POLYMER GEL SYSTEM

TO CONTROL STEAM & WATER PRODUCTION

By EPT Inc. USA

Contact:

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PRODUCING WELL WATER CONTROL USING TEMPERATURE STABLE CROSSLINKED POLYMER GELS.
OVERVIEW

1.) TYPICAL WATER PROBLEMS
2.) EFFECT OF WATER PRODUCTION ON PRODUCING WELL ECONOMICS
3.) POTENTIAL SOLUTIONS
4.) CANDIDATE WELL SELECTION
5.) PROPER APPROACH TO SUCCESSFUL WATER CONTROL TREATMENTS
6.) IMPORTANCE OF "WATER PRODUCTION ZONE ISOLATION"
7.) PRODUCING WELL TREATMENT EXAMPLES WITH ECONOMIC RESULTS
TYPICAL WATER PROBLEMS
PRODUCTION WELLS

PROBLEMS

- HIGH WATER CUTS
- HIGH FLUID LEVELS

RESULTS

• HIGH FLUID LIFTING COST
• HIGH WATER TREATMENT COST
• HIGH WATER DISPOSAL COST
• REDUCED OIL PRODUCTION
• ENVIRONMENTAL PROBLEMS
EFFECT OF WATER PRODUCTION ON PRODUCING WELL ECONOMICS
ECONOMIC EFFECT OF WATER PRODUCTION
TYPICAL EXAMPLE

DIRECT WATER LIFTING COST : US$ 0.12/BBL
WATER SEPERATION COST : US$ 0.05/BBL
WATER TREATMENT COST : US$ 0.07/BBL
WATER REINJECTION/DISPOSAL COST : US$ 0.08/BBL

TOTAL WATER COST : US$ 0.32/BBL

EXCESS WATER PRODUCTION COST

<table>
<thead>
<tr>
<th>BARRELS WATER PER DAY</th>
<th>DOLLAR COST/BBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 BPD x 0.32 = US$ 320 x 365 = $ 116,800 PER YEAR</td>
<td></td>
</tr>
<tr>
<td>2,000 BPD x 0.32 = US$ 640 x 365 = $ 233,600 PER YEAR</td>
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</tr>
<tr>
<td>4,000 BPD x 0.32 = US$ 1,280 x 365 = $ 467,200 PER YEAR</td>
<td></td>
</tr>
<tr>
<td>6,000 BPD x 0.32 = US$ 1,920 x 365 = $ 700,800 PER YEAR</td>
<td></td>
</tr>
<tr>
<td>8,000 BPD x 0.32 = US$ 2,560 x 365 = $ 934,400 PER YEAR</td>
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</tr>
<tr>
<td>10,000 BPD x 0.32 = US$ 3,200 x 365 = $ 1,168,000 PER YEAR</td>
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</tbody>
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LARGER PUMPING EQUIPMENT +$ ??
EFFECTS OF POSSIBLE REDUCTION IN OIL PRODUCTION

BARRELS OIL PER DAY  $ REVENUE LOST

50 BPD x US$25.00 = $1,250 x 365 = $ 456,250 PER YEAR
100 BPD x US$25.00 = $2,500 x 365 = $ 912,500 PER YEAR
200 BPD x US$25.00 = $5,000 x 365 = $ 1,825,000 PER YEAR

TOTAL YEARLY COST OF EXCESS WATER PRODUCTION

WATER  OIL  US$ COST/BBL

1,000 BPD = $ 116,800 + 456,250 (50 BOPD) = $ 573,050
2,000 BPD = $ 244,600 + 912,500 (100 BOPD) = $ 1,157,100
4,000 BPD = $ 467,200 + 1,825,000 (200 BOPD) = $ 2,292,200
6,000 BPD = $ 700,800 + 1,825,000 (200 BOPD) = $ 2,525,800
8,000 BPD = $ 934,400 + 1,825,000 (200 BOPD) = $ 2,759,400
10,000 BPD = $ 1,168,000 + 1,825,000 (200 BOPD) = $ 2,993,000
WATER PRODUCTION
POTENTIAL SOLUTIONS
• CEMENTING OFF WATER ZONE
• SODIUM SILLICATE
• PLASTIC PLUGS
• HIGH TEMPERATURE STABLE POLYMER GELS.

CEMENT

• CEMENT DOES NOT PENETRATE INTO THE ROCK MATRIX
• CEMENT MAY NOT STOP VERTICAL WATER MIGRATION
SODIUM SILICATE

• NOT REMOVEABLE IN THE EVENT OF IMPROPER PLACEMENT

• SENSITIVE TO DIFFERENCES IN MEASURED VERSES ACTUAL BOTTOM HOLE TEMPERATURES

• TEMPERATURE DIFFERENCES WILL CAUSE PREMATURE SOLIDIFICATION, OR NO SOLIDIFICATION

• TYPICAL SUCCESS RATES APPROXIMATELY 50%

• WELL MAY BE PERMANENTLY DAMAGED

PLASTIC PLUGS

• PLASTIC PLUGS CAN NOT BE REMOVED IN THE EVENT OF IMPROPER PLACEMENT

• PLASTIC PLUGS ARE VERY SENSITIVE TO DIFFERENCES IN MEASURED VERSES ACTUAL BOTTOM HOLE TEMPERATURES

• TEMPERATURE DIFFERENCES WILL CAUSE PREMATURE SOLIDIFICATION OR NO SOLIDIFICATION

• TYPICAL SUCCESS RATES ARE LESS THAN 50%

• THE WELL MAY BE PERMANENTLY DAMAGED
TEMPERATURE STABLE CROSSLINKED POLYMER GELS

- Deep penetration into the reservoir
- Reduces or eliminates vertical water movement into oil productive zones
- In the event of equipment failure causing the polymer to be placed across the oil zone
- The polymer gel may be removed by treating with sodium hypochlorite bleach

EPT METHODS OF WATER CONTROL

- Organically cross-linked, high temperature stable polymer gels
- HE100\textsuperscript{T} hostile environment polymers
- HE300\textsuperscript{T} hostile environment polymers
- Non-ionic polyacrylamides
HE100ᵀ AND HE300ᵀ ORGANICALLY CROSSLINKED POLYMERS

• ADVANTAGES

• NO CHROMIUM OR OTHER HEAVY METAL ION

• EXCELLENT CONTROL OF GEL TIME OVER A WIDE TEMPERATURE RANGE

• PROVEN MULTI YEAR GEL STABILITY AT TEMPERATURES OF 90°F (32°C) TO 360°F (176°C)

• GOOD GELS IN FRESH WATER, SEA WATER AND UP TO 200,000 PPM FORMATION BRINES
CANDIDATE WELL SELECTION
WELL SELECTION CONSIDERATIONS -1

CANDIDATE WELLS MUST HAVE THE POTENTIAL FOR ECONOMIC SUCCESS

ECONOMIC SUCCESS

1.) INCREASED OIL PRODUCTION
2.) REDUCED WATER PRODUCTION COST
3.) REDUCED WATER SEPARATION COST
4.) REDUCED WATER DISPOSAL COST
5.) REDUCED ENVIRONMENTAL MITIGATION COSTS

WELL SELECTION CONSIDERATIONS -2

KNOW WHERE THE WATER IS COMING FROM

1.) BOTTOM WATER CONING
2.) SPECIFIC WATER CHANNEL
3.) ENCROACHING OIL WATER CONTACT
4.) WATER ZONE IN PRODUCTION INTERVAL
5.) POOR CEMENT JOB
6.) WATER AND OIL CO-PRODUCED
WELL SELECTION CONSIDERATIONS -3

1.) SELECT WELLS THAT HAVE ACCURATE OIL AND WATER PRODUCTION HISTORY DATA

2.) SELECT WELLS THAT HAVE BEEN PRODUCTIVE IN THE PAST

3.) SELECT WELLS THAT DO NOT HAVE SEVERE MECHANICAL PROBLEMS

WELL SELECTION CONSIDERATIONS -4

ISOLATE THE WATER PRODUCTION ZONE

1.) BE ABLE TO PROTECT THE OIL ZONE

2.) BE ABLE TO SET PACKERS FOR ISOLATION

3.) BE ABLE TO PERFORATE AS REQUIRED

4.) BE ABLE TO SET PACKERS OR BRIDGE PLUGS, AS REQUIRED, TO PRODUCE THE OIL AFTER THE POLYMER TREATMENT
PROPER APPROACH TO SUCCESSFUL WATER CONTROL TREATMENTS
EPT'S APPROACH TO SUCCESSFUL TREATMENTS-1

• PROPER IDENTIFICATION OF THE PROBLEM

EPT'S APPROACH TO SUCCESSFUL TREATMENTS-2

• PROPER TREATMENT MATERIAL SELECTION
EPT'S APPROACH TO SUCCESSFUL TREATMENTS-3

• PROPER TREATMENT PROCEDURE SELECTION

EPT'S APPROACH TO SUCCESSFUL TREATMENTS-4

• PROPER PRE-TREATMENT WELL PREPARATION
EPT'S APPROACH TO SUCCESSFUL TREATMENTS-5

- ON SITE TREATMENT OPTIMIZATION
- ON SITE SUPERVISION AND CONTROL

EPT'S APPROACH TO SUCCESSFUL TREATMENTS-6

- PROPER END OF JOB TUBING & CASING DISPLACEMENT
IMPORTANCE OF WATER PRODUCTION ZONE ISOLATION
DOWN HOLE MECHANISM
POLYMER GEL APPLICATIONS
IMPORTANT CONSIDERATIONS

• ISOLATE THE ZONE TO BE TREATED

• YEARS OF FIELD EXPERIENCE HAVE PROVEN THAT A MUCH HIGHER SUCCESS RATE IS OBTAINED WHERE THE TARGET ZONE IS ISOLATED, AND THE OIL PRODUCTION ZONE IS ISOLATED FROM THE POLYMER

POLYMER GEL APPLICATIONS
IMPORTANT CONSIDERATIONS

• TYPICAL SUCCESS RATES ARE 80-85% WHEN ZONE ISOLATION IS UTILIZED ON GOOD WELL CANDIDATES

• WHEN ZONE ISOLATION IS NOT UTILIZED, THE SUCCESS RATES ARE ONLY 60-65% ON GOOD WELL CANDIDATES
POLYMER GEL APPLICATION CONSIDERATIONS
FOR SUCCESSFUL TREATMENTS

1.) EXPERIENCED SUPERVISION SHOULD BE PROVIDED FOR EACH WELL TREATMENT

2.) THE TREATMENT PROGRAM AND PROCEDURE MUST BE FLEXIBLE AND ALLOW FOR ON-SITE RESPONSE AND OPTIMIZATION TO SPECIFIC CONDITIONS ENCOUNTERED DURING TREATMENT

3.) A STATISTICALLY VALID NUMBER OF WELLS SHOULD BE TREATED, SO THE EFFECTIVENESS OF THE POLYMER TREATMENTS CAN BE MAXIMIZED
PRODUCING WELL TREATMENT EXAMPLES WITH ECONOMIC RESULTS
ECONOMIC BENEFIT FOR LOS ANGELES BASIN PRODUCING WELL, 1,200 BBL TREATMENT @ 186°F

POLYMER TREATMENT COST: US$ 72,000
WORKOVER COST TO PREPARE WELL FOR POLYMER TREATMENT: US$ 46,800
TOTAL TREATMENT COST: US$ 118,800

WATER LIFTING COST: US$ 0.052/BBL
WATER TREATMENT COST: US$ 0.005/BBL
WATER REINJECTION COST: US$ 0.017/BBL
TOTAL WATER COST: US$ 0.074/BBL

PAYOUT TIME = 106 DAYS @ US$20.00/BBL OIL
NET PAYOUT AFTER 1 YEAR: US$ 237,975
NET PAYOUT AFTER 2 YEARS: US$ 500,000
AMT. DUE TO REDUCED WATER: US$ 17,300
ECONOMIC BENEFIT FOR WELL # 9E-51

POLYMER TREATMENT COST: US$ 125,000
WORKOVER COST TO PREPARE WELL FOR POLYMER TREATMENT: US$ 63,400
TOTAL TREATMENT COST: US$ 188,400

WATER LIFTING COST: US$ 0.128/BBL
WATER TREATMENT COST: US$ 0.031/BBL
WATER REINJECTION COST: US$ 0.073/BBL
TOTAL WATER COST: US$ 0.232/BBL

PAYOUT TIME = 218 DAYS @ US$20.00/BBL OIL

NET PAYOUT AFTER 2 YEARS: US$ 1,185,050
NET PAYOUT AFTER 3 YEARS: US$ 2,587,012
NET PAYOUT AFTER 4 YEARS: US$ 3,560,470
NET PAYOUT AFTER 5 YEARS: US$ 4,523,335
NET PAYOUT AFTER 6 YEARS: US$ 5,448,375
NET PAYOUT AFTER 6.5 YEARS: US$ 5,886,810
AMT. DUE TO REDUCED WATER: US$ 1,219,340
ABSTRACT
Excessive water production is a serious problem operators face with increasing frequency. Coning due to bottom water drive and production from high permeability, watered-out channels during waterflooding are primary causes contributing to water production problems.

A variety of mechanical and chemical processes have been developed to reduce water production in producing wells. Both types of processes have had various degrees of success when applied. The advantage of a chemical process, such as resin or polymer, is that treatments can be injected deeper into the reservoir matrix. This can have longer lasting effects on water production. The most effective chemical methods involve the crosslinking of water soluble polymers to form gels. Gel systems can be placed either around injection wells or production wells. Injection well treatments are implemented to improve the vertical conformance, while production well treatments are intended to reduce water production while maintaining or increasing oil production.

Most crosslinked polymer treatments for controlling water production have been carried out at low temperatures. The majority of the low temperature processes use polyacrylamide crosslinked with trivalent metal ions, such as chromium. At high temperatures, thermal degradation can occur which is detrimental to gel quality and stability. Temperatures above 170°F dictate the use of polymers with a molecular structure that resists thermal or hydrolytic degradation.

This paper focuses on the results of applying an acrylamide copolymer and organic crosslinker treatment for water control in a high temperature (210°F) sandstone reservoir. Two wells were treated with a substantial decrease in water production and a significant amount of oil recovered.

INTRODUCTION
The tendency of water to channel through the reservoir to production wells has been one of the most serious problems associated with oil production throughout the world (Mody et al., 1988). High water cuts adversely affect the economic feasibility of oil production often leading to early abandonment.

Water cut problems are prevalent in the Minas field. The average Minas producer produces 5000 BFPD at a 92% water cut with a working fluid level of 600 feet. Isolating high water cut zones through mechanical means has been a major activity in the Minas field. In addition to completely isolating wet sands, attempts have also been made to reduce water cuts in individual sands. The method used to reduce water cuts in individual sands has been mechanical isolation of the lower, wet portion of the sand. This is done with cup packers or by cement squeezing all the perforations, and then selectively perforating the upper portion. While this method was somewhat successful in Minas in the past, it is usually unsuccessful now. At best, there is a short period of
CONCLUSIONS

A stable acrylic amide copolymer/organic crosslinker gel treatment has been developed and field tested for high temperature applications. The gel treatments have been in place for more than a year and have proven to be technically successful by significantly reducing fluid production. Excess water production from water channeling has been suppressed, extending the producing life of the production wells. Oil decline rates have been arrested and significant amounts of incremental oil produced. Future success of the treatments can be improved by minimizing the migration of the gel into the oil zone through proper placement techniques.

ACKNOWLEDGMENTS

We would like to thank the staff of CPI and Texaco for contributions and expert assistance in preparing this paper. We extend special thanks to the Minas laboratory, engineering and operations staff and to Lempgas for their assistance and contributions throughout the project. In addition, we are grateful to Pertamina/Calco Pacific Indonesia for approval to publish this paper.

REFERENCES


HY-TEMP POLYMER WATER SHUTOFF TREATMENT
CALTEX INDONESIA, MINAS WELL #541 (8E-77)
TREATED WITH 1,950 BARRELS OF HE100 POLYMER GEL SOLUTION ON MAY 18, 1993
RESERVOIR TEMPERATURE 223°F (106°C)

ECONOMIC BENEFIT FOR WELL # 8E-77

POLYMER TREATMENT COST: US$ 99,450
WORKOVER COST TO PREPARE WELL FOR POLYMER TREATMENT: US$ 58,700
TOTAL TREATMENT COST: US$ 158,150

WATER LIFTING COST: US$ 0.128/BBL
WATER TREATMENT COST: US$ 0.031/BBL
WATER REINJECTION COST: US$ 0.073/BBL
TOTAL WATER COST: US$ 0.232/BBL

PAYOUT TIME = 115 DAYS @ US$20.00/BBL OIL
NET PAYOUT AFTER 1 YEARS: US$ 400,000
NET PAYOUT AFTER 2 YEARS: US$ 1,399,000
NET PAYOUT AFTER 3 YEARS: US$ 2,498,910
NET PAYOUT AFTER 4 YEARS: US$ 3,690,350
NET PAYOUT AFTER 5 YEARS: US$ 4,840,010
NET PAYOUT AFTER 5.5 YEARS: US$ 5,422,550
AMT. DUE TO REDUCED WATER: US$ 2,259,010
INDONESIA POLYMER WATER SHUT-OFF
WELL #6D-32WALIO PETROMER TREND
TREATED APRIL 1996
1,500 BBL HE-100 POLYMER - ORGANIC CROSSLINKERS
RESERVOIR TEMPERATURE 230°F (110°C)

SOUTH AMERICAN PRODUCING WELL WATER SHUTOFF POLYMER TREATMENT
BOTTOM HOLE TEMPERATURE 148°C (298°F)
1,200 BBL HE300 POLYMER - ORGANIC CROSSLINKERS
ECONOMIC BENEFIT FOR SOUTH AMERICAN PRODUCING WELL, 1,200 BBL TREATMENT @ 298°F

POLYMER TREATMENT COST: US$ 76,800
WORKOVER COST TO PREPARE WELL FOR POLYMER TREATMENT: US$ 91,300
TOTAL TREATMENT COST: US$ 168,100

WATER LIFTING COST: US$ 0.171/BBL
WATER TREATMENT COST: US$ 0.011/BBL
WATER REINJECTION COST: US$ 0.036/BBL
TOTAL WATER COST: US$ 0.218/BBL

PAYOUT TIME = 79 DAYS @ US$20.00/BBL OIL
NET PAYOUT AFTER 1 YEAR: US$ 3,346,835
NET PAYOUT AFTER 2 YEARS: US$ 8,290,325
NET PAYOUT AFTER 3 YEARS: US$ 13,127,640
AMT. DUE TO REDUCED WATER : US$ 1,508,060

SOUTH AMERICAN PRODUCING WELL WATER SHUTOFF POLYMER TREATMENT
BOTTOM HOLE TEMPERATURE 150°C (302°F)
640 BBL HE300 POLYMER - ORGANIC CROSS LINKERS
ECONOMIC BENEFIT FOR SOUTH AMERICAN PRODUCING WELL, 640 BBL TREATMENT @ 302°F

POLYMER TREATMENT COST: US$ 40,960
WORKOVER COST TO PREPARE WELL FOR POLYMER TREATMENT: US$ 86,200
TOTAL TREATMENT COST: US$ 127,160

WATER LIFTING COST: US$ 0.181/BBL
WATER TREATMENT COST: US$ 0.011/BBL
WATER REINJECTION COST: US$ 0.036/BBL
TOTAL WATER COST: US$ 0.228/BBL

PAYOUT TIME = 25 DAYS @ US$20.00/BBL OIL
NET PAYOUT AFTER 1 YEAR: US$ 1,737,100
NET PAYOUT AFTER 2 YEARS: US$ 3,580,375
NET PAYOUT AFTER 3 YEARS: US$ 5,081,250
AMT. DUE TO REDUCED WATER: US$ 704,210

MARATHON SOUTH CHINA SEA PRODUCING WELL WATER SHUTOFF
KH PLATFORM, WELL #KH-9S/L
1,400 BBL HE300 POLYMER - ORGANIC CROSSLINKERS
BOTTOM HOLE TEMPERATURE 262°F
## ECONOMIC BENEFIT FOR MARATHON SOUTH CHINA SEA, KH PLATFORM PRODUCING WELL #KH-9 S/L, 1,400 BBL TREATMENT @ 262°F (128°C)

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (US$)</th>
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<tbody>
<tr>
<td>Polymer Treatment Cost</td>
<td>86,000</td>
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<tr>
<td>Workover Cost to Prepare Well for Polymer Treatment</td>
<td>72,000</td>
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<td>Total Treatment Cost</td>
<td>158,000</td>
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<td>Water Lifting Cost</td>
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<td>Water Treatment Cost</td>
<td>1,012</td>
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<td>Water Reinjection Cost</td>
<td>480</td>
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<td>Total Water Cost</td>
<td>1,124</td>
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<td>Payout Time = 14 Days @ US$25.00/BBL Oil</td>
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<tr>
<td>Net Payout After 1 Year</td>
<td>3,993,510</td>
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<td>Net Payout After 2 Years</td>
<td>8,145,020</td>
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<tr>
<td>AMT. Due to Reduced Water</td>
<td>90,520</td>
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### Additional Information

Marathon Petroleum Indonesia, Ltd.

March 28, 1996

ENHANCED PETROLEUM TECHNOLOGY
P.O. Box 212
Bakersfield, California 93302
U.S.A.

Attention: Ralph Evans

RE: KH-9 WATER SQUEEZE TREATMENT

Attached is a plot showing production from well KH-9 for the last 2-1/2 years. I know it will be hard to read in black and white, so I have made a color copy. If you look closely, you can see that the water rate has been stable for the last 2 months. We have been using a Water Shut-off technology (WSD) chemical. As you can see, there has been a significant decrease in water production, and in June 1995, there has been a further decrease.

As you can see, although the water rate decreased only about 1000 BPD, the oil was increased by some 200,000 BPD. This decrease has been sustained for almost 1 year.

We are preparing two more water shut-off treatments for this field. We would like to do one and evaluate it for a few months, and then perform the other. The KH field is always at economics, but these will probably be the final treatments, but we look forward to continued success in this field. You would like to do this work in June, and I look forward to hearing from you regarding your schedule.

As we discussed while designing the KH-9 treatment, a decrease in water production is not unusual, because there is no gas associated with the produced water. However, we found that any decrease in water would result in our ability to gas-off a more efficiently resulting in a shorter field life and therefore, reduced expenses. We anticipate that the two new treatments proposed will result in the acceleration of almost 1000 BOPD, as a result in a significantly shorter field life for KH. This will benefit the company, as well as allow the equipment in being required more expenses to keep it operational.

Sincerely,

Matt Haney
Senior Operations Engineer

Attach. 1
SOUTH AMERICAN PRODUCING WELL WATER SHUTOFF
SC# 24 POLYMER TREATMENT BOTTOM HOLE TEMP. 151°C (304°F)
440 BBL HE300 POLYMER - ORGANICALLY CROSSLINKED

LOS ANGELES BASIN POLYMER, WATER CHANNEL SHUT-OFF
PRODUCTION WELL 234 FT. GROSS—184 FT. NET, TREATED MARCH 1990
850 BBL EPT-135-PM POLYMER, WITH ORGANIC CROSS LINKERS
RESERVOIR TEMPERATURE 167°F.
SANTA MARIA: WATER SHUT-OFF WITH HY-TEMP POLYMER PRODUCER WITH 310 FT. GROSS--200 FT. NET PERF. TOP PERF. @ 2,570 FT. 18 FT. ZONE ISOLATED AND TREATED MAY 1988 USING 1,200 BBL P-351 POLYMER, WITH ORGANIC CROSSLINKERS

RESERVOIR TEMPERATURE 173°F

WATERFLOOD INJECTOR HE100 POLYMER TREATMENT, LOS ANGELES BASIN
WATERFLOOD INJECTOR TREATED WITH 1,300 BBL OF ORGANICALLY CROSSLINKED HE100 POLYMER 2,100 BARRELS PER DAY WATER INJECTION PROFILE, DECEMBER 1990, BEFORE TREATMENT

% WATER INJECTED PER DAY (ON A SLIGHT VACUUM)
WATERFLOOD INJECTOR HE100 POLYMER TREATMENT, LOS ANGELES BASIN
WATERFLOOD INJECTOR TREATED WITH 1,300 BBL OF ORGANICALLY CROSSLINKED HE100 POLYMER ON JAN. 1991
2,100 BARRELS PER DAY WATER INJECTION PROFILE, MAY 1991, AFTER TREATMENT

% WATER INJECTED PER DAY @ 260 PSI

WATERFLOOD INJECTOR HE100 POLYMER TREATMENT, LOS ANGELES BASIN
WATERFLOOD INJECTOR TREATED WITH 1,300 BBL OF ORGANICALLY CROSSLINKED HE100 POLYMER ON JAN. 1991
2,100 BARRELS PER DAY WATER INJECTION PROFILE, JULY 1992, AFTER TREATMENT

% WATER INJECTED PER DAY @ 126 PSI
0.8% HE300 GEL TIME/TEMPERATURE

SERIES #1 = 0.2% P AND 0.5% F
SERIES #2 = 0.3% P AND 0.75% F
1.0% HE300\textsuperscript{T} HEAT STABILITY AT 300\textdegree F

SERIES #1 = 0.2\% P AND 0.5\% F
SERIES #2 = 0.3\% P AND 0.75\% F

% GEL STRENGTH

HE300\textsuperscript{T} POLYMER VISCOSITY/TEMPERATURE IN 1.0\% KCl

SERIES #1 = 0.7\% POLYMER—SERIES #2 = 0.8\% POLYMER
SERIES #3 = 0.9\% POLYMER—SERIES #4 = 1.0\% POLYMER

VISCOSITY IN CENTAPOSE

TEMPERATURE °F
INJECTION WELLS

• PROBLEM
• POOR INJECTION PROFILE
• RESULTS
• INEFFECTIVE USE OF INJECTION WATER
• EXCESSIVE INJECTION COSTS
• SOLUTION
• PROFILE MODIFICATION WITH POLYMER GEL
  • EPT/ TES TREATMENT METHOD
• ORGANICALLY CROSS-LINKED POLYMERS
• DRILLING SPECIALTIES HE100T & 300T POLYMER
• NON-IONIC POLYMERS
Korespondensi Perusahaan

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