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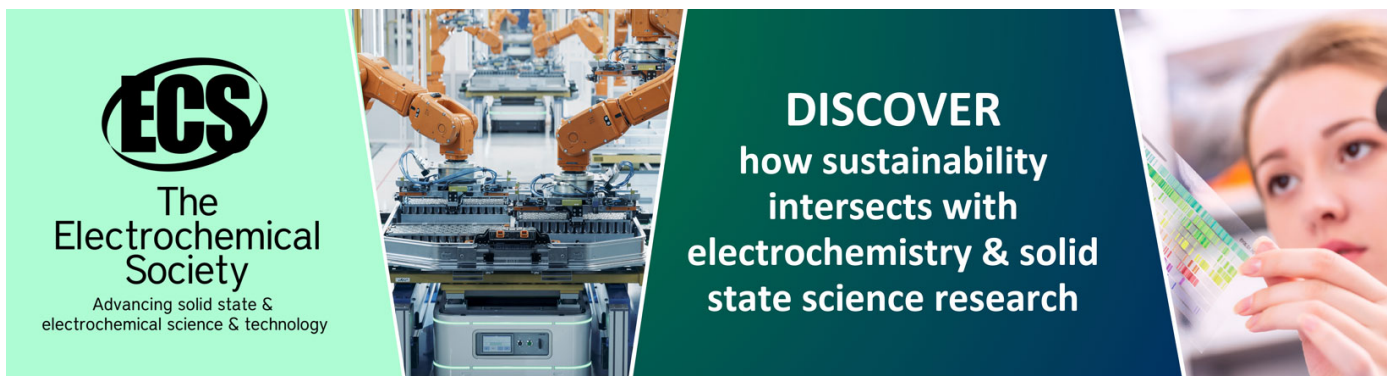
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Evaluation of Oil Fields in and Around Diyarbakır (SE Anatolia of Turkey) in Terms of Production

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Abstract. This study aims to give information about the oil production of 42 Oil Fields and the wells of each field in Diyarbakır and the surrounding area where is geologically located at the boundary of Anatolian plate and Middle Eastern oil region in the Southeastern Anatolia of Turkey. The structure of oil reservoirs at this region, the interaction of oil and water at the reservoir, capping mechanism of reservoir oil and water are the given topics about the reservoir. Average drilling depth of oil wells at the surrounding area, chemical structure and physical properties of production formations, calculation of production rate, pump types and selecting the suitable type of pump for several production rates, advantages and disadvantages of the pump types are also the other given information about the region. Moreover, regional evaluation of the oil and water ratios, API gravity of produced oil, salinity and pH values of produced water are mentioned by using the analysis of samples taken from the wells in different regions of Diyarbakır province. The other purpose of the study is to inform about stocking of produced oil and water by using surface systems, separation systems of oil from the water, injecting of separated water to water injection wells, analysing the downhole and surface equipment failures for production wells and environmental effects of oil production. Giving information about the economical aspect of the oil production for Turkey and Diyarbakır region is also one of the other goal. Solutions are offered for the encountered problems during the production, separation, transportation, and the refinery processes of the reserves in Diyarbakır city of Turkey, that imports most of its petroleum and natural gas use despite being very close to relatively large reserves.

1. Introduction

With humanity, energy continues its existence in the life of man every day in different forms. The development of civilizations caused the more need for energy and accordingly energy sources have changed. Materials that were ready to burn in nature for many years were the primary energy source, but after the Industrial Revolution coal became the primary energy source. Along with technological needs that have evolved over time, coal has left its place as the most important source of energy today, oil and natural gas. With the increasing importance of oil, Turkey have begun to oil exploration and production activities as many other countries. After the 1940s this work has given further momentum. As a result of the work made for these purposes around the Turkey's southeastern province of Diyarbakır, oil was first found in 1963. In the following years, the number of discovered fields are reached 42 with the contributions of private and state companies. This oil fields spreaded all around the Diyarbakır especially in the northern regions are concentrated. (Figure 1)



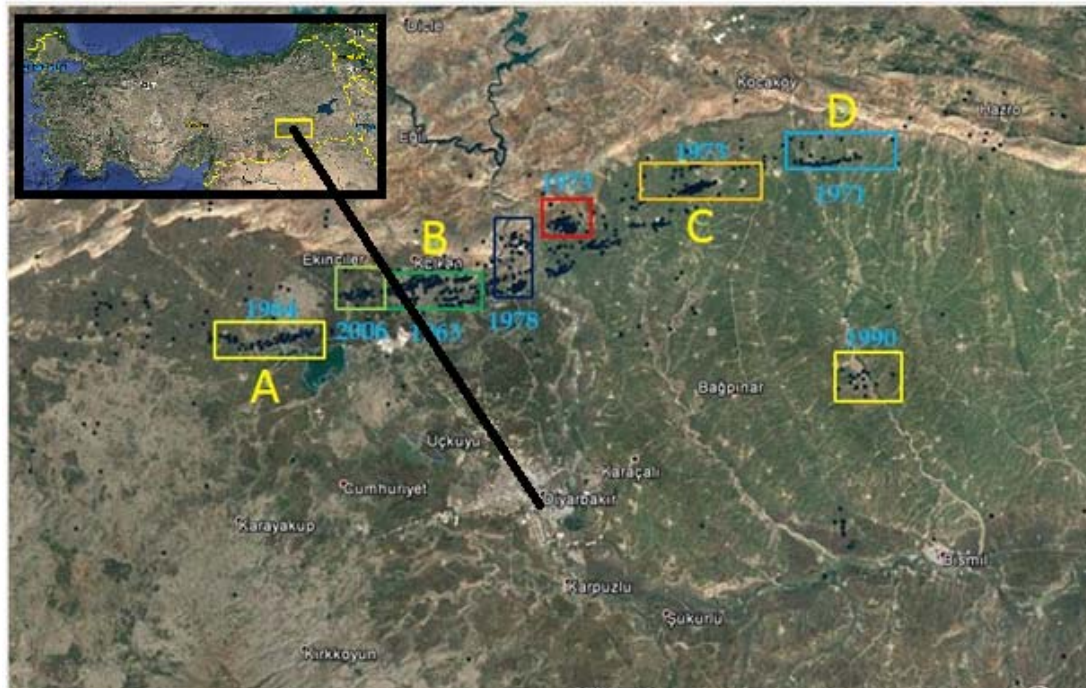


Figure 1. Distribution map of Oil Fields around Diyarbakır province

In Diyarbakır, the production mechanism of the reservoirs from which the petroleum was extracted is in the form of water treatment, and reservoir shows structural trap feature. The reservoir rocks are lithologically characterized by limestone, carbonate and dolomitic limestone properties [1]. The name of formations in which the petroleum is extracted from averagely 1500-2400 meters below the ground are Mardin group and Diyarbakir group. General formation features showed in table 1 for 4 different regions (A, B, C, D) painted on figure 1.

Table 1. General reservoir features of Diyarbakır Oil Fields [2]

REGIONS				
	A	B	C	D
STRUCTURE	ANTICLINAL	ANTICLINAL	ANTICLINAL	ANTICLINAL
TRAP	STRUCTURAL	STRUCTURAL	STRUCTURAL	STRUCTURAL
FORMATION	MARDİN	MARDİN	SABUNSUYU	DERDERE
LITHOLOGY	CARBONATE	CARBONATE	DOLOMITIC LESTONE	DOLOMITIC LESTONE
AGE	CRETACEOUS	CRETACEOUS	CRETACEOUS	CRETACEOUS
PRODUCTION MECHANISM	WATER TREATMENT	WATER TREATMENT	WATER TREATMENT - EXPANSION	WATER TREATMENT
WELL DEPTH (m)	1900	1600	2100	1600

In 2018, There are 42 oil fields in Diyarbakır and 32 of them are actively producing oil. Oil and water samples taken from the above-mentioned regions are examined and it is seen that the API gravity of petroleum varies between 26-32 API, which is medium quality, as seen in Table 2, and that the water salinity has values close to meteoric water (between 5000 ppm-20000 ppm). The pH range in the water varies from 6.5 to 7.

Table 2. General Oil in water features of Diyarbakır Oil Fields

	REGIONS			
	A	B	C	D
API	26	31	32	29
Ph	7	7	6,5	7
SALINITY (ppm)	7000-13000	5000-11000	9000-17000	4000-10000

Since the water / petroleum ratio in the samples taken from the producing wells in Diyarbakır is very high, it is possible to separate the oil from the water by using chemical and physical separation systems. Depending on the production rate and the emulsion ratio, chemical separation is achieved by injecting certain amounts of emulsion breaker chemical into the production lines. The physical separation is made by a system called separation tank system in which the fluid coming from the wells is kept waiting in big tanks and the separation of oil and water is carried out or the fluid coming from the well is heated by heating systems especially in cold weather for reducing the surface tension of petroleum. (figure 2, 3).



Figure 2. Tanks separating petroleum from water by overflow system in Diyarbakır, Kurkan oilfield

Generally three types of pump systems are used in Diyarbakır. the most important data for choosing the suitable pump is productivity index (PI). progressive cavity pumps (PCP- figure 4-A) are also used for lower gravity but higher flow rates(100-1000 bbl/day), electrical submersible pumps (ESP-figure 4-B) are used for higher flow rates (400-10000 bbl/day), sucker rod pumps (SRP-figure 4-C) are used for lower flow rates (50-600 bbl/day) and lower oil gravity reservoirs. The pump types using in Diyarbakır showed in figure 4.



Figure 3. Heater treater system in which water, oil and gas are separated by heating method (Diyarbakır, Sarıcak)

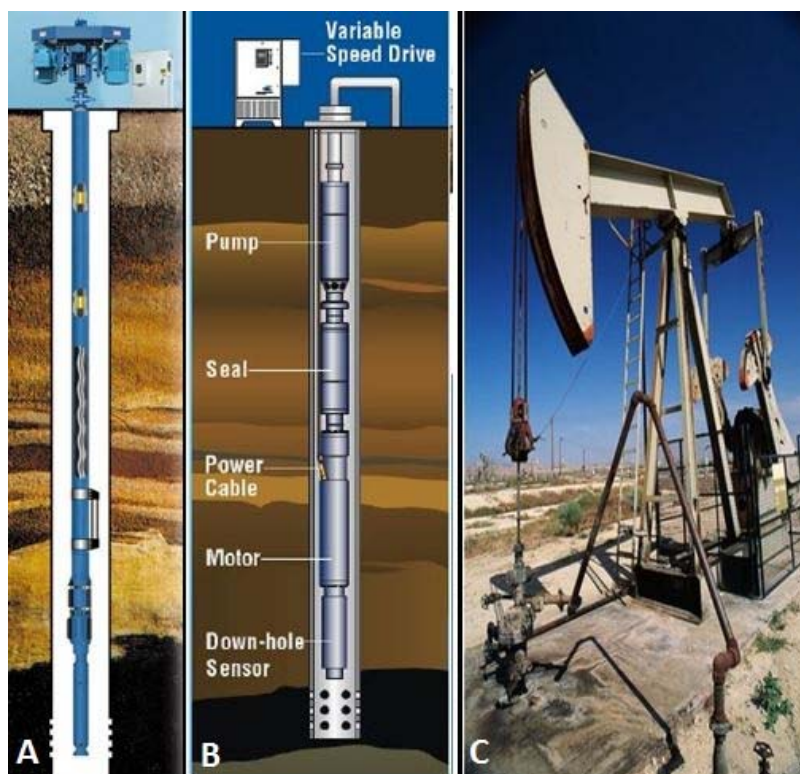


Figure 4. The pump types using in Diyarbakır

Due to the high water content, the production of corrosive chemicals such as H_2S with the oil causes corrosion in the pump, tubing, production line and tanks. While fibre pipes are used to prevent underground defects caused by corrosion, corrosion prevention chemicals are also being used on

surface lines to prevent this problem. In this regard, there are also special works carried out in Diyarbakır fields. [3]

Another problem encountered in production lines in Diyarbakır fields is scale formation. In some cases, scale formations were observed in the pipelines due to the combination of the production from different reservoirs. Scale is an undesirable condition that causes diameter contraction in pipelines, causing the increase of pipe line pressures and even line leakages. [4] Figure 4 shows the contraction of the pipe after barium sulfate scale formation.



Figure 5. Narrowing of pipe after BaSO₄ scale formation in Sarıcak , Diyarbakır.

Producing of well with high water percentages in Diyarbakır causes high volume of waste water drainage problem, injection of waste water to the injection wells needs more energy costs. In some wells, water ratios may increase suddenly due to water coning. After water coning or high water percentages, gel applications are made in Diyarbakır for lower water cut, so lower water makes lower costs for injection of waste water. With the injection of polymer gel, the discharge energy cost can be reduced by reducing water production. Some criteria are considered for the selection of the most suitable wells for polymer gel application [5]. Table 3 shows the production values in some wells before and after polymer gel application in A region wells showed figure 1.

Table 3. Pre and after gel application comparison for some wells in Diyarbakır

A Region Wells	PRE-GEL APP.			AFTER GEL APP.			Difference of oil Production bbl/d	Decrease of water Production bbl/d
	Gross . bbl/d	% water cut	Oil bbl/d	Gross . bbl/d	% water cut	Oil bbl/d		
w-1	2720	99	27	360	98	7.2	-20	2340
w-2	1108	99	11	240	88	28.8	17.72	885.72
w-3	4571	99	46	105	100	0	-45.71	4420.29
w-4	1863	99	19	470	80	94	75.37	1468.37
w-5	2296	98	46	176	94	10.56	-35.36	2084.64
w-6	1715	98	34	410	25	307.5	273.2	1578.2
w-7	4680	99	47	760	57	326.8	280	4200
w-8	720	97	22	290	50	145	123.4	553.4
			251			920	668.62	17530.62

2. Results and discussions

As seen in Table 1, there are reservoirs with water treating and structural trap in Diyarbakır region and oil production is done at an average of 1500-2400 meters' depth. As seen in Table 2, the API gravities of petroleum samples taken from different fields were measured and it was determined that Diyarbakır petroleum is in the middle class. It is understood from the salinity values of the water samples (5000-20000 ppm) taken from the wells that the reservoir water is connected to the surface water.

It has been observed that some physical and chemical methods have been used to separate the Diyarbakır oil from the reservoir water, and separation is less difficult and cheaper compared with heavy oil separation.

Corrosion is one of the most important problem encountered in Diyarbakır oil fields. Analysis of samples taken from the wells showed that reservoir has H_2S , CO_2 , O_2 compounds which are corrosive molecules. The use of corrosion inhibiting chemicals to prevent corrosion is needed for Diyarbakır fields.

Pipe line leakages and occlusion of pipes due to scale formations are another problem encountered. Preventing of scale by the way of analyse of combining waters, which have the scale potentials, before surface equipments are installed is very important.

In Diyarbakır fields where has high water production, there are wells that the injection of polymer gel is successful and unsuccessful. It is seen that the selection of correct wells for gel application provides less water injection costs and more oil production as shown in table 3.

3. Conclusions

Turkey is despite being close in distance to the Middle East is too far to the Middle East in terms of oil wealth, so oil has a large share in country imports. Therefore, oil producing regions such as Diyarbakır exhibits very great importance for the national economy. To avoid the problems encountered during production, applying enhancing oil production methods and taking cost-cutting steps are also very important. Taking preventive precautions against the problems encountered during the oil production, making efforts to increase the production will provide great contribution to the economy of the country

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