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A Deep Understanding on dripping out crude oil mechanisms of its obstacles and solutions with part of case study

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Abstract :-

In this article the basis mechanisms of tripping out of crude oil from oil wells by basic functions and introduction to crude oil its basic types and with examples of their fossils they found. Here its mainly associated with the working of Christmas tree (oil dripping machine) , the function and effects of MUD and its formation and the dosing (in ppm) calculations.

Key Words :- Tripping , Christmas tree , MUD , Dosing in ppm

HIGHLIGHTS

Fig 1.1 Highlights of Article

Introduction and Basics Of Crude Oil

Crude oil :-

Basically mixture of hydrocarbons also consist of Sulfur, nitrogen and oxygen, it exist in liquid phase in natural underground reservoirs at atmospheric pressure.

Contents of crude oil in percentage :

a. Carbon – 84 to 86 %
b. Hydrogen – 11 to 14 %
c. Other – S, O_2 , N_2

Other main Contents :

i. Paraffins [Alkanes] :

Formula : C_nH_{2n+2}

$C_1 – C_3$ → Gaseous Form → Isomers doesn't form

$C_4 – C_{16}$ → Liquid Form → Neobutane , Isobutane

$C_{17} – C_{30}$ → Semi – Solid

Beyond C_{30} → Solid

They are stable and not attacked by H_2SO_4 or any oxidizing agent

Eg: Mostly Obtained from Bombay High

ii. Unsaturated Olefins [Alkene] :

Formula : C_nH_{2n}

$C_1 – C_4$ → Gaseous Form

$C_5 – C_{15}$ → Liquid Form

Beyond C_{15} → Solid Form

Not attacked by H_2SO_4

iii. Acetylene [Alkyne] :

Formula : C_nH_{2n-2}

Ammounical solution of copper salts will use to get acetylene (crystalline solution)

Attacked by H_2SO_4

iv. Diolefins [Alkynes]

v. Napthenes [Alkenes]
Ring Saturated Compounds
It starts from C_5 compounds because C_2 and C_3 are not stable to form any compound.

vi. Aromatics [Alkynes]
Unsaturated ring compounds
Benzene
Toluene
Xylene
[BTX]

Types of Crude oil :

i. Heavy Crude oil < 20 – 21 ° API
Eg: Crude oil of Mexico

ii. Light Crude Oil > 20 – 21 ° API

iii. Sour Crude : Crude oil containing high amount of impurity and sulfur. When total sulfur level of crude is more than 0.5%. eg – From Saudi Arab

iv. Sweet Crude Oil : Crude oil containing small amount of hydrogen sulfide and CO_2 generally less than 0.42 % sulfur known as sweet crude eg- Beeny Light Crude oil (Nigeria)
Girasal (Angala)
Murban (Abu Dhabhi)

Effect of Temperature on Crude oil : (W.R.T. Viscosity)

In general liquid crude oil tends to get thinner , When their temperature increases.

Oil tend to flow at higher temperature, Therefore by increasing temperature , Viscosity decreases .

Effect of temperature on crude oil : (W.R.T. Density)

In general liquid crude oil tends to expand when their temperature increases.

For eg: The boiling of same mass water at 100 °C than at 20 °C

Therefore as temperature increases density decreases.

Discovery and Research of Well :-

ONGC is India's Top Energy Company and ranks 20th among global energy majors (Platts). ONGC ranks 14th in 'Oil and Gas operations' and 220th overall in Forbes Global 2000. Acclaimed for its Corporate Governance practices, Transparency International has ranked ONGC 26th among the biggest publicly traded global giants.

In 1961 instrumental is transferring limited.

ONGC not only found new resources in assam but also establish new oil province in cambay basin.

ONGC went off-shore in early 1970s and found a giant oil field in form of Bombay high now known as Mumbai high till 1990.

Crude oil produced from Bombay High is considered to be of very good quality as compared to crudes produced in middle east. Bombay High crude has more than 60% paraffinic content while light Arabian crude has only 25% paraffin.

Role of Chemist for drilling oil field :-

Chemistry role starts from primary parameter only that to treat the oil and water from well which is found out from geo- physicists.

Now there is a team called at well site called drill team to place drill according to land conditions.

The chemists manufacture drill fluid called as MUD (a mud is the mixture of stabilizers, bentonite, solvents etc)

According to drill nature the hole should be made in different sizes and it becomes smaller as goes deeper like phase wise drilling, the sizes of holes are as follows in sequences:-

i. 17 ½ inch hole
ii. Quarter 12 hole
iii. 8.30 inch hole

As the hole undergoes it must be filled with mud so the manufacturing of mud should be done in such a nature that as hole goes deeper the temperature and pressure conditions increases, so its properties should be defined like :-

Viscosity

Weight

pH

It should be checked according to the physical conditions of inner side of earth crust as hole made.

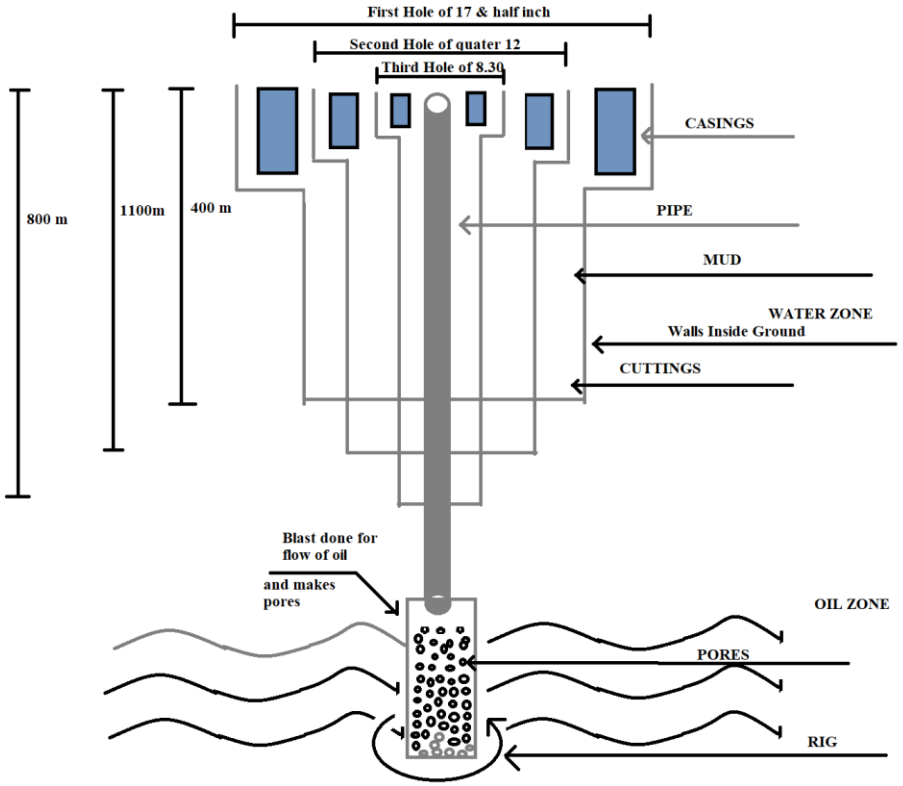

Fig 1.2 Example of crude drilling inside earth

Uses Of MUD (drilling fluid) During drilling :

i. As per drilling process is continuous it creates cuttings of land which remains in the hole and as it makes blockage and afterwards cant allow to make hole further, so in order to bring out cuttings mud is added from side spaces as shown in figure 1.1

TO LIFT CUTTINGS

ii. As to provide a function of lubricant, When mud added or introduced from bottom part it provides smoothing to bit so that it can rotate easily otherwise more heat introduced than collapse there only.

TO PROVIDE COOLING

iii. As the liquid (oil) once came inside it has some pressure to come out as if pressure increases it comes out suddenly and this condition is called as blow out , so to counter pressure mud is used with particular weight. Due to some times loose formation if we add mud which goes inside and doesn't of use so we lose mud at this movement lose circulation materials are added with mud and also without mud which is use to counter this problem.
Eg : As a case happens in assam its pressure increases inside suddenly and that crude burns up till 84 – 85 days and then controlled by safety team. Hence particular characteristics of mud should be defined.

TO MAINTAIN HYDROSTATIC PRESSURE

Per day charge to drill is 15 – 18 Lakhs

iv. As during drilling if constructed walls falls down or cracks takes place than ?
To counter this problem mud is added to inlet side spacings it makes a single thin sheet type border to make stable the walls or which protect walls to fall down.

TO MAKE STABLE WALLS

As mud is in solid form but it should make liquid form by mixing it with universal solvent water.

At some places more pressure are there inside ground so another oil based mixed mud is utilized.

Types of Installation :

1. EPS :- Early Processing System (Processing is done)

2. WHI :- Well Head Installation (Anklav site)
   In this installation there is no treatment done only storage is done. Also having less capacity of storage

3. GGS :- Group Gathering System (Processing is done). It has large capacity of storage as compare to all.
4. CTF :-

There is one figure shown for complete arrangement of installation :-

In this direct storage also possible and indirect storage can also be done as shown in figure as another wells 8,9,10,11 are connected with WHI which directly goes to main installation GGS.

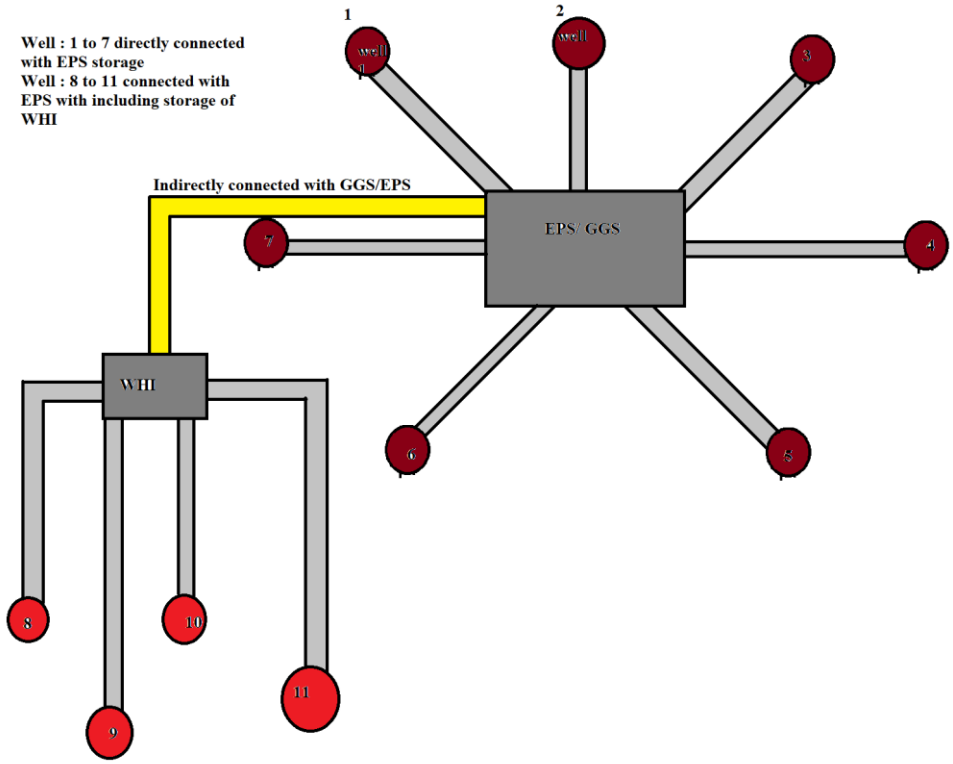

Fig 1.3 Storage Systems or Installation Arrangements

As for example if there is drilling of oil well found to be 10 well then success rate of getting oil is may be 3 or 4 not more than that. As per the survey of geological and geo-physicists.

The material of heavy weight drill pipes in the middle of the whole process is of steel material.

There is many types of mud cleaner assembly where mud is cleaned by filtration and can be recirculated to utilize another time.

In drilling there is one Christmas tree (Oil well)

The primary function of a tree is to control the flow, usually oil or gas, out of the well. (A tree may also be used to control the injection of gas or water into a non-producing well in order to enhance production rates of oil from other wells.) When the well and facilities are ready to produce and receive oil or gas, tree valves are opened and the formation fluids are allowed to go through a flow line. This leads to a processing facility, storage depot and/or other pipeline eventually leading to a refinery or distribution centre (for gas). Flow lines on subsea wells usually lead to a fixed or floating production platform or to a storage ship or barge, known as a floating storage offloading vessel (FSO), or floating processing unit (FPU), or floating production, storage and offloading vessel (FPSO).

A tree often provides numerous additional functions including chemical injection points, well intervention means, pressure relief means, monitoring points (such as pressure, temperature, corrosion, erosion, sand detection, flow rate, flow composition, valve and choke position feedback), and connection points for devices such as down hole pressure and temperature transducers (DHPT). On producing wells, chemicals or alcohols or oil distillates may be injected to preclude production problems (such as blockages).

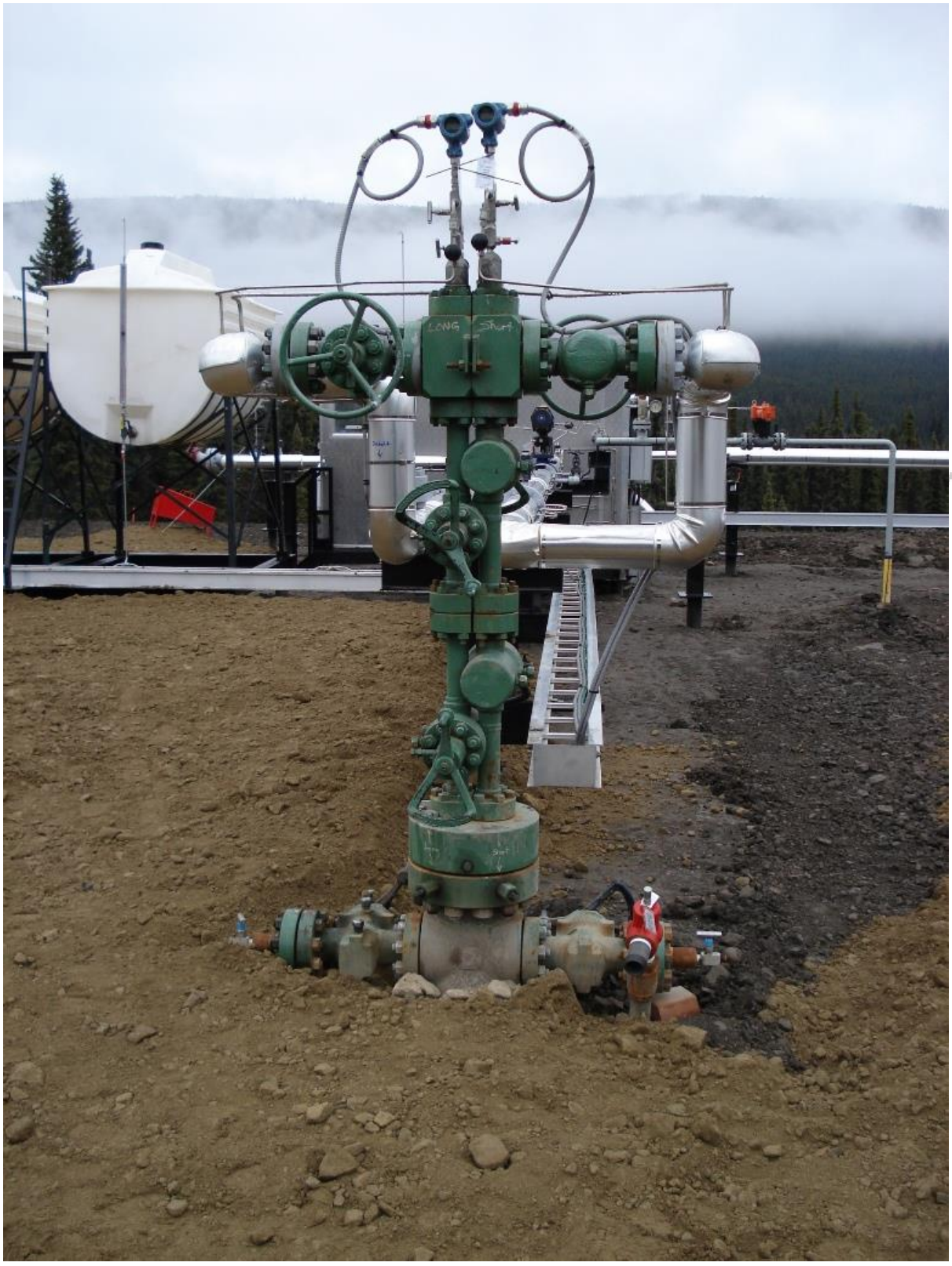

Fig 1.4 Oil Well (Christmas Tree)

After this discussion the main aims of all departments in this cambay is allotted in points like :-

i. Find Oil well
ii. Exploration (Chemist Department)
iii. Drilling well
iv. Production of oil
v. Separation through GGS/EPS
vi. Pump not required separated products to other refineries

Separated gas supplied to GAIL (Gas Authority Of India Limited) and other small refineries or local authorities.

In India major advantage for oil drilling companies is that the oil drilled from underground most of the part is sweet crude , means very less sulfur content hence doesn't require more treatment.

In production the major role comes at chemistry lab where the sample oil of different sites are brought and its quality monitoring is done in every decades.

Here oil and water treatment is done by different parameters.

The sites where ONGC had build drilling of oil are as follows :-

i. Siswa Field
ii. Nadiad Field
iii. Anklav Field
iv. Kathana Field (GGS)
v. Akholjuni Field (GGS)
vi. Vadtal Field
vii. Padra Field (GGS)

At chemistry section there are many work to be done like sampling, Quality Monitoring, salinity of effluent water.

The main aim is to remove water from oil and according to norms of ONGC the oil should have less than 1% water in oil.

For eg :- 100ml crude than it should have 1 ml water.

As the well working starts and keeps on up till 15 to 16 years then may be well looses it formability of production of oil as if firstly production oil comes of $10m^3$ but after 15 years it comes as $2m^3$ so by looking over it also the well is designed or jobs designed that the works came from well services.

These type of problem occurs because as the pores in the sedimentary rocks which are connected with each other called permeability. There are two terms :-

i. Porosity :- Empty spaces between rocks
ii. Permeability :- The channels created between pores to pores where flow of oil takes place.

As shown in the figure 1.1 lower part.

The solvent also added inside the ground as to dissolve wax and other non required impurities. The last casing is called as production casing where two valves are provided one is at tube in and another at production casing. Some times permeability becomes decreases or down due to asphalting contents. As to kill the well during solvent injecting or anu issue the another substances called NaCl or KCl are added by adding with water as like if we add mud at starting to counter the pressure.

Analysis Parameters :-

There are three types of analyzing parameters:-

i. Water Analysis Parameters
ii. Crude oil Parameters
iii. Drilling Fluid Parameters

CRUDE OIL PARAMETERS

Water Content :-

Apparatus:-

- Heating Mantle
- Round Bottom flask
- Receiver
- Condenser
- Measuring cylinder

Chemical required:-

Toluene

Procedure:-

Take 50ml crude oil and add 50ml toluene in a round bottom flask.

Place the flask in heating mantle. Attach the receiver with flask and condenser. Heat the mixture up to 15 min or till all water from the crude comes into the receiver. Observer the level of water present in the receiver as X ml.

Calculation:-

Water Content = Xx2 in % (v/v)

Bottom Sediment and water (BS AND W)

Apparatus:-

Centrifuge machine, Centrifuge tubes (100 ml), Heating mantle

Chemical:-

Toluene

Procedure:-

Take 50ml toluene in a centrifuge tube and add 50 ml crude oil in it. Agitate thoroughly for 15-20 times. Heat it up to 70°C. Place the tube into the centrifuge machine and rotate it at RPM for 10 minutes. Note the reading up to where the sediments and water have settled in to the tube (X ml).

Calculation:-

BS And W (%)= X x 2

Mud Weight

The instrument used for measuring mud weight is Mud Balance. This consists of a cup, a graduated bar with sliding weight and fulcrum. The scale is graduated in four different units with the following ranges.

- Specific gravity (g/cc): 0.72-2.88
- Pounds/gallon (ppg): 6-24
- Pounds/ft3 : 45-180
- Psi/100 ft : 310-1250
- Mud weigh in lb/gallon (ppg)=8.33x Sp. Gravity (g/cc)

Procedure:-

Fill the mud in the cup and place the lid. Close the hole of the lid with finger and wash the cup thoroughly. Place the balance on the fulcrum. Adjust bubble of the leveller with sliding weight. Read the value.

Calibration:-

With distilled it should read 1.0g/cc, Sp. gravity. Mud balance can be recalibrated by unscrewing the screw at the end of the bar and adding removing the calibration lead shots.

Funnel Viscosity

The equipment used for measuring funnel viscosity is called 'Marsh funnel'. The funnel is conical in shape, 6 inches in diameter at the top and 12 inches long with a capacity of 1500 cc. A 10 mesh screen covers half of the top. The mud runs through the fixed office of 2 inches long and 3/16 inches diameter at the end of the funnel. A graduated cup to measure out 1 quart (946 ml) of the draining mud.

Procedure:-

Fill the mud in to the funnel cloning the office. Allow the mud to drain from the funnel in to the mug to fill 1 quart or 946 cc and measure the time taken in sec. Report viscosity in seconds.

Calibration:-

Funnel viscosity of water at 70 (+-) 5°F (21 (+-) 2°C) is 26 (+-) 0.5 seconds.

Oil, water and solid content by Retort kit

The equipment used is called oil water Retort kit. It has a sample cup of 10 ml capacity, a condenser, a heating system placed in insulator pf steel container. The contents are heated. Liquids evaporate, condense and are collected in graduated 10 ml cylinder. The solids are left behind in sample cup.

Procedure:-

Take out retort assembly out of the insulator, remove mud chamber or cup. Fill mud chamber with mud. Fit the assembly. Heat the content. Collect volume of liquid in the cylinder.

Calculation:-

MBC (cc)= ml of titrant solution/ ml of mud

Bentonite / clay (lbs / bbl) = 5* MBC

Bentonite/ clay (Kg/m3) = 2.853*5* MBC (cc)

DOSING CALCULATIONS :-

Conversion in to PPM

1 % Concentration in PPM

1 gm/L = ? PPM (mg/L)

= 1 * 10000

= 10000 PPM

Same as 10 % = 100000 PPM

Step 1 :- Calculations of PPD (Pour Point Depressant)

Example :- 2000 PPD

Means 2000 mg in 1 L of Oil

Now what s it for 400 m^3 (400 * 1000 L)

Given data :-

Dosing Concentration = 2000 PPM for 1 L of oil

For 400 m^3 = How much PPD Required ?----------(i)

For 10 % = How much volume required ? ----------(ii)

Solutions :-

1 L oil = 2000 mg

4000000 L oil = ?

= 4000000*2000

= 800000000 gm

= 800000/1000

For 400m^3 = 800 kg ----------(answer i)

For 1 m^3 = 1 *1000 L

= 1000 L

As 2000 PPD in 1 L of oil

1 L = 2000 mg

? = 1000 mg

= 2000/1000

= 2 Kg

10 % of Solution = 10 gm in 100 ml

= 100000 PPM

100000 = 1 L

2000 = ?

0.1 Kg in 1 L = 20 L

Hence

2 Kg required ----------(answer ii)

Another Sample Question :-

Dosing Concentration = 2500 PPM

For 200 ml of oil

At 1 m^3

Required PPD ----------(i)

At 10 % Required volume ----------(ii)

Solution :-

2500 mg PPD in 1 L oil

1000 ml = 1 L

200 ml of oil = ?

= 0.2 L

1L = 2500 mg

0.2 L = ?

= 500 gm ----------(i)

10 % = 10 gm in 100 ml

100000/ 10^6

= 0.1

100000 PPD = 0.2 L
2500 PPD = ?

2500 * 0.2 / 2500
= 0.005 L

Want concentration in ml
1 L = 1000 ml
0.005 = ?
= 1000 * 0.005
= 5 ml required at $1m^3$ for 200 ml ----------(answer ii)

DIRECT METHOD FOR DOSING CALCULATION :-

$M_1V_1 = M_2V_2$
2500 ppm * 200 = 100000 * V_2
V_2 = 500000 / 100000
V_2 = 5 ---------- Volume required.

Conclusion :-

From the above mention information its concluded that the method for drilling out of fluid with respect to the mud properties and its specific conditions meet the increasing global demand, However some issues with different outcomes can be taken out from previous system but its negligible.

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