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Study of Some Physical and Chemical Analysis of Treated Produced Water on Heglieg Oil Field

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Abstract: Heglieg oil field (HOF) is located in West Kordofan State. This work aims to assess some produced treated water chartraization. Treated water from HOF Water samples were collected in clean containers after treatment physical and chemical properties of treated water in HOF area were investigated. The pH and electric conductivity (EC) were measured using a pH meter and a conductivity meter, respectively. Percentage amount of oil and grease was measured using oil and extraction method with Soxlet apparatus. The concentrations of metal elements of the water, samples were measured using an atomic spectrophotometer. In Heglieg oil field the treated water was strongly alkaline (pH 8.9), EC (1.4 dS/m) and oil and grease was 1.3 mg/L. These results are within the standard of the Ministry of Petroleum. The elements detected in meq/l were Na (204), Mg (61.77), K (2.24), Fe (1.163), Cr(0.010), Ca(0.013), Cu(0.006), Co(0.001), Cd (0.094) while Pb and Mn were very trace.

Introduction

In subsurface formations, naturally occurring rocks are generally permeated with fluid such as water, oil, or gas (or some combination of these fluids). It is believed that the rocks in most oil-bearing formations were completely saturated with water prior to the invasion and trapping of petroleum (Amyx *et al.*, 1960). The less dense hydrocarbons migrated to trap locations, displacing some of the water from the formation in becoming hydrocarbon reservoirs. Thus, reservoir rocks normally contain both petroleum hydrocarbons (liquid and gas) and water. Sources of this water may include flow from above or below the hydrocarbon zone, flow from

within the hydrocarbon zone, or flow from injected fluids and additives resulting from production activities. This water is frequently referred to as “connate water” or “formation water” and becomes produced water when the reservoir is produced and these fluids are brought to the surface. Produced water is any water that is present in a reservoir with the hydrocarbon resource and is produced to the surface with the crude oil or natural gas.

When hydrocarbons are produced, they are brought to the surface as a produced fluid mixture. The composition of this produced fluid is dependent on whether crude oil or natural gas is being produced and generally includes a mixture of either liquid or gaseous hydrocarbons, produced water, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that may have been placed in the formation as a result of exploration and production activities. Production of coal bed methane (CBM) involves removal of formation water so that the natural gas in the coal seams can migrate to the collection wells. This formation water is also referred to as produced water. It shares some of the same properties as produced water from oil or conventional gas production, but may be quite different in composition.

Knowledge of the constituents of specific produced waters is needed for regulatory compliance and for selecting management disposal options such as secondary recovery and disposal. Oil and grease are the constituents of produced water that receive the most attention in both onshore and offshore operations, while salt content (expressed as salinity, conductivity, or TDS) is a primary constituent of concern in onshore operations. In addition, produced water contains many organic and inorganic compounds. These vary greatly from location to location and even over time in the same well.

The organic and inorganic components of produced water discharged from offshore wells can be in a variety of physical states including solution, suspension, emulsion, adsorbed particles, and particulates (Tibbetts *et al*., 1992). In addition to its natural components, produced waters from oil production may also contain groundwater or seawater (generally called “source” water) injected to maintain reservoir pressure, as well as miscellaneous solids and bacteria. Most produced waters are more saline than seawater (Cline, 1998). They may also include chemical additives used in drilling and producing operations and in the oil/water separation process.

Treatment chemicals are typically complex mixtures of various molecular compounds. These mixtures can include:

1- Corrosion inhibitors and oxygen scavengers to reduce equipment corrosion.

2- Scale inhibitors to limit mineral scale deposits; biocides to mitigate bacterial fouling.
3- Emulsion breakers and clarifiers to break water-in-oil emulsions and breakers to break oil-in-water emulsions.
4- Coagulants, flocculants, and clarifiers to remove solids; and Solvents to reduce paraffin deposits (Cline, 1998).

In produced water, these chemicals can affect the oil/water partition coefficient, toxicity, bioavailability, and biodegradability (McCutcheon & Schnoor, 2003).

Materials and Methods

Hegleig oil field:

This study landscape is located in the high wood land savanna zone in Western Kordofan State latitude 9.5958N, 9.99944°N longitude 29.23E, 29.39861°E. The rainy season begins in mid-May, causing a surge of foliage and regrowth in natural vegetation areas as well as in crops and pasture grasses. This period normally lasts until the end of September. The dry season begins in December, lasting until May. The landscape as a whole includes secondary forest fragments, pastures, and crop fields.

Rainfall annual average in the area is 570-800 mm; the annual maximum temperature average is 28.0ºC and the minimum temperature is 18ºC.

Heglieg treated water Bioremediation system:

The system consists of a series of 6 lagoons, 6 reed beds and 6 small canals. On exiting the reed bed the treated water is fed into a large forest areas.

Measurement of Biophysical Parameters

Sample collection produced:

Produced water was collected from Heglieg oil field in western Kordofan state. The samples were kept after collection in brown glass bottles closed tightly for further analysis while the pH and EC were measured immediately. Each sample was replicated three times.

Produced and analysis

Determination of pH:

The pH was determined using pH meter with glass electrode (Tandon, 1993). Three replicated samples of 50 ml of water were each taken in 100 ml clean beaker and the pH glass electrode was immersed, and the reading was recorded.

Determination of electrical conductivity (EC):

The electrical conductivity (EC) was determined using Electrical Resistance Bridge model (CM 35) according to the method of Tandon (1993). Three replicated samples of 50 ml of water were taken in 100 ml clean beakers and the conductivity cell was rinsed with distilled water and then with the sample. The reading was recorded.

Determination of elements:

The determination of elements was done by atomic absorption spectrophotometer (Perkin, 1994).Three samples each of 50 ml were filtered through a 0.45 micron micro-pore membrane to avoid clogging of the burner capillary. The determination of each sample was directly determined. The concentration of each element by atomic absorption spectroscopy (Perkin, 1994) was recorded.

Determination of oil & greases:

This measurement was done in the Central Petroleum Laboratories (CPL). Soxlet extraction method by hexane solvent on samples of produced and waste water was used. (Examination of Water and Waste Water, 1998).

The sample was acidified by 1 ml conc. Hcl and extracted in a soxhlet apparatus at a rate of 20 cycle /h for 4 h.

Oil and grease were calculated using the following equation:

Oil and grease % of dry solids:

$$= \frac{\text{gain in weight of flask, g} \times 100}{\text{Weight of wet solids, g} \times \text{dry solid fraction}}$$

Results

pH ,EC and oil and greases means of the treated Produced water

The results showed that treated Heglieg oil field produced water pH was greater than 8 alkaline and the EC ≥ 1.0 (table1). According to Ministry of Petroleum Standard (2014), the pH and oil and greases were within the standard limits.

Elements concentrations in treated produced water

The results showed that elements concentration in treated produced water in Heglieg oil field was high in Na, Mg, K, and Fe and low in Ca, Zn, Cu, Co while Pb and Mn were not dedected (table 2). According to the Ministry of Petroleum Standard minerals, minerals results were within the standard.

Tables

Table (1) pH, EC and oil and greases means in treated Produced water in Heglieg oil field

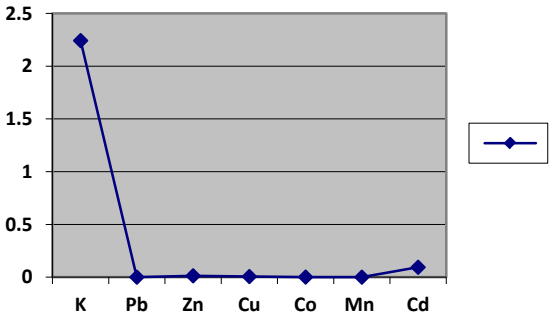
Waste water	p H	EC (dS/m)	Oil and greases mg/L
Mean	8.9	1.4	1.3
Standard	6-9	-	5

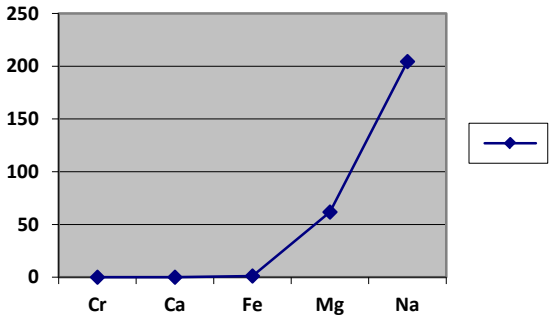
Table (2) Elements concentrations in treated produced water in Heglieg oil field

Produced water	**Cr**	**Ca**	**Fe**	**Mg**	**Na**
Mean mg/L	0.010	0.013	1.163	61.77	204.4

K	**Pb**	**Zn**	**Cu**	**Co**	**Mn**	**Cd**
2.242	0	0.013	0.006	0.001	0	0.094

Figures





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