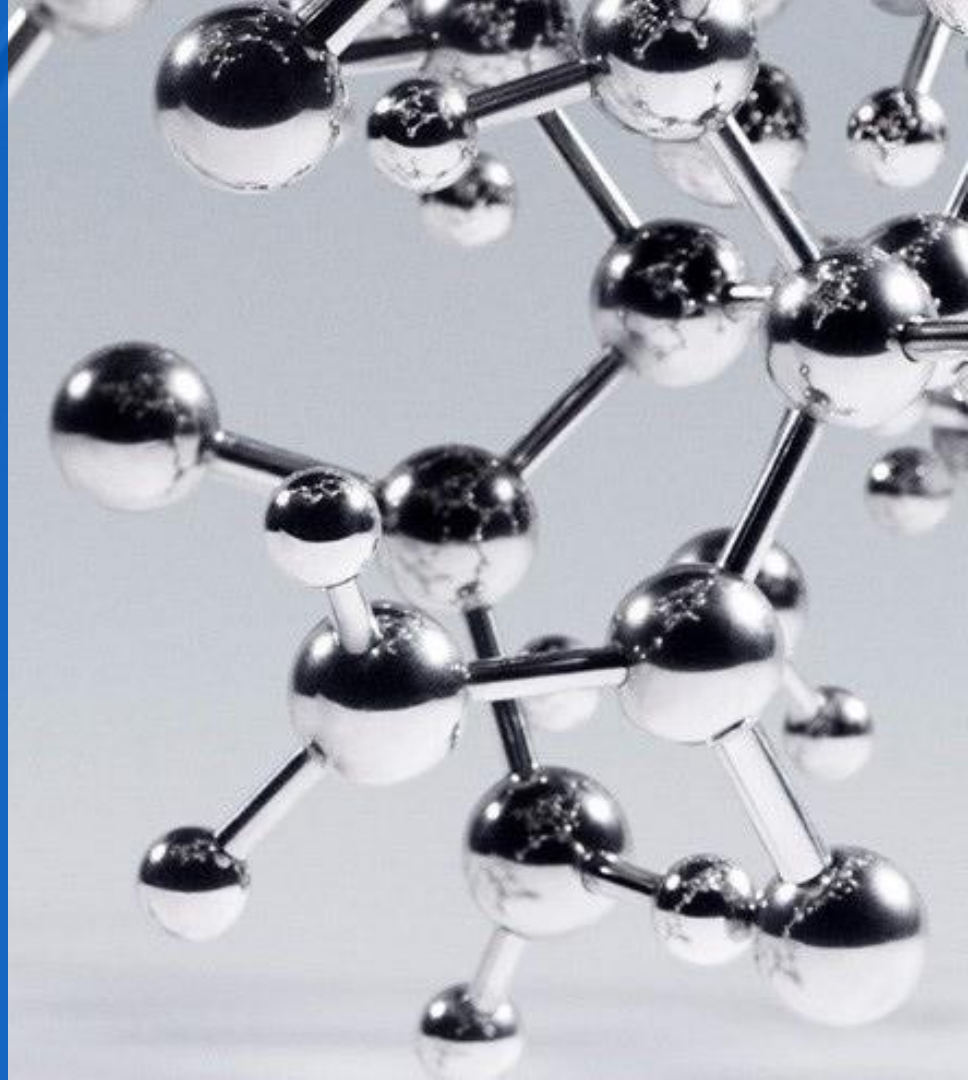
Senior Technical Manager, IOR, Oilfield Services,
Americas

randy.prater@kemira.com

Field experience since 1977

Polymer IOR experience since 1989

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Michael Hurd

Oil & Gas

Applications Manager, Oil & Gas, Americas

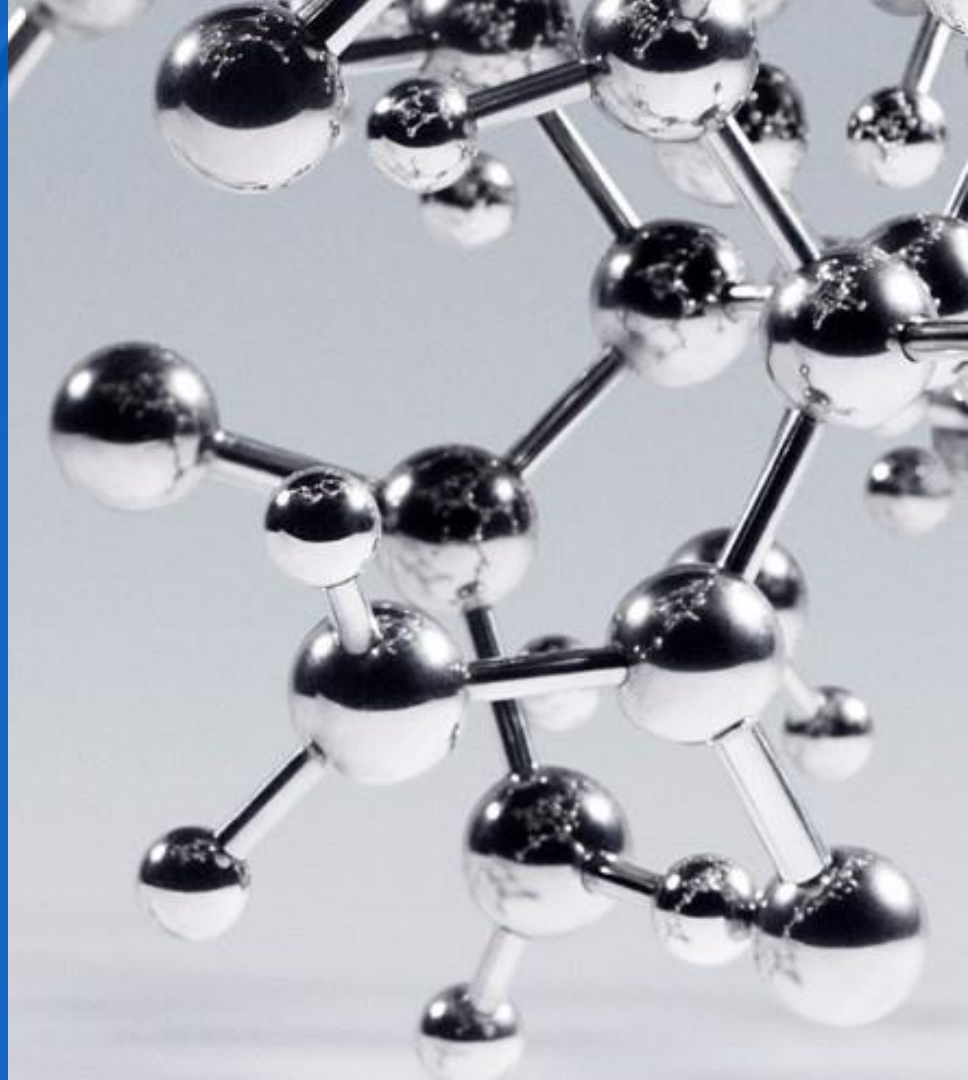
michael.hurd@kemira.com

Petroleum Engineer

Industry experience since 1978

EOR/IOR experience since 1980

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Conformance Control for Advanced
Secondary Recovery Techniques

Michael Hurd

A proud history of
conformance work

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Kemira's heritage of conformance work

1978 | **American Cyanamid** (AmCy) begins a field service unit.

1984 | American Cyanamid is **No. 1** in polyacrylamide supply to EOR and IOR services.

1989 **Polymer Services** begins operations.

1999 | **CYTEC** collaborates with Marathon for high temp gels and improvements in **MaraSeal and Marcit** gel offerings.

2008 | Kemira officially starts an Oil & Gas division.

2015 | Kemira purchases Polymer Services, offering comprehensive **IOR and EOR services** to the industry.

1982

1990

1998

2006

2014

1978

1986

1994

2002

2010

2016

1983 | American Cyanamid purchases **Custom Oil Recovery Technology**, the service extension of the Phillips crosslinking patents.

1993 | **CYTEC** Ind. splits from AMCY.

2006 | Kemira purchases **CYTEC** polymers manufacturing.

Conformance Control for Advanced
Secondary Recovery Techniques

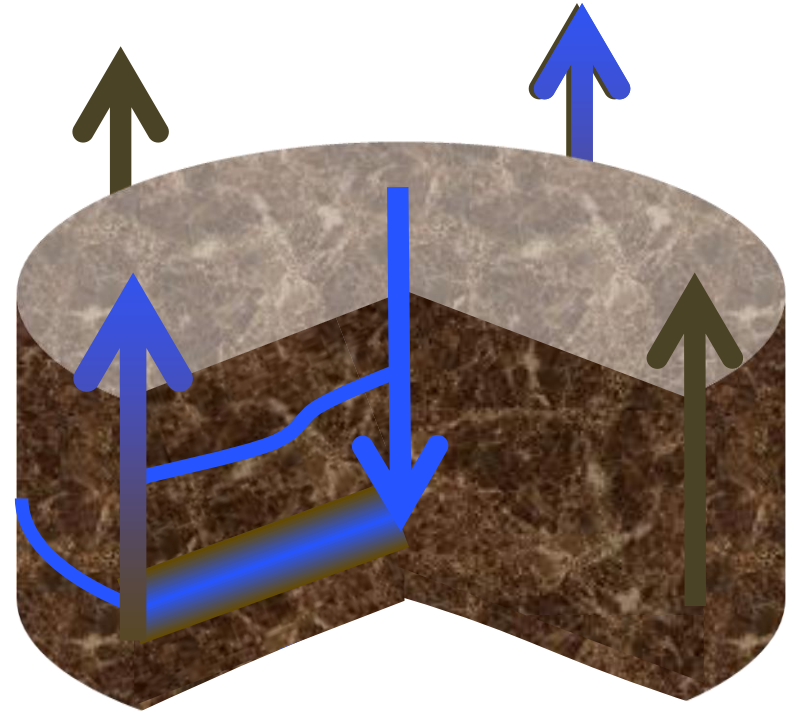
Michael Hurd

Conformance control

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Conformance control

- Generally treated from injection side
 - Waterflooding and CEOR
 - Typically more field-wide
 - Single problem wells
- In-depth diversion of fluids
 - Used with a variety of fluids
 - Water
 - Polymer
 - SP/ASP
 - CO₂ and N₂
 - Vertical and Aerial sweep
 - Channel blocking



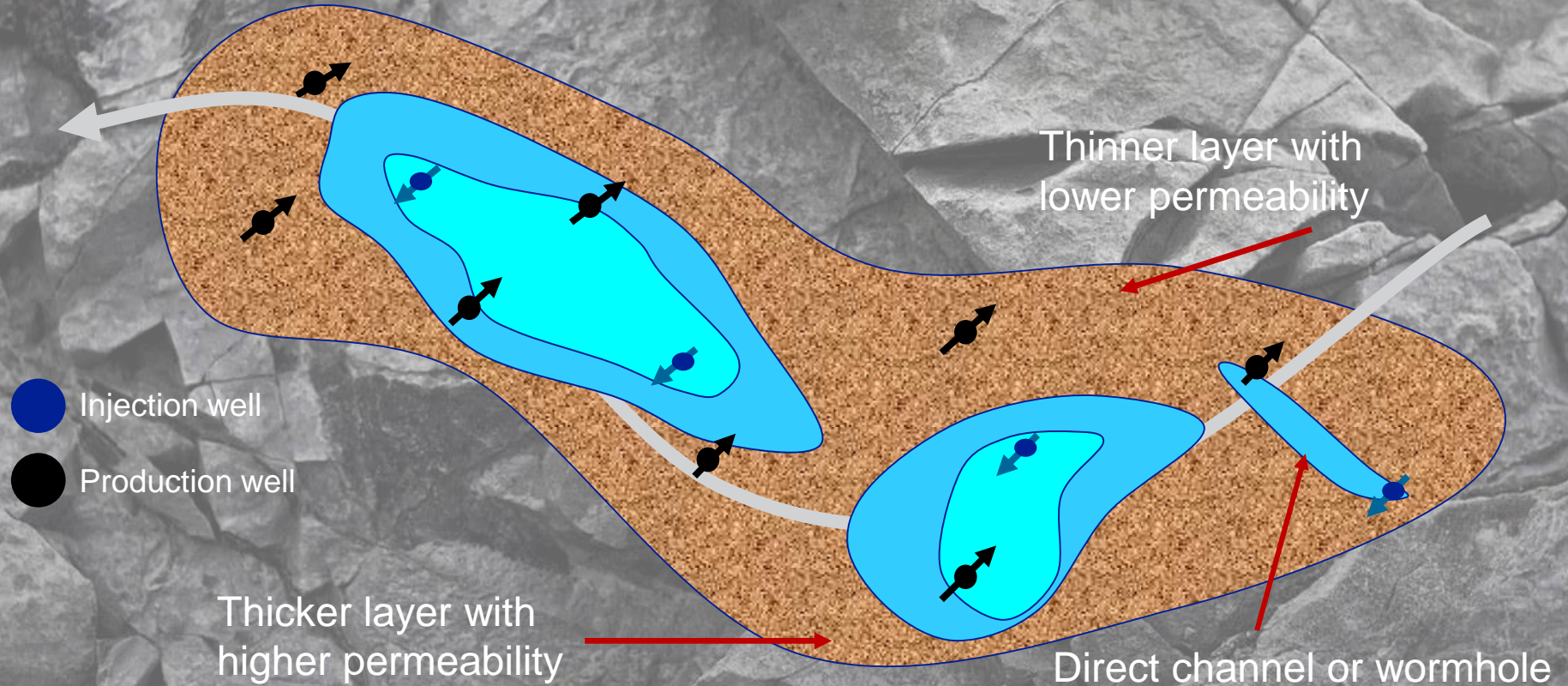
Before we design a job

Factors to consider

- Define flow path injector to producer
 - Job strength
 - Reservoir water
- Crossflow mechanisms?
 - Matrix, fracture, wormhole
 - Treatment application
- Estimating flow volume
 - Drawdown at the producer
 - Injection rate vs K profile



Objectives and results



The role of chemicals

- Gelation
 - Timing (control crosslinker)
 - In-depth placement – greater interference
 - Near-well – less interference
 - Gel strength (control polymer)
 - In-depth high molecular weight and ‘weaker’ gels
 - Near-well lower MW and ‘stronger’ gels
- Placement
 - Adsorption
 - Dilution
 - Reduction
 - Interference
 - pH
 - Metals
 - H₂S



Foam gels

A person wearing a white lab coat and safety glasses is holding a test tube with a blue gel inside. The background is blurred, showing another person in a lab coat and safety glasses.

- Defined usage
 - Low pressure injection
 - Continued permeability
 - Lower volume usage
 - Carrier gas
- Initial development
 - Temperature
 - pH
 - Placement

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Secondary Recovery Techniques

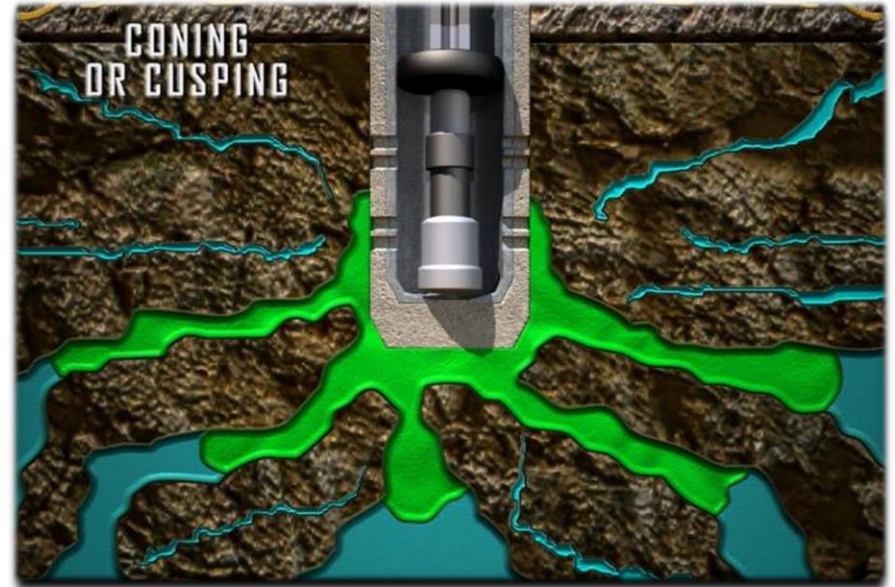
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Profile modification

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Profile modification

- Producing wells
 - Improved Oil Recovery (IOR)
 - Generally confined to single well treatments
- Near wellbore treatments
 - Designed to control produced water
 - Well defined water problems
 - Bottom Water drive
 - Excess production rate
 - High Water-Oil Ratio (WOR)
 - Fractured wells
 - High permeability variation
 - Quick payback



Conformance Control for Advanced
Secondary Recovery Techniques

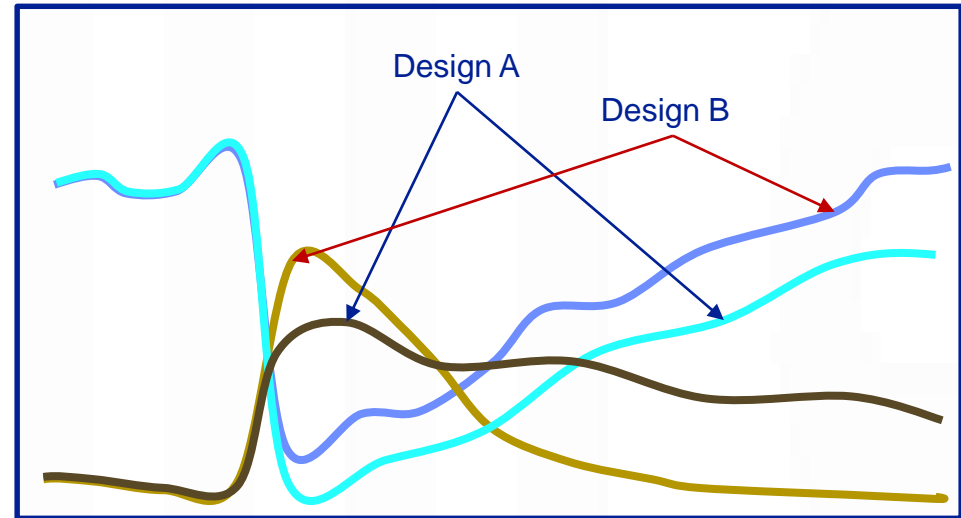
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Success measured in
more ways than one

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Measuring success

- Water-Oil Ratio (WOR)
 - Water decrease and/or oil increase on production wells
 - Immediate improvement on production wells
 - For near-well work
 - For fracture blocks from injectors
- Well conditions
 - Higher injection pressures
 - Lower production rates
 - Short-term profit/long-term invest
- Payout
 - Not just more oil/less water
 - Costs
 - Objectives



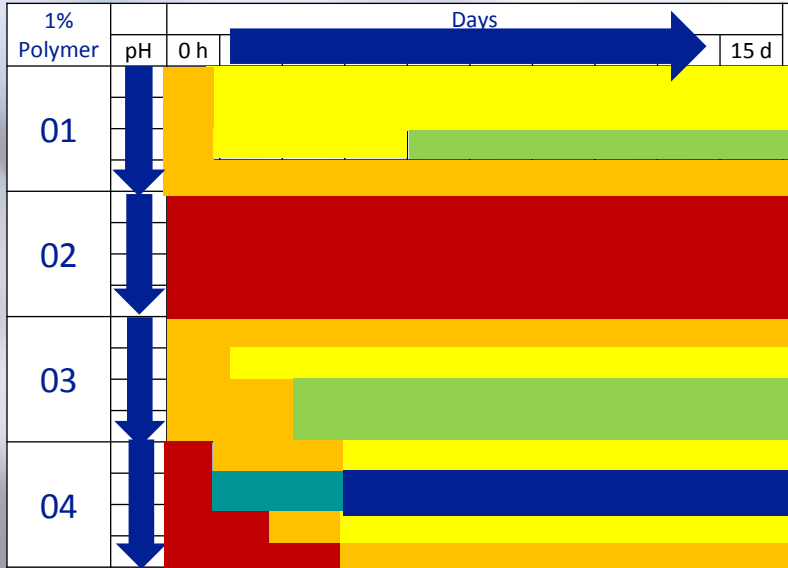
Kemira Oilfield Services

Helping to reduce risk while increasing production and profits

Treatment value

- Production wells
 - Good short-term payout
 - Arrested decline curve long-term
 - Improved re-start production
- Injections wells
 - Improved aerial sweep efficiency
 - Improved injection profile
 - Equipment support
- Equipment specific to IOR
 - Consistent fluid quality
 - Experienced field crews
 - Minimizes operational risk
- Collaboration
 - Other field processes and issues
 - Innovation for new applications

pH effects



- Different polymers
 - Functionalization
- pH effects
 - Use with acid, CO2, N2
 - Reservoir water
- Gelation time
 - Placement
 - Design application
- Gel strength
 - Eliminate treatment movement

Improved Oil Recovery (IOR) techniques

- Engineered fluid-comprising surfactant, dispersant and iron control in an aqueous external phase for IOR. Multiple component fluids:
 - Surfactant component: Molecules designed to lower surface tension at the oil-water interface. Consists of oil-soluble molecules bonded to a water-soluble molecule
 - Lowers surface tension
 - Lowers IFT
 - Improves film formation (lowers contact angles)
 - Paraffin dispersant: Molecule that disperses concentrations of paraffin in the reservoir
 - Iron control: Controls the redox chemistry of dissolved iron in reservoir fluid
- KemRelease™ solutions can be injected
 - Pre-flush: Conditions the reservoir and assists with gel injection into primary water flow intervals
 - Post-flush: KemRelease + crude to clean well-bore and re-establish communication with the oil zone

Experience



- Over 4,000 jobs completed
 - Wyoming: Big Horn Basin, Tensleep Sandstone Formation
 - Texas: Permian Basin
 - Illinois: Geneva Dolomite
 - Oklahoma: Bartlesville Sand, Oil Creek Sand
 - Kansas: Arbuckle, Mississippi, Gorham Sand, Bartlesville Sand, Viola, LKC, Morrow Sand
 - Nebraska: Hunton Lime
 - Arkansas Fayetteville Shale
 - Alberta: Unconsolidated Sandstone
 - Saskatchewan: Shaunavon dolomitic limestone, Roseray sandstone, Bakken Shale, Viking
 - Argentina: Entre Lomas, Piedras Blancas, El Caracol
- Over 100 years of cumulative experience in the application
- Extensive library of treatments, formations, successes, and failures

Thank you!

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