American Journal of Oil and Chemical Technologies
ISSN (Online Version): 2326-6589, ISSN (Print Version): 2326-6570
Impact Factor: 1.135 (2017); ISI

"The role of engineering calculations and changes observed in assessment on the hydrostatic pressure of drilling fluid properties and quality of operation of oil and gas wells"

Author :……………………
Fluids Expert: National Iranian Drilling Company
Email:…………..@.......com
Title all authors : Engineering Technology Chemical Industry, Iran

Abstract: Nowadays, one of the most important parts of Fluids Engineering to drill exploration and development formation is fluids characterization test. To present these properties with quantitative and qualitative attention in accordance with the program and ISO quality management, we have to consider three up-to-date scientific parameters in equipment and laboratory science material. In this article, we discuss study's findings and research in three subjects.

1. Special and related learning and knowledge of chemistry and electrochemistry science in fluids.
2. Having modern equipment and adequate knowledge of this type of specialized equipment.
3. Solution knowledge and having knowledge of fluids test science and specialized laboratory solutions in this field.

In this context, we have considered this research in all aspects of this science and correct usage of equipment with the lowest cost, least-scale experiments and also to changes in mechanical devices method in automatic and digital method, accuracy and correctness of quantities and the difference between the percentage of errors in a digital device to its mechanical type and related it to these traditional with technical science methods and experience with theory and practical method.

In consideration of drilling fluids properties to reduce operational problems in test repositories drillings tat using cheap and traditional fluids cause serious damage to repositories. Given the current situation of modern fluid, using appropriate methods and modern equipment could be necessary in drilling fluids. In this article, we have presented new computational methods in making your invented device and modern equipment and a dispute arising from these calculations which have obtained practical.

Keywords: Modern equipment, testing methods, drilling fluids, computational science, correctness and accuracy, quality management

1. Introduction:

Drilling industry is the foremost factor in oil extraction after the oil reservoirs since access to the exploratory and developmental reservoirs in oil and gas fields is owed to drilling industry and specialists of this complex and fatigable industry. Also it is not possible to access to drilling industry except by circulation of special fluid in this industry. These fluids possess specific scientific conditions e.g. chemical, mechanical, physical, electrochemical, hydraulic, thermodynamic, static, industrial engineering, chemistry of materials and equipment and accurate tools etc. per se with types of behavior under special conditions. Therefore, conducting scientific operation requires for a lot of expertise and experience in this field. National Iranian Drilling Company possesses ninety active drilling machines throughout the country and it is an international company. Each of these machineries includes mobile laboratory for the fluids. All materials and types of fluids are manufactured and tested by experts in fluids of machineries. The soluble chemical materials are prepared and standardized for testing in the central lab and sent to satellite lab. Moreover, the primary experiment is conducted on most of extracted fossil, mineral, and organic materials from exploitation reservoirs by fluid mechanical experts and their sample with the given specifications is sent to central oil laboratory. The result of these tests is so important that it may lead to make decisions accordingly toward the planning in the future. This test comprises of about 10 to 12 samples of chemical solution received from central laboratory of engineering department and the fluids and types of extracted fossil materials from the well are tested by the same solutions and the existing machines in a totally standard process. Despite high cost and shortage of the consuming solution and development of technology, this operation is still done in traditional form. Most of these machines operate mechanically and traditionally; of course, this may be the only weak point so this weak point can be relatively by ease through using experience and expertise of the elite and experienced experts and given empirical techniques. We proposed several methods for the interested readers of this field in this paper and other articles.

2. Problem interpretation:

An oil reservoir is the plainest form of collection of an oil reserve in a field and underground and the economically smallest unit in the given field. There are several fields with reservoirs with variable volume and pressure compared to any field. One of the properties on any reservoir is the identical hydrostatic pressure and or reservoir pressure in all points of reservoir and oil and or gas parts are treated under that quantity of pressure. Size and surface area vary from a few square meters to several hundred square meters in different quantities. The oil contents of a reservoir may comprise of gas, gas-oil, or mainly oil. There are some layers of minerals such as salt water saturated by calcium and types of ionic hardness in reservoir in which they may emit during operation. One of 15 known tasks of fluids is control of reservoir pressures (MombeniGodazhdar, Omid Ali, Conference on management of economy and humanities, Istanbul, Turkey, 17th May, 2015).

Measurement of physical and chemical properties of drilling fluids, especially measurement of parameters of discharge, viscosity, and density etc. is assumed very important in drilling process and extraction of crude oil because these three parameters and their factors are important in creating pressure of fluid column on reservoir. However the foremost primary test is related to fluid density that is planned by calculation of the predicted pressure in developing and possible wells is controlled in exploratory wells. Following to rising demand for fossil energy and fuels, the complexities of drilling process will be increased for improving efficiency and rate of further extraction from these deposits. Therefore, it also seems necessary to provide analyst equipment of oil industry, instruments, accurate tools, and kits for conducting standard API tests in fluids and drilling by modern and economic equipment.

The laboratory operation in chemical industries is composed of technical and non-technical qualifications where the technical qualifications are proposed under following titles:

- Application and maintenance of laboratory materials and devices
- Preparation of chemical products in lab
- Production of solution and conducting standard fluidization tests
- Implementation of tests to determine specifications of chemicals
- Skill and knowledge for techniques of balancing systems
- Potential of method of sample test in types of scale
- As the first specialized and independent laboratory, drilling fluid lab possesses the competency certificate from Iran Standard Organization (ISO). The quality control for different parameters of drilling fluids is determined according to the latest version of API (American Petroleum Institute), OCMA (Oil Companies Material Association), ASTM (American Society for Testing Materials), and IPS (Iranian Petroleum Standard) and assessment of rheology of properties in basic hydraulic systems of drilling fluids by API technique and assessment of rheology properties in basic oil systems of drilling fluids by API technique.
- Calibration of fluid loss at high temperature and under high pressure (HPHT)
- Assessment of shale and their stability in various drilling fluid systems
- Assessment of thermal resistance of types of systems of drilling fluids and types of chemicals of drilling fluids
- Chemical analysis of pilot test and conducting operational tests based on simulation in lab
- Analysis on comparative- balancing application for standardization of machine
- Preparation of various chemicals and laboratory solutions of drilling fluid

By laboratory consultations in the given wide range the importance of training and operation with equipment is revealed.

- Preparation of laboratory solutions for testing properties of drilling fluids and executive instructions as per API[8]

An experiment was practically analyzed at small scale on a sample of oil-based fluid with the quantity of Cl_2 ion in the lab and the results were given. Most of tests follow the example in the following table. In this method, sample and consumption of materials is reduced to the half rate; as a result, no change was seen in correctness of test.

Table 1: Testing of materials at various scales and variance in result

(Result) Mg/litr	Silver nitrate /CC	Potassium chromate (drop)	Distilled water/cc	Acetone/ cc	Methyl ethyl ketone /CC	Sample size /CC	row
384000	16	10	10	15	10	2	1
384000	8	7	10	10	10	1	2
378000	7.8	5	10	7.5	5	1	3
384000	8	5	10	7	5	1	4

Table 1 is based on change in formula for consumption of materials and sample to obtain PPM for calcium chloride and sodium chloride salts in oil-base drilling fluid. This technique has been simple and executable in water-base fluid. The exclusive formula for is used for calculation of CaCl2 in oil-base fluid to which only 2 is added and the sample is reduced to one half. Thereforeaccording to this formula and by placement of consumption quantity of silver nitrate in parameter in table as (A) and B percent of water quantity, an oil-base fluid will be derived from special testing device (Retor kit). The formula can be changed.

One of the exclusive formulas for calculation of properties of drilling fluids:

$$Cacl_2 M_g/lit = \frac{A \times 2 \times 15.5 \times 10^6}{A \times 2 \times 15.5 \times B}$$

Example: Notice row no 2 of Table 1 in which the amount of consuming nitrate depends on sample size. This rule applies to all fluid tests; of course if it is intensified quantity. Under condition of quantitative amount of molar unit (MombeniGodazhdar, Omid Ali, February 2015, the 2nd national conference on the applied researches in sciences of chemistry, biology, and geology, The paper about research and application of laboratory chemical soluble materials in drilling fluids). [3]

3. Computational techniques:

As density of drilling fluid is determined in resistance against inter-wall pressure of a reservoir, this empirical rule can be also used to identify fluid viscosity using free fall technique in order to compute cuttings and time of exit from one hole (length of well depth) or retardation from fluid velocity rather than current calculations for appropriate viscosity.

4. Measurement of limit speed for a spherical object or similar one in a fluid and determination of viscosity of that fluid according to Stokes' law:

Stokes' law is the basis for falling viscometers. If the static fluid is placed in a vertical glass tube we let a small metal flux with certain quantity and density to fall in the fluid. If you can record properly falling velocity of flux (time need for passing flux through two indices) the electronic sensor may be utilized for ease of operation and with high accuracy for this operation. Having flux velocity, quantity, and density for the given fluid, one can use Stokes' law for calculation of fluid viscosity.

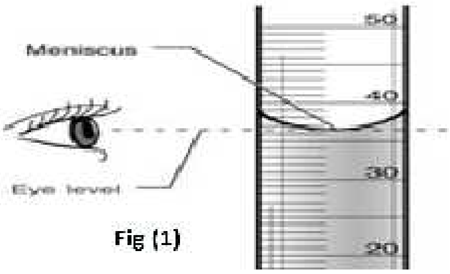


Fig (1)

A series of metallic balls with different sizes should be utilized to improve accuracy level of calculations. The needed materials are composed of fluids and also devices necessary for a sample with drilling cuttings or pseudo-cutting ball or similar volume and weight, chronometer, wedge, and pycnometer. First, ball weight should be measured and then we measure the given volume by pycnometer and drive it finally. At the next step, limit speed should be measured. To this end, we fill the column with the given fluid and turn on light source that has been provided for better visibility of metallic ball (the column is graded to measure distance of passing fluid). Now, we leave the ball through the column and measure the certain period of passing ball through the column. We do it within several time intervals to measure ball velocity within different distances.

Radius of ball or simulated object: 0.6cm (6mm)

Ball weight: 1.9g

Ball volume: $4/3\pi.r^3 = 4/3\times\pi\times(0.6)^2 = 0.9\ cm^3$

Density of spherical object or ball: ρ_p =m/V= 1.9/0.9= 2.11 g/cm^3
Limit speed: U = 2.2 cm/s
Fluid density: 50s/h-P= 1.09 g/cm^3

Error cases: It is better not to leave the ball from the high distance through the fluid if possible. The ball should move at the middle of cylinder in order to avoid from error in measurement of velocity. (Ibrahim OsarehDezfooli, Chemistry weblog) http://shimidoc.persianblog.ir/post/311

5. Criteria for selection of calibration device:

1- All measurements include permitted limit of error.
2- It necessitates for analysis of error sources.
3- To what extent calibration is done close to reality
4- Does the same value result from repeated calibration?
5- Do calibration conditions (pressure, temperature, and humidity …) affect in measurement? (Standard conditions)
6- Are operator's features involved in calibration?
7- Does the measured value remain fixed for several years? (Calibration)
8- Is calibration range selected appropriately in device?
9- What is the reaction speed versus variable quantities?

Note: The proximity of the measured quantity to the real value is used instead of standard value. Accuracy is expressed by maximum error limit of device.

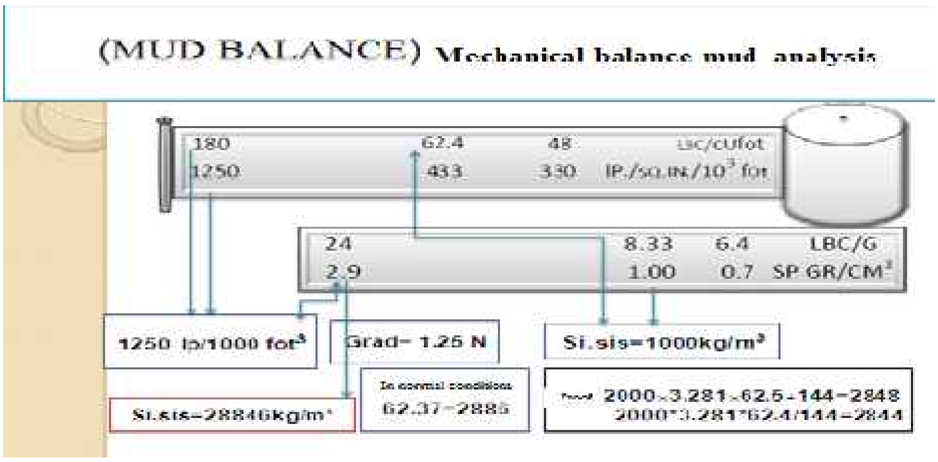
(Formula 1) $\%E = \frac{A-B}{B} \times 100$

E = A – B
E: error of measurement
A: Measured value
B: Standard measured value

Comparing to the given calibration, error number may be positive or negative. (Ibrahim OsarehDezfooli, Chemistry weblog) [5]

6. Mechanism of performance of mechanical scales for measurement of fluid density (mud balance) in a test and percent of intangible error:

1- Changes in mud balance: One can create the added pressure to and reduced pressure from predicted plan by analysis of engineering computations for a mechanical scales and the least vision error where this process may increase or decrease hydrostatic pressure. With respect to relationship between temperature and density in reservoirs, the rate of density varies by rising temperature and this should be noticed in the given computations. The following figure indicates analysis on application of mechanical scales (mud balance).



(fig. 2)

figure(2)by analysis of mechanical scales (mud balance) one can find that despite technology of complementary calculation, there is numerical difference in all three systems (SI, CGS, and PCF) especially human's vision error. With respect to preparation of digital dens meter and assuming error level (0.01), this error can be minimized as possible.

Example: In Fig 2, density of 180lb/ft3 in engineering system is 1'250 per unit (lb/SQ.IN/1000ft^3) and 2.9 in CGS system with the same pressure gradient and also 24 in British PPG system with the same equivalent. It has been shown in Fig (2) i.e. analysis of mechanical

scales that if vertical depth of a well is 2'000, by considering volume of this well (2'844- 2848), it creates hydrostatic pressure at temperature 60°C. The error of this device is ignorable but it is defective in calculation of pressure gradient. For instance, how can we ensure the bobbin on this chassis is adjusted accurately on level 62.337 or 62.43? Therefore difference is tangible. The maximum accuracy is observable in theoretical vision. Under the best conditions, if we assume water specific density 62.4 at ground level (row) we have pressure gradient at level 0.433 and if we consider water density as 62.37, error emerges at level 0.0002 and this error approaches to 0.0004 at vertical depth (column) 2'000m of the well. Regardless temperature change that can be ignored, but digital densimeter indicates water density 62.400 and pressure reaches to 0.0004 and increases 62.37 compared to weight. However at high weight this example covers the created error in mechanical system with maximum 180 lb/ft^3 and 2.9 kg/m^3 since if this level (180 lb/ft^3) is supposed as equivalent to 1'250 in other unit system, the quantity of 2.9 should be equivalent to 2'900 because 2.9 (unit) is converted from CGS system to engineering system. Number 180 in this system is equivalent to 180.96. Therefore, the created difference by digital calculations is as follows:
180÷62.4 = 2.88×1000=2884

In Fig (2), it is mainly discussed about numbers 2.9 and 180 that indicate maximum weight density in this device.

Table (2): Calculation of temperature and density of water based on various units according to imperial toolbox

Temperature - *t* - (°F)	Density - *ρ* - (*slugs/ft^3*)	Specific Weight - *γ* -	
		(*lb/ft^3*)	(*lb/US gallon*)
32	1.940	62.42	8.3436
40	1.940	62.43	8.3451
50	1.940	62.41	8.3430
60	1.938	62.37	8.3378
70	1.936	62.30	8.3290
80	1.934	62.22	8.3176
90	1.931	62.11	8.3077
100	1.927	62	8.2877
120	1.918	61.71	8.2498
140	1.908	61.38	8.2048
160	1.896	61	8.1537
180	1.883	60.58	8.0969
200	1.869	60.12	8.0351
212	1.860	59.83	7.9957

With respect to analysis of mechanical scales of fluid and with these calculations, the water density has been considered for water fluid (weight: 180 PCF) that is equivalent to 62.9 because unit quantity of 2.9 is converted from CGS system (cm^3) into SI system (m^3) i.e. 2'900. If density of water (180) is assumed 62.09 therefore density of 2.9 should be 2'884 in this unit system. [1]

7. Change in relative viscosity:

This device calculates automatically changes in system by two methods of electric conductivity and laser light spectrum that mechanically computes relative viscosity. (Table 2)

Fig (1): The invented digital device (author of paper)

Given Table (2) in which calculation of water density in engineering system is presented at different temperatures and Table (3) shows viscosity at various temperatures in SI system.

These calculations are comprehensible in Image (1). Therefore, computational calibration device with the least error is the product of our studies and it has been built for the first time in Iran and it performs digitally five tasks of laboratory accurate tools at the same time. Efficiency of this apparatus, digital densimeter, relative viscosity with Electric conductivity (EC) through fluids and new optical technique, industrial pH-meter, 5-purpose hot plate, magnetic stirrer and built-in and adjustable mixer all these parameters should be implemented in one environment and at the same time under equal conditions. Using modern fluids needs to modern calibration equipment for properties of fluids.

Unreal and wrong techniques may cover hazardous agents for the reservoirs and follow byirrecoverable cost. The effect of formation damage with traditional fluid can occur in all various phases of drilling, well finishing, stimulation, and repair and production from well. The agents which can damage this formation and structure may be classified into four main groups:

1- Mechanical factors
2- Chemical factors
3- Biological factors
4- Thermal- thermodynamic factors

Mechanical factors:

Whereas this paper mainly aims to refer to effect of mechanical and chemical factors, we deal with a summary of these two factors.

One can refer to migration of fine-grained particles e.g. sand migration from the reservoir to the well that depends on their size. They are entrapped either inside the formation or in the hub of connection between holes and block fluid stream or if they pass from these holes and entry in well they cause severe erosion in intra- and extra-well facilities. Production discharge and kind of reservoir rock can be highly determinative in occurrence of this type of damage. One of the other mechanical factors in damaging formation is the blocking cause of entrapping fluids in the porous environment (phase trapping). Some current examples of this type of damage include phenomenon of creating gas liquefactions in the liquefied gas reservoirs and tapering water and gas from upper layers to the produced layer. Mashing and grazing internal surface of well caused by contact to drilling bit is also considered as one of the mechanical factors that occur due to serious heat created by rotation of drill and it may create problem for entry of fluid into the well. Geomechanical stresses occur due to pressure of upper layers exerted to the formation. Hydrostatic pressure caused by exertion of density and rising pump pressure by relative viscosity as well as pressure loss etc. can be some consequences of error in device (Amin Gholami (Eng.), studies of Iranian Students News Agency ISNA).

Hydrostatic pressure difference in densimeter system and mechanical and digital viscometer

Density denotes a quantity of material that occupies unit of volume. Density is a scalar quantity and it needs only to amount for description. Specific weight is the weight of material existing in unit of volume or in other words the exerted gravitational forces to it. [6]

(Formula 2)

$$\gamma = \rho g = \frac{w}{v} m = \rho v$$

W: weight
V: volume

Density and specific weight depend on number of existing molecules in unit of volume:

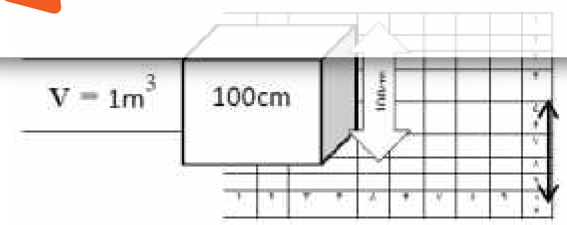
Molecular activity increase by rise of temperature and number of molecules decreases in unit of volume. As a result, density and specific weight decrease.

Expansion and contraction of water is the exception to this rule. The capillary properties are seen in fluids of internal well for this reason.

Expansion and contraction of water is different from other liquids and there is an exception in it. Similar to other fluids, water expands at temperatures higher than 4°C but it expands instead of contraction within range of zero to almost 4°C. It has the least volume at 4° to 3.98°C (39.16°F) and it expands similar to other fluids at higher than 4°C and it expands at temperature among zero to almost 4°C instead of contraction. Therefore density of water is not always 62.4 lb/ft3.

It has the maximum density (mass per unit of volume) and its maximum density is 1 g/com3 (0.9999750). Water density is smaller than this quantity at other temperatures. This is due to the same behavior of water that the upper layers of water are initially frozen. If water lacked this maximum density, it would be frozen from bottom to top and became problematic. On analysis of the following figures, volume of one cubic meter of water and density is based on kilogram.

Example: We analyze accuracy of hydrostatic in the balanced table under the cube and assume this cube as a reservoir.



N/SQ=1000Kg/m^3= 10kg/1SQ

Given that one cubic meter includes 1’000cm^3; therefore, one cubic meter is totally 1’000’000mm^3.

1000000mm^3= 1000 cm^3 =0.001m^3

Thus according to Newtonian law, the purified water with volume of one cubic meter at fixed temperature and highest molecular compressibility creates 1’000 units of gravitational force. Density of water is 1’000 kg/m^3 in SI system.

In CGS system:

$$CGS = 1000\ \frac{kg}{m^3} \times \frac{1000gr}{1kg} \times \frac{1m3}{1000000cm3} = \mathbf{1gr/cm3}$$

(Formula 3)

In Ipm engineering system:

$$1\frac{gr}{cm^3} \times \frac{1lb}{454.5gr} \times \frac{(2.54cm)^3}{1in3} \times \frac{(12in)^3}{1ft3} = \frac{1 \times 16.387 \times 1728}{453.59} =$$

62.428 *lb/fot3*, (Formula 4)

If density of water is 62.4 in above-said, weight of one kilogram of water is 999.8g in this

Given system based on Newton’s law; namely, one kilogram is not greater than 1’000g and gravitational force is not also 10 and it is among 9.8 and 10. If we suppose one kilogram as 2.2lb, the figure 453.50 become 454.5 in this system; as a result, density of water becomes 62.3. Thus, this rule is effective in calculation of big numbers. This calculation tends to determine if we put square no 10 with moving outlet in the reservoir and this reservoir is filled by water up to 0.50 what pressure is exerted to square no 10?

(Formula 5)

$$Pa = \rho gh \Rightarrow 1000 \times 10 \times 0.5 = 5000kp \div 1000 = 5kpa$$

Result: 1000x10x0.4=400pa−4kpa−0.580psi

Therefore, 4kPa pressure is exerted on this outlet i.e. equivalent to 0.580 psi.

$$\mathbf{5kp} \times \frac{1at}{101.3kp} \times \frac{14.7psi}{1at} = \mathbf{0.0725psi} \qquad \text{(Formula 6)}$$

In these computations value of **0.0725×14.7 = 1.065psi** is derived by the former method as 0.710 because Formula (6) is used in this system.

$$\mathbf{P.HL} = \frac{0.5 \times 3.281 \times 62.4}{144} = \mathbf{0.710 \Rightarrow 0.5 \times 3.281 \times 62.4 \div 144 = 0.699}\boldsymbol{psi} \qquad \text{(Formula 7)}$$

We examine the same calculation in cyclic space in an oil well under drilling with 3’000m depth and at the given temperature from the fluid (140°F) with respect to density of inverse fluid in dialysis space. According to international engineering table (2), temperature of 140°F with density of (61.38 lb/ft^3 (PCF)) in pumped water fluid is placed at temperature 32°F and density of 62.43 PCF will be 61.38 PCF in cyclic surface and space. Given the mixed fluid is contaminated by cutting and natural muds, based on objective observation the inverse fluid weight (63.5 PCF) exerts pressure 4’340.48 psi. If density of inverse fluid is 62.4 after refinement and coldness, density of fluid in pipes and bottom of well may be 61.38 that create pressure difference with cyclic space. It exerts equivalent pressure 4’195.57 psi to the reservoirs. If we consider weight of mixed fluid to cuttings, we have positive pressure difference 144.91. If density of drilling props does not affect in density of fluid, based on equivalent difference in following calculation, (specified to drilling fluids: effect of rising density and heavy fluid with reducing density)In a direct and indirect control system, the pressure inside the wells falls outside the engineers:

$$\mathbf{P.HD} = \frac{3000 \times 3.281 \times 61.38}{144} = \mathbf{4195.57}$$

$$\square\ \mathbf{3000 \times 3.281 \times 62.4 \div 144 = 4265}\boldsymbol{psi}$$

Equivalent pressure difference may change idleness or flow in one reservoir we are exposed to it because in fragile and low-pressure reservoirs, pressure difference of formation should be very low with pressure of fluid column. These issues are proposed with respect to thermodynamics and theoretical laws. Precision of all these computations requires for necessity of advanced equipment for calibration of properties of fluids. This point should be added to these calculations (+++) because other properties of fluid that is relevant to this topic and follow temperature and changeable and they may intervene in this process. Temperature is too high at depth 3-4 thousand meters but due to pressure of fluid column and lack of space for expansion, the density is low. Inversely, the same quantity is visible when fluid approaches to surface reservoirs and becomes cold in rising weight.

Therefore effect of temperature, density, and accuracy in quantity and precision of quality in calibration device, work knowledge and awareness about this device and the resulting operational experience is vitally important for economy and development in this industry. We explore briefly subject of viscosity in various systems due to importance of this knowledge. Kinematic viscosity of water at temperature 20-25°C is deemed as Stokes parameter in kinematic unit which 26s in Marsh Funnel viscometer and it is 1.79 centi- Stokes at zero temperature. This unit is 0.294 centi-Stokes (or centi-poise) at 100°C and pressure of 23.83 g/cm3, the common relative viscosity of fluid is derived from Marsh Funnel viscometer. Viscosity unit in Newton’s law and Reynolds number determine rate of fluid resistance against motion and flowing and it is shown by symbol *mu* μ in which force is exerted to surface area and fluid is placed between parallel pages of force.

Viscosity in centi-poise (CP) unit is based on stress (τ) is equal to fluid pressure (Pa/s) and fluid velocity (m/s), and fluid distance between the given objects.

$$\mu = \frac{26cp}{1000} = 0.026\ Pa.s$$

We calculate velocity 1m/s and distance of 1cm between two objects. CP unit is very small in CGS system. The 100 centi-poise is equivalent to 1poise. Namely: [5]

$$4000cp = 40poise$$

$$1cp = \frac{1poise}{100cp} \times \frac{0.1pa.s}{1poise} = 0.001pa.s \qquad 4pa.s$$

$$= \frac{1poise}{0.1pa.s} \times \frac{100cp}{1poise} = 4000cp$$

(Formula 8)

Table(3): Thermodynamic table for water properties in CGS and SI systems (Iranian Scientific Hydrology Association, properties and specifications of water)

Temperature (°C)	Density (g/cm^3)	Specific weight	Latent heat of vaporization (kj/g)	Dynamic viscosity (centi-poise)	Kinematic viscosity (centi-Stokes)	Vapor pressure (mmHg)	vapor pressure (g/cm^3)
0	0.99984	0.99987	2500	1.79	1.79	4.58	6.23
5	0.99996	0.99999	2489	1.52	1.52	6.54	8.89
10	0.99970	0.99973	2477	1.31	1.31	9.20	12.51
15	0.99910	0.99913	2465	1.14	1.14	12.78	17.38
20	0.99821	0.99824	2453	1.00	1.00	17.53	23.83
25	0.99705	0.99708	2441	0.89	0.893	23.76	32.30
30	0.99565	0.99568	2430	0.798	0.801	31.83	43.27
35	0.99404	0.99407	2418	0.719	0.723	42.18	57.34
40	0.99222	0.99225	2406	0.653	0.658	55.34	75.23
50	0.98804	0.98807	2382	0.547	0.554	92.56	125.83
60	0.98320	0.98323	2358	0.466	0.474	149.46	203.19

With respect to above-said issues and table and Figs. 1 and 2, we examine pressure difference in digital electronic densimeter system by accuracy and precision and compare its value with traditional and mechanical system. The results also indicated that the necessity for densimeter by its calibration in comparative automatic system in the balanced unit of SI and CGS system and unit of lb/ft3 is implemented very accurately and with the minimum error. [1]

8. Foam and air as important agents in changes of properties of fluids (density and pressure)

The foam of fluids is one of the other factors causing pressure difference and density since if air flow and foam are mixed with lighter fluid we will have reducing density and if foam and air exit we have rising density. Pressure also follows density and pressure varies by input and output of foam of fluid. This may confuse the observer engineers about inter-well pressure loss or pressure exerted by fluid. Both of cases may occur at the same time.

Fluid foam: The surfactants are classified with respect to type of their existing polar group. Anionic surfactants are one of these types of surfactants. These molecules usually include sulfonate salts and sulfates of fatty acids with chain length (8-12 carbon atoms) which are used in preparation of detergents. Sodium dodecyl sulfonate is one of the foremost and widely used anionic surfactants. If these molecules are placed in water their hydrocarbon tail is repulsed by water molecules and they are collected together in colonies (30-300 monomers) in such a way that the hydrophobic parts are placed beside each other and they are protected from contact to polar solution mass. Such accumulation is called micelle.

Micelles are spheres with polar surface and nonpolar center and suitable place for dissolution of nonpolar molecules including fats and dust stains and dirt. Therefore it seems an emulsion has been created from dissipated fact drops in water and this stability is owed to presence of surfactant molecules as micelles.

Foaming is one of the characteristics of salty fluids. Oxygen foamy agent (O_2) and carbon dioxide (CO_2) are placed in fluid and their source may be the formation and or bacterial synthesis of fluid additives.

Foaming on the surface of mud may not be generally problematic unless the amount of foam increases more by mixing with stirrers. Sometimes the quantity of foam may be reduced by rising alkalinity of mud (PM).

The experience has shown in this case if pH of fluid is higher than 10 this problem will be almost resolved.
In order to describe foam effect, it can be mentioned that for example as by shaking water and soap solution, the tiny air bubbles are entrapped in water and soap solution and a new surface of gas-liquid is formed, formation of this level is accompanied to rising surface tension. Presence of surfactant molecules reduces surface tension in solution mass. Then a gradient of surface tension is created among solution and new surface and this causes surfactant molecules to move from solution mass to the new surface and opposite moving of solvent (water) from the surface to solution mass; as a result, the created surface is dehydrated and stabilized and increased gradually. Therefore bubbles become larger and foam is created.
1- Foam created by aeration of fluid (Aerated mud)
2- Foam created by contaminated ambience of mold agent in fluids (Mold- contaminated)
The surface foam on fluids: This type of foam is volatile and unstable and usually created at time of building fluid. It can be due to chaotic flow in fluid and it does not create problem for properties of fluid under undisturbed conditions. It is not recommended to use anti-foam under this condition (because of mentioned reason in section 2) since it is removed by constant circulation of fluid and changing their properties.
If these bubbles permeate throughout the fluid and emulsion is created, the fluid is contaminated with mold. Difference of temperature also directly affects.
Given drilling fluid is liquid-solid and gas mixture, such a phenomenon occurs in fluids as well. There is the aerated mud for treatment of a fluid e.g. salt water with starch and resin by involvement of alkaline and pH properties. If this system is going to become emulsion i.e. size of agent bubble is the same as size of particles of treated side, the exerted properties should be taken more carefully into consideration.
2-1- *Method of using filtration or semi-permeable membrane*: If foam separately moves or the fluid is passed through reservoir of apparatus via two outputs this technique is called pseudo-membrane or filtration and that process is impossible due to absence of specific hardware. By employing degasser device (C-flow) and presence of degasser oil tolls (Drike), filtration mesh should be washed after operation and or the lattice part should be detached from it before using apparatus and it should be utilized without lattice part and fluids should be passed several times to implement resolution operation.
2-2- *Using deformer (antifoam) or lubricant oils in fluids*: Based on aforesaid reason, sometimes using gasoil or oil materials in salt water, the existing polar and nonpolar surfaces and ionization of pH agent of carboxyl may create foam and concentration in activity of polymeric particles. pH change is useful. In the case of using agent polymer compulsorily, it should be tried to exit it from the fluid since if the ambience is prepared for chemical reaction, it can change in rheology properties of fluid.
I have explained it in ISI paper title ‘Importance of management of drilling fluids in oil and gas extraction’ found in address (http://pharmascope.org/ijrls/index.php/announce/review/v/5/106) in chapter regarding consequences of using oils and effect on rheology of Rheopectic and thixotropic fluid.
Important note: Antifoam does not foam-producing agents and or may not deactivate them chemically but it reduces temporarily stability in structure of produced foams. The foam agent should be identified and then treated. Types of treatment have been implied in specialized papers about contaminated fluids. [9]

1-8 Foam destruction mechanism by antifoam

Insoluble suspended oil drops enter into surface layer and they are displaced by active materials at constituent level as gaseous bubble on total surface. The force a drop needs to permeate through membrane layer is called input barrier or resistant force of membrane layer. The studies have shown that suspended particles incompatible to water in antifoams reduce input barrier force to membrane layer and make antifoam very effective and efficient. Foam structure immediately starts discharge after bubble layer of foam becomes weak and slim. Antifoam drop makes oil lens along membrane layer. Drop is drawn as membrane layers are tangent and compacted together and finally foam bubble explodes following to drawn drop tears. This action takes place during a few seconds so that it is one of features of fast antifoams. If oil drop could not enter in membrane and it destructs foam, it will be naturally entrapped in borders of foam bubble and it is led outside bubble as an additional liquid in structure of foam discharge canal. [9]

9. The role of geological phenomena on drilling fluids and in-well pressures.

The role of geological phenomena on drilling fluids and in-well pressures.
One of the most important factors in the development of drilling and its success is the constant communication between the fluid expert and the geologist and the geo-physical information issue.
In general, we must consider the four phenomena unknown, the fluid floor, the shale, the barium and the

minerals, the halite, and the polar fluid problem during drilling and their effect on the pressure inside the well. These four phenomena should be controlled, treated, and responded to the correct, timely, and useful response of the experts due to direct impact on fluids and drilling operations in various ways.

This article is not a forum for discussing these phenomena, and it should be done in trainee training courses and continuous training during staffing. But in previous papers, we brought the phenomenon of foam, or the same, the floor, and in part polar and polar fluids, and its effect, and this chapter deals with Halite's phenomenon.

Halite is a kind of sodium chloride Caso4. 2H2oSnacl, which is found mostly in the Gachsaran layer. The difference is salt with other salts in structural terms, which is soluble in solid form during the drilling process as a powder. In the empirical study of this phenomenon and the water-borne drilling fluid reaction, we found important results. As we communicated with the experts in the field chemistry field, the results of the data and the reaction of the fluid expert, we conclude that this is an exponential phenomenon and insufficient knowledge of experts and their incorrect analysis leads to delays in work, abundance and stinginess The tubes, of course, were very small due to variations in density, resulting in the eruption of mineral fluids.

Signs that are important at this time are the same symptoms associated with the loss of calcium from salt water. But fixed and without increasing volume. The Halite phenomenon appears in a special table in geology, and it identifies layers that have such conditions. And in some areas, such as the Unpacked Persia Given that without any research and practical laboratory examination any scientific phenomenon can be proved, it can be said that this is the first to be reviewed.

The phenomenon of halite, anhydrite, marl, lemstone, gypsum formation, halite transformation, and this phenomenon is highly sedimentation. In investigating the reduction of the pressure of the exploited tanks, it was concluded that the cause of sediment in the wellhead is halite phenomena. If the percentage of halite in drilling fluids is more than normal, its effect on drilling pipes and in the higher parts of the well is known. First, a thin layer of clay is created. Then with the continuation of the operation and the effect of temperature, thick and finally crystalline salt is revealed. That is why, in some cases, only drill pipes in the wellhead section are experiencing such a phenomenon. In any case, with no effect on the properties of the fluid, if not carefully.

Material activity

Salt rock

$Caso_4\ 2H_2o$ Snac

Decrease PH

Rheological modifications and density reduction, behavioral flow behavior

Reduced operation efficiency, human error and cost increase, fluid weight increase, pipe misalignment,

An outflow of fluid into the well.

This phenomenon has occurred and drilling engineers in a field repeatedly led to a failure of salt water and increased pollution, which did not result in a single result. Indeed, the attempt to detect Hallite phenomena, if experts know and do not recognize it with flood water, will always fail. But this is not the reason why any changes are Halite phenomena. Because of every twenty changes one may be related to such a topic. Especially in the case of static fluid conditions, because good ROP can reduce the effect of fluid flow. Therefore, experts should always expect the risk of flood in the well. But with knowledge, knowledge and ability to analyze all the components of the pressure inside the well and a variety of balancing calculations to the specifications of the formations and information obtained from adjacent fields and their study. Considering that in drilling operations and fluids, there are not always two or two fours. Always have to choose the best way. Because the decision is wrong and it does not change in the middle. The time of decision and reaction is important.

10. Review on polarization of nonpolar fluids and organic materials in changes of viscosity:

The apparent viscosity of water-base emulsion fluid under primary production conditions when electrical stability occurs is usually due to ambient conditions and related to ionic properties, high pH, and possession of ideal phase bond. Such conditions are continued as long as the factors for linking phases are not threatened. These factors may include entry of external high-alkaline or acid fluids and calcium-content, temperature, and fermentation of polymers etc. However viscosity of oil-base fluid is subject to severe fluctuations under primary conditions as electrical stability does not take place. This factor depends on polar conditions of electrical phase of polar fluid and non- electric oil-phase. By role Electrical Conductivity (or EC) it is clarified here that phase molecular bond and suitable size have not been formed in the existing phases. By mixing fluid at higher temperature than laboratory conditions and at right time with fluid conditions, electric stability (Es') occurs and system is fixed toward becoming single-phase thereby EC current is easily facilitated. Sometimes engineers immediately add oil in case of high primary concentration of fresh fluid[1] and this causes lubrication of fluid but the fluid is subject to pause in creation of good stability (ES). This is because the fluid needs again to become single-phase or emulsified with the added new phase. Or as we add water phase to an oil fluid, the phenomenon occurs inversely. In other words, density increases and this is because of creating bipolarity of fluid and great size of molecule in water phase. The water-wetting phenomenon of solid materials, which had been under oil-wetting conditions, takes place temporarily. Due to hydrophilic nature of clay materials in contact with water or saturated liquid with monovalent or bivalent chlorine it is inflated with respect to activity rate and the electric chain reacts for the time drawn in oil fluid for the lubricant systems. For example, minerals include some levels with negative and positive charge in their crystalline network. Oil-wetting agents and surfactants with positive charge are absorbed by surfaces of minerals with negative charge. The long hydrocarbon chain is placed in oil-phase and minerals receive oil coverage and prevent from water absorption and hydrating them. In other words, nonpolar chain in oil-phase and polar head are drawn to the surface of oil drops and positive charge is created on oil drops. When these drops reach to negative surface of minerals with their positive coating they are absorbed due to electrostatic attraction and they break and a hydrocarbon layer is generated on solid materials. The anionic surfactants are absorbed in positive sites at the end of soil crystal and among oil and water. Also non-ionic materials compete for absorption on lateral surface of clay crystals. Under such conditions, wetting-oil operation is done and the fluid acquires certain viscosity and ideal properties. Now, as we add water to the fluid, this phenomenon occurs inversely. The fluid is treated with ionic reaction and this is led to fluctuations in electrochemical reactive behavior and physical behavior of fluid and it becomes wetting-water or hydrated and for some period of time, there are not active fatty acids by emulsifiers and alkyds, imidazolines, and phospholipids to play wetting role for treatment and petroleum-wetting or oil-wetting of hydrated oil to return to the first status (Abstract of analysis for research, specialized, and expert discussion for importance of subject, author of paper).

Note: If an emulsifier is used with higher solubility in polar side this causes oil drops to be placed easily as dispersive phase in a continuous phase. Thus, it is called Emulsion Mud oil, but if the solubility is higher in nonpolar side, oil is placed in the continuous phase and water in dispersive phase and they are composed of Mud Invert Oil. [4]

11. Conclusion:

By conducting calculations on percentage of the error in creating inter-well pressure and the given pressure in fluid column at critical and low-pressure reservoirs, 50 and 100 psi flow (rising volume), or given idle capacity in this process, systematic error is reduced to great extent if no human's error occurs. By adaption of new and scientific method toward the least figure, minimum error, smallest scale and the minimal consumption and cost we can conclude that despite knowledge-based nature, how this economy becomes institutionalized, monopoly is removed, and this path is paved for further studies and education. The apparatus was made for this operation along with the related studies and writing of two scientific applied papers were presented where the first essay was posited to conference of knowledge-based economy and the other became the superior essay in conference of laboratory equipment and materials in Iranian Oil Industry.[2]

The superior essay in conference of laboratory equipment and materials in Iranian Oil Industry is the outcome of our studies in surveying manufacture and application of digital laboratory automatic system for calibration of properties of fluids (relative viscosity, densimeter, ionic properties of liquids, and temperature in polar and nonpolar and emulsified fluids) in analysis of changes.

Note 1: It is for the first time in these techniques that density of drilling fluids is derived digitally by computation of scales or densimeter of mud balance electronic system.

Note 2: Relative viscosity is calculated automatically by Marsh Funnel viscometer based on mechanic law and by means of two techniques of Electrical Conductivity (EC) of fluids and laser optic spectrum as sensitive to type of fluids.

Note 3: It has been indicated in this paper what is the relationship and effective importance of the factors which have not been so far considered as important because of their trivial role. These cases include paying attention to calculations of inter-well fluid weight before and after refinement by operational experts and engineers, intangible effect of temperature, and prediction of possible invisible

1 - Fresh, ready: (here cold fluid is identified as fresh)

2 - Design new ways to optimize and reduce the use of chemical solutions at National Iranian Drilling Company

relative viscosity, combination of type of mixture, effect of created pressure in column, considering percentage of solid materials and density of mixed materials in fluid as well as computation of rate of penetration (ROP) in fluid circulation system and also the relationship among effect of density with volumes of drilling cuttings in light fluid and its impact in heavy fluid.

Similar to the previous papers, I reserve this right of criticism for my colleagues in this field of study by implying scientific reason in this paper.

Thanks to research management of National Iranian Drilling Company

12. References:

[1] Empirical laboratory studies: Theoretical and inventive bases under REG No 89793-04/09/2016, author of this paper

[2] Sediment titration technique (Karl Friedrich Mohr) on 4th November 1806 (Germany)

[3] Mombeni, Omid Ali, Role of fluids in drilling, An article posited in Conference of economic management, Istanbul Turkey, 17th May 2015

[4] Assessment of compatibility of employing types of drilling fluids and -
http://69.90.243.152/~hypower6/index.php/focus/oil-a-gas
environment, Monthly of nanotechnology: 13th year, May 2014, vol. 2, series 1990

[5]Sire: Research department of PakmanCompany :http://www.factualworld.co; http://www.iun.edu/~cpanhd/C101webnotes

[6] Conference on laboratory materials and equipment for Iranian Oil Industry, 18th October 2016, University of Tehran

[7] TariFayezeh, Mehdi Attarpoor- Depcialized doctorate students- Chemistry engineering-Ministry of petroleum, Oil Industry Research Center, Study center of chemistry and petrochemical industry- application of nanotechnology in equipment

[8]API 13A (1993). Specification for drilling fluid materials, American Petroleum Institute, Washington D.C., 15thed. May
MISwaco

[9] ,Kamali P, G. Jam, " Drilling Fluids Engineering Manual Version 2.1
Resources, Tools and Basic Information for Engineering and Design of Technical Applications!
!- adapts seamlessly to phones, pads and desktops