WATER TREATMENT RESULTING FROM THE EXPLOITATION OF GAS DEPOSIT - CASE STUDY

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ABSTRACT

The water produced is the water brought to the surface through the oil and gas wells. It is made of natural deposit water, mixed with the hydrocarbons in the deposit. Due to the fact that more and more deposits are reaching maturity, the volume of water produced increases over time, so its disposal is now mandatory and conditions the continuation of gas production. Separation of the impurity gases is carried out within the group of probes, by means of installations called liquid separators. They are mounted on the path of each pipe of the well's supply, and their maintenance is equal to the duration of the probe's production time. The mounting of the separators for the adduction wells is usually done inside the well group, so that they can be controlled and exploited according to some rigorously designed schemes. This study presents the separation of the gases from the water using the separators with F.S. filter type.

Keywords: *deposit, separators, filter, gas, water injection*

INTRODUCTION

The exploitation of natural gas is most often associated with the "exploitation", independent of our will, of the reservoir water, condensate or other mechanical impurities. Separation and retention of liquid and solid impurities resulting from or resulting from condensation due to lower temperatures in the extraction pipes, is the most important function of the surface technological installation, at a natural gas extraction well. Due to technological interests, it is necessary to perform a 3-step separation of the gas from the other impurities. Of all the impurities, the reservoir water raises the most delicate problems.

PRODUCED WATER

The water produced is the water brought to the surface through the oil and gas wells. It is made of natural deposit water, mixed with the hydrocarbons in the deposit. Because more and more deposits are reaching maturity, the volume of water produced increases over time, so its disposal is now mandatory and conditions the continuation of gas production.

The produced waters are usually salt solutions, having a high content of substances. In figure 1. the range of possible components of the produced water is presented. In general, the produced waters are very complex, there are numerous methods of treating them. In some cases, the separation of the water from the crude oil can be easily achieved by simple gravitational separation. In this situation, the quality of the separate production water has almost the same values as the water quality needed for the injection. However, there are deposits for which the fluids produced can contain stable emulsions, H2S, fine solid particles in suspension and sand. In these situations, treating it to obtain sufficiently pure / clean water to be injected back into the layer can be a real challenge. Taking into account the main impurities found in the production water, the treatment process will focus on the separation of the oil / water emulsion and the removal of the suspended solids and crude oil. [1]

In addition, various chemical treatment methods may be needed to ensure corrosion control, crust formation and bacterial activity.

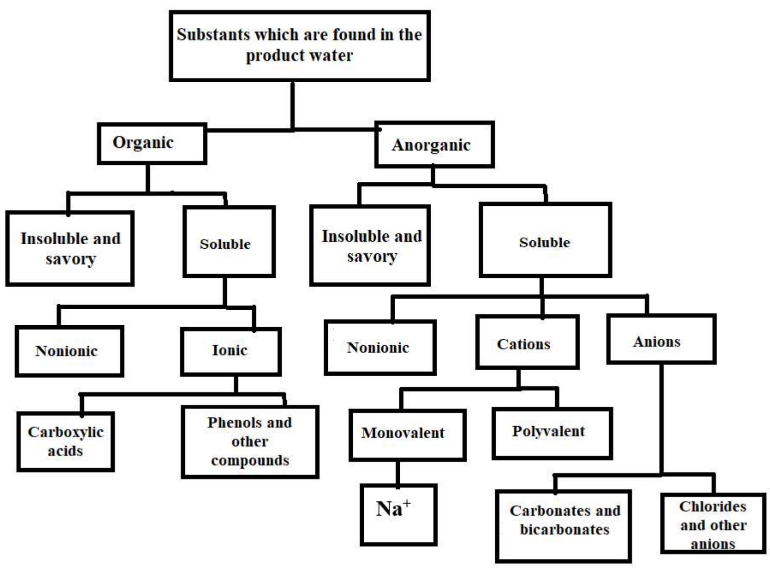

Fig.1. *Possible constituents of the water produced.*

WATER TREATMENT: METHODS AND METHODOLOGY

The properties of the deposit formation determine the quality of the water needed for the long-term success of the injection process. In this sense, the water source usually requires special treatment. The use of this treatment is mainly determined by the quality of the raw water available and the quality of the water needed. Each source of water, for example water from aquifer, seawater or production water, requires special treatments. This analysis will focus on the water produced from the gas fields, as this is the most widely used source of water for injection, requiring also underground drainage.

Methods

Separation of the impurity gases is carried out within the group of probes, by means of installations called liquid separators. They are mounted on the path of each pipe of the well's supply, and their maintenance is equal to the duration of the probe's production time.

The mounting of the separators for the adduction wells is usually done inside the well group, so that they can be controlled and exploited according to some rigorously designed schemes.

The operating principle of liquid separators is based on the use of centrifugal force (centrifugal separators with filter type F.S.- fig. 2 a, b, c), or gravitational (gravitational separators - fig. 3.a and b). Gravitational separators are the most numerous and functionally support the separation of water by depositing it at the bottom of the separator. [2], [3]

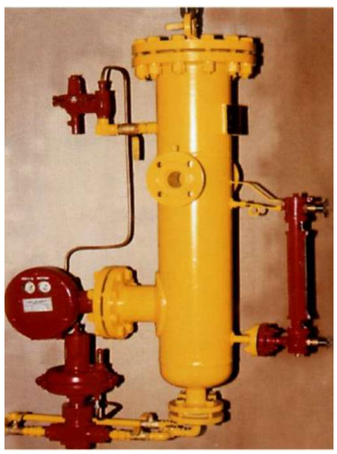

Fig. 2. a *F.S type natural gas separator filter*

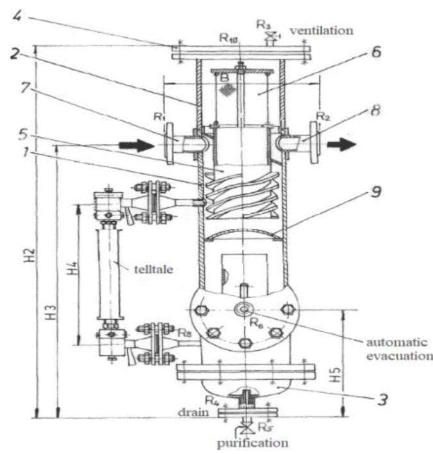

Fig. 2. b *-F.S.- with automatic evacuation*

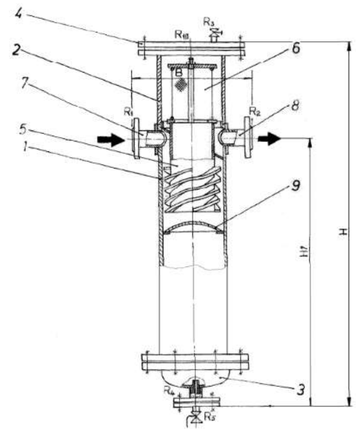

Fig. 2. c *- F.S. - without automatic evacuation and without level indicator*

F.S. type filter components:

1. the body of the separator;
2. the filter body;
3. blind flange provided with drain and purge connection;
4. blind flange provided with vent connection;
5. separator tube;
6. filter cartridge;
7. Inlet connection provided with flange;
8. outlet connection provided with flange;
9. deflector.

Methodology

The operating principle of the filter type F.S.

- the gas enters the separator body through the inlet connection;
- a centrifugal motion is printed here;
- due to the centrifugal and gravitational forces, the solid and liquid particles are mostly separated in the separator tube;
- the gas then hits the deflector, changing its direction by 180 °, then passing through the filter cartridge to the outlet through the filter body;
- the filter cartridge will hold the rest of the solid and liquid particles. [4], [5]

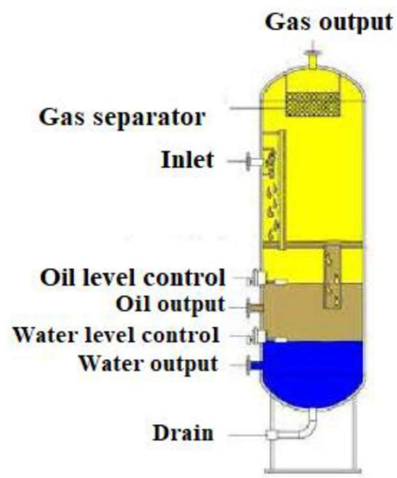

Fig. 3. a *Schematic of the three-phase vertical gravity separator*

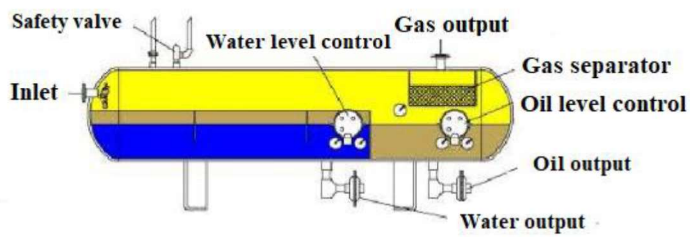

Fig. 3. b *Schematic of the three-phase horizontal gravity separator (SOT).*

The horizontal gravity separator is used in gas processing plants to separate impurities from natural gas. The separator can also be used to separate the liquid phases from the extraction gas fields.

WATER TREATMENT RESULTING IN THE EXPLOITATION OF OMEGA GAS DEPOSIT - CASE STUDY

For the groundwater, the analyzes that are carried out consider the degree of pollution with liquid or gaseous petroleum products. The natural state of the groundwater is influenced by the characteristics of the rock layers and the subsoils they cross. In some situations, there are strong interactions between naturally occurring compounds in groundwater and compounds from various sources of pollution.

In general, the status of groundwater is characterized by the size of the following parameters:

- content of petroleum products;
- temporary and permanent hardness;

- pH;
- suspensions;
- dissolved gases;
- anion content;
- radioactivity;
- electrical conductivity;
- corrosiveness;
- microbiological content;
- organoleptic characteristics.

The assessment of the results obtained from the analyzes carried out on the samples taken from the reservoir waters must take into account the degree of precision of the methods and the analysis equipment used. [1], [5]

The water resulting from the exploitation of the OMEGA gas deposit is analyzed and the resulting values are passed in the analysis bulletin represented in table 1.

RESULTS

Table 1. *The result of the analysis for the water resulting from the exploitation of the OMEGA deposit*

Nr. Crt.	Determination	Measured value	U. M.	Method of determination
1	pH	6,1	PH units	**SR ISO 10523-2012**
2	Chloride	105469,12	mg/l	**SR ISO 9297/ 2001**
3	Calcium	4288,56	mg/l	**SR ISO 6058- 2008**
4	Magnezium	1288,96	mg/l	**SR ISO 6059- 2008**
5	Total alkalinity	854	mg HCO_3/l	**SR EN ISO 9963/1-2002**
6	Total materials in suspension	213	mg/l	**STAS 6953- 1981**
7	Salinity	173,80	gNaCl/l	**Laboratory analysis**
8	Salinity	17,38	% NaCl	**Laboratory analysis**

The analysis data contains the following data: [5]

1. **Beneficiary: Gas extraction company**
2. **Sample identification data:**

   Sample type: Reservoir water;
   Sample code: L1;
   Sampling point: OMEGA deposit;
   Sample collection: Laboratory;
   Date of receipt: 12.06.2017;
   Date of sampling: 12.06.2017;
   Measuring conditions pH: 25 ° C;
   Water density: 1.110 g / cmc.

3. Performer: Analyst X

The used equipment to measure water salinity is a laboratory conductometer for EC / TDS / Salinity with ATC-HI 2300 (Fig. 4). It is a device for measuring electrical conductivity, salinity and temperature.

The meter uses a 4-ring potentiometric conductivity probe with platinum sensors. By using four-ring probes, it is possible to measure very low or very high conductivity levels without having to change the probes.

The HI2300 also offers three options for temperature compensation, as well as an adjustable temperature coefficient. It can be connected to the computer via USB, facilitating the transfer of measured data.

This apparatus is designed for choosing the appropriate conductivity and can be easily changed in salinity mode to measure from 0.0 to 400.0% NaCl.

For calibration the apparatus will be made using the standard HI7037 100% NaCl solution.

***Fig. 4** - Laboratory conductometer for EC / TDS / Salinity with ATC - HI 2300. [5], [6]*

Before transporting crude oil and gas for processing, they are treated on site by removing sand and water. If the oil and gas are extracted together, their separation takes place.

The scheme for separating water, oil and gas is presented in figure 5.

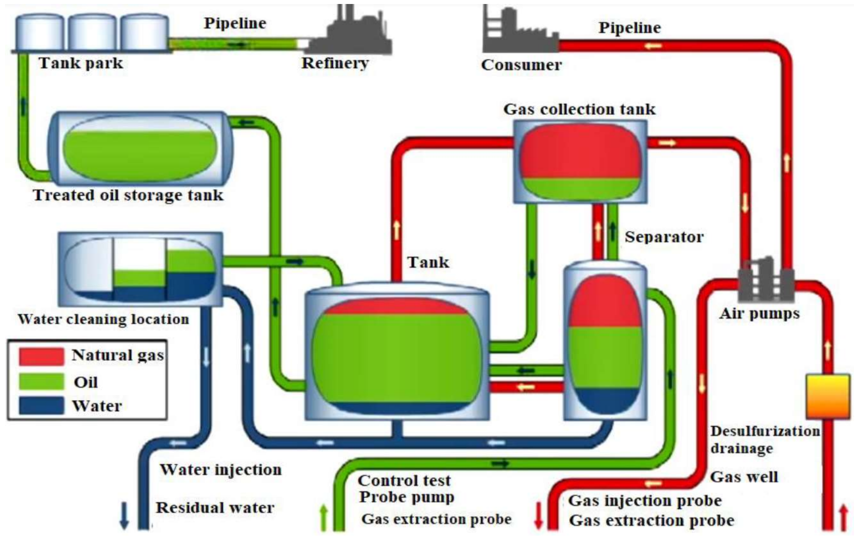

Fig. 5. *Scheme for the separation of water, oil and gas [5]*

METHODOLOGY

The probe fluid enters the separator body through the inlet connection and meets the deflector (1). Due to the impact, an initial separation of the liquid from the gas occurs and atomization of the fluid flow leading to a faster separation of the droplets. The liquid is directed to the accumulation area, and the large droplets carried by the gas flow immediately begin to fall due to the gravitational force, the phenomenon being favored also by the sudden decrease of the speed as the passage section increases.The gas, which has low density, and the small droplets will float in the upper area of the vessel, while the liquid phases will accumulate at the lower part of it. There is a natural separation between water and liquid hydrocarbons, because water has a higher density than that of hydrocarbons. A separation plate (7) delimits the area of accumulation of water from that of hydrocarbons. The plate (7) has adjustable height, in this way it is possible to adapt the operation of the three-phase separator to very different concentrations of the phases present in the well fluid. Further, the fluid passes through the coalescer plates (3) which are intended to facilitate the fusion of the droplets of liquid for their gravitational separation. To reduce the tendency of foaming of the liquid phase, the separator is provided with a soothing plate (4). Before leaving the vessel, the gas passes through the tank (5) which will filter out the small droplets remaining in the stream. The gas pressure is kept constant by means of a pneumatic pressure regulator. Water and liquid hydrocarbons are discharged through specially provided fittings. Their purging is done with the help of pneumatic control valves, controlled by pneumatic level controllers. Liquid levels can be observed using visual magnetic level indicators. After the phases are separated and leave the separator vessel, their measurement is followed. [5], [7]

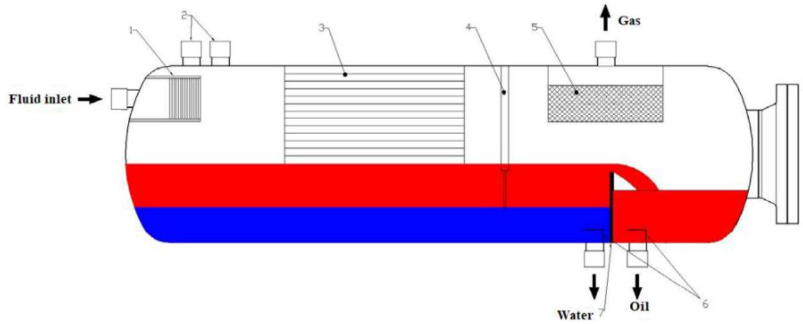

Fig. 6 *- Three-phase separator vessel 1 - deflector; 2 - safety valve connections; 3 - coalescer plates; 4 - calming plate; 5 - demister; 6 - flow stabilizers; 7 - separation plate.*

CONCLUSION

1. The quality of the injection water is the first step in choosing the treatment equipment.
2. The quality parameters of the water injection must be selected in the design of the reservoir engineering in correlation with the type of injection (above or below the fracture pressure) and the properties of the deposit.
3. The treated water is not stable (the content of suspended particles and their size increases over time), either due to precipitation of iron hydroxide, calcium carbonate, iron sulphide or bacterial activity.
4. Following the separation action next to the water from the gas, some hydrocarbons that are in liquid form are also separated, which must be recovered and directed to the fractionation plants.
5. After receiving and interpreting the results of the analyzes, it is determined whether the water treatment or its injection will be carried out in the layer.
6. Investigations for water treatment involve high costs, approved equipment and authorized personnel. Research results can also be used in similar cases.

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