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Produced Water Management in Gialo 59E Field

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Abstract

This paper provides an overview of the management options to deal with produced water in Gialo 59E oil field. The findings reached that deeper investigations and studies for water management options is needed. Down hole oil water separation (DHOWS) and conventional water exclusion operations might be applicable options.

Keywords: Water exclusion; DHOWS; reuse.

1. Introduction and Overview [1, 2]

Produced water is defined as the water (brine) brought up from the hydrocarbon bearing strata during the extraction of oil and/or gas, and can be very salty, up to four times higher than seawater. This brine contains a lot of metal salts, significant level of organic and inorganic materials, and crude petroleum that can be partially soluble in the water. Maximum impact reduction on the environment (see picture 3.4) requires the optimal utilization of existing technologies and complete knowledge of the production process. In addition, the reduction of contaminants and the volume of discharged water into the environment are goals of integrated produced water management. This practice follows these series of steps: Reduction in the volume of water produced. Reuse of produced water if water quality allows. Reduction in the volume of produced water discharged to the ambient environment Reduction in pollutant concentrations of discharged water. Selection of the hazardous chemicals in order to minimize the water toxicity.

Factors Affecting Produced Water Production and Volume [3]

- Type of well drilled.
- Location of well within reservoir structure.
- Type of completion.
- Type of water separation and treatment facilities.
- Water flooding for enhanced oil recovery.
- Insufficient produced water volume for water flooding.
- Loss of mechanical integrity.
- Subsurface communication problems.

Problems related to produced water

The problems related to produced water could not be mentioned specifically, but they can be summarized in one of the following categories:

- Technical problems
- Economic problems
- Environmental problems

2. Produced Water Management Options

To manage produced water, many scenarios can be followed. The most appropriate option for a given

location will be a function of several factors, including site location, regulatory acceptance, technical feasibility, cost, and availability of infrastructure and equipment. The primary alternatives being used today are underground injection, discharge, and beneficial reuse, although some other options are used at selected locations

Water Minimization Options

Within a producing formation, water and petroleum hydrocarbons are not fully mixed; they exist as a separate adjacent fluid layers, with the hydrocarbon layer typically lying above the water layer by virtue of its lower specific gravity. Operators try their best to design wells to produce from the hydrocarbon layer. It is challenging to minimize the amount of water produced into the well, but there are some strategies that can be used to restrict water from entering the well bore.

Options for Keeping Water away from the Wells

a) Mechanical Blocking Devices:

Operators have used various mechanical and well construction techniques to block water from entering the well. These techniques have been used for many years, but do not work well in all applications.

b) Water Shut-Off Chemicals:

It is the use of chemicals that are injected into the formation to minimize the water mobility and shutting off the water zones. Most of these products are polymer gels or their pre-gel forms.

Options for Keeping Water from Getting to the Surface

Lifting water to the surface and managing it represents a substantial expense for operators. A variety of technologies have been developed that attempt to manage water in the well bore itself. Although these technologies do not minimize the volume of water entering the well, they do minimize the volume of water that comes to the surface.

a) Dual Completion Wells

This means completing the well with two separate tubing strings and pumps. The primary completion is made at a depth corresponding to strong oil production, and a secondary completion is made lower in the interval, at a depth with strong water production. The two completions are separated by a packer. The oil collected above the packer is produced to the surface, and the water collected below the packer is injected into a lower formation.

Table 2.1: Costs related to producing water

	$/Oil BBL	$/year
Power Cost	0.28	9,709,000
Chemicals Cost	0.01	346,750
Indirect Costs	0.4	13,870,000
Total	0.69	23,925,750 = 24 Million

b) Downhole Oil/Water Separators

Downhole oil/water separators (DHOWS, also referred to as DOWS) separate oil from water in the well bore itself. DHOWS technology reduces the quantity of produced water that is handled at the surface by injecting it underground. A DHOWS system includes many components, but the two primary ones are an oil/water separation system and at least one pump to lift oil to the surface and inject the water. Two basic types of DHOWS have been developed. One type using hydrocyclones to mechanically separate oil and water, and the other relying on gravity separation that takes place in the well bore. [6]

Cost related to produced water in Gialo field

In Gialo field that produces $95,000\,BOPD$ against $380,000\,BWPD$, the cost related to producing this quantity of water might be summarized in table [1]. In addition to the direct expenses related to produced water that mentioned above, a considerable indirect expenses should be considered, but it is not easy to estimate, like the effect of produced water on the surface and subsurface production facilities and operating expense. (Assume $= 0.4\,\$/bbl$). [4, 5]

3. Solutions to manage produced water in Gialo 59E field

Subsurface disposal:

According to Waha Oil Company records, subsurface disposal option is gives good results in Gialo oil field due to the success of the disposal pilot plant

in station one which injects about $70,000\,BWPD$ successfully.

Conventional Water Exclusion:

Water exclusion operations are defined as any operation that is applied in the oil well to reduce it's water cut. In Gialo field, the only conventional method used is plug and re-perforation. The easy procedure to apply this method is plugging the high water cut zone and re-perforate the well at better oil productivity zone. Water exclusion jobs which were done in the last years in Gialo field can be illustrated in Table 2.1, and Figure 3.1. It can be noticed that this operation has given good results by reducing the water produced and a reasonable amount of oil was added. But, unfortunately, this method cannot be applied in all cases.

Downhole Oil Water Separation

The following example represents a Downhole oil water separation applications in Canadian and American oil fields, Table 3.2, Figure 3.2. Although Downhole oil water separation (DHOWS) and water exclusion jobs may not be able to be applied in the same case, Figure 3.3 gives an indication to compare between these two technologies profitability by investing the same amount of money, (about 2.5 Millions of Dollars).

Using Gialo field produced water in other fields

Gialo field location where many oil fields are there allows to use it's produced water in other fields for maintaining the reservoir pressure of these reservoir if the water characteristics are compatible with the rocks and fluids of these reservoirs. This option is very supported by National Oil Corporation (NOC) because it will manage the produced water in Gialo field perfectly and give a good resource to be used in another field. Two separate visibility studies were conducted to evaluate the possibility of using Gialo produced water in another fields. The first study was started in 2009 which evaluate the possibility of using Gialo produced water to maintain the reservoir pressure in Amal field (Harouge Oil Operations), and this study is still in progress. The second was started in 2010 and evaluate the possibility of using Gialo produced water to maintain the reservoir pressure in Abu-Attafil field (Mellitah Oil & Gas B.V.). These two studies well be continued in parallel, and in addition to the economical factor, the compatibility test is the most important effective factor for the success of these projects, because if the water was not compatible with the rocks and fluids of the target reservoir the problem will be worse.

Figure 3.1: Water exclusion jobs in Gialo field in last ten years

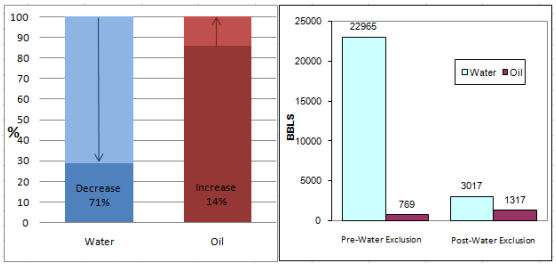

Figure 3.2: Downhole oil water separation application

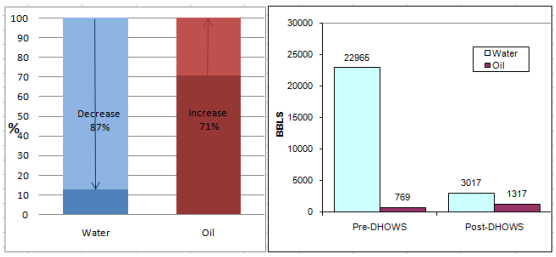

Figure 3.3: Comparison between Downhole separation ant water exclusion

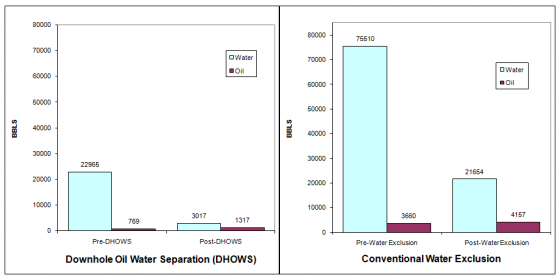

Table 3.1: Water exclusion jobs in Gialo field in the last years

WELL	Date of move out	OIL		WATER		WATER CUT		COST (1000$)
		Pre-water Exclusion	Post-water Exclusion	Pre-water Exclusion	Post-water Exclusion	Pre-water Exclusion	Post-water Exclusion	
E-37	10/26/2000	201	106	4559	2449	96%	96%	137.892
E-24	6/24/2003	106	304	3054	317	97%	51%	184.406
E-84	2/7/2004	244	224	6636	2208	96%	91%	322.814
E-31	4/2/2005	828	407	13144	865	94%	68%	349.304
E-193	12/19/2005	380	460	7328	664	95%	59%	214.257
E-275	10/5/2006	1	56	3955	1644	100%	98%	197.722
E-40	2/2/2007	934	228	17741	1752	91%	79%	171.646
E-179	3/27/2007	128	196	4808	7424	97%	97%	108.647
E-183	9/6/2007	248	332	2392	1299	91%	79%	180.693
E-93	3/17/2002	104	451	2603	193	96%	30%	184.908
E-263	7/19/2003	144	412	2264	316	94%	43%	186.811
E-257	7/6/2003	50	309	2430	927	98%	75%	62.378
E-147	10/11/2003	180	468	3588	1456	95%	76%	65.154
E-280	3/19/2005	112	204	1008	140	90%	41%	162.975
TOTAL		3660	4157	75510	21654	95%	84%	2529.607

Figure 3.4: Satellite image for Gialo field water pits

Table 3.2: Downhole oil water separation application[6]

Operator and well name	OIL		WATER		WATER CUT		COST (1000$)
	Pre-water Exclusion	Post-water Exclusion	Pre-water Exclusion	Post-water Exclusion	Pre-water Exclusion	Post-water Exclusion	
Imperial Redwater # 1-26	19	24	1780	59	99%	71%	180
Pinnacle-Alliance 7C2	44	100	380	95	90%	49%	180
Pinnacle-Alliance 06D	25	100	820	160	97%	62%	180
Pinnacle-Alliance 07C	38	37	1200	220	97%	86%	180
PanCanadian 00/02-09	13	164	428	239	97%	59%	180
Talisman Energy	6	39	629	21	99%	35%	180
Anderson 08-17	176	264	3648	264	95%	50%	180
Talisman Energy	113	277	2516	126	96%	31%	180
Chevron Fee 153X	45	32	1400	500	97%	94%	180
Wascana B7-27	76	0	2450	380	97%	100%	180
Talisman Energy	88	50	1700	189	95%	79%	180
Marathon Etah # 7	70	78	4000	320	98%	80%	180
Gulf Canada 02/12	21	117	1038	217	98%	65%	180
Tri-Link Resources Bender	35	35	976	227	97%	87%	180
TOTAL	769	1317	22965	3017	97%	68%	2520

4. Conclusion

1. Conventional water exclusion operations which are still being applied in Gialo field gave good results in the last years by decreasing the water produced sharply (71%), and reasonable increase in oil production (14%).

2. According to Waha Oil Company records, subsurface disposal option is feasible and can be applied in Gialo oil due to the success of the disposal pilot plant in Gialo station one which injects about $70,000\,BWPD$.

3. According to the results from the studies that made on Gialo field and some applications in other areas, many wells in Gialo field can be a candidate cases for downhole oil water separation (DHOWS) and this technique can be applied in this field.

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