Use of Renewable Energy in Exploration and Production of Hydrocarbons

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Abstract: **Hydrocarbons are used to generate energy. Most of the day to day products used by human beings are also derived from hydrocarbons. The use of hydrocarbons for generating energy will leave more global warming gases into the atmosphere. It is better to replace the hydrocarbon usage with renewable energy resource to generate energy. But we cannot stop producing hydrocarbons due to the usage of their derived products in day to day life. The replacement of hydrocarbons with non renewable sources of energy can be started from the point of exploration and production of hydrocarbons itself. In this paper we have designed various concepts for compensating the use of hydrocarbons with renewable energy resources to generate energy for the exploration and production of hydrocarbons both in onshore and offshore.**

***Keywords*—Hydrocarbons, Renewable energy, global warming, onshore, offshore**

I. INTRODUCTION

The Hydrocarbons are used to fulfil the needs of human beings i.e. fuel for energy needs, Daily products for daily usage such as plastic, cosmetics e.t.c. To recover the Hydrocarbons from sub surface we are using Heavy machines and equipment which are run by the fuels and generate more pollutants and also occupy more space in offshore platforms. Due to present scenario in oil industry the crude oil prices comes down to a stage where the companies are not willing to establish new projects and want to increase the production from the existing projects. Maximising productivity from existing projects involves usage of Enhanced oil recovery Techniques which unfolds the need for more Energy and also to drill new wells in the existing fields. It is suitable to use Renewable Energy resources instead of using by products of Hydrocarbons to generate energy for running of equipment. We can use Various Renewable Energy Sources like Solar Energy, Wind Energy and Wave energy.

A. Solar energy

The solar energy is one of the promising renewable energy resources where sunlight is abundant in the tropical regions, which is having a minimum temperature of $25^{o}C$ around the year. Most of the sedimentary basins located in tropical regions containing mostly Heavy oil. Normally to recover Heavy oil we use a lot of heat energy to produce using thermal EOR process. To compensate this energy needs we can use Solar EOR process which has to be planed before drilling so that the energy generated can used from initial stage of field Development. If we want to produce solar power in initial stage only we can fix these solar panels to the infrastructure at the Drilling site and these can be mobilised with rig to the new location. We have different types of solar panels like general PV cells, flexible PV cells with different power ratings.

These solar panels can be installed at different places on the rig site such as on the roof of bunkers and cabins of crew based upon spatial availability and safety constraints. The main requirement for the installation of solar panels is available space, while placing these solar panels we have to consider required voltage and hours of power output that needs to be generated. For a simple calculation consideration, an average size bunker is considered with a height of 8 ft, length of 20 ft and width of 8 ft.

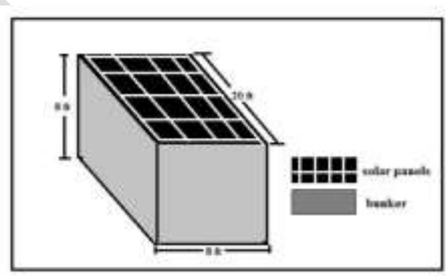

Fig. 1 Diagram showing the bunker with solar panels installed on its roof.

From the Fig. 1 the top surface area can be calculated easily i.e. width x length.

Therefore the available roof space on an average sized bunker is about 160 square feet. This can hold 16 solar power cells.

The excess load on the bunker due to installation of solar panels has to be considered which helps in planning for transportation of bunkers. The weight specifications for a solar power cell having a length of 5 ft and width 2 ft is about 4.5 lbs, which are generally used in the boats and ferry, and can generate about 140W of power. Based upon the above data the total the load acting on the bunker and total power generated by solar power cells can be calculated.

Therefore the total no. of total power cell that can be installed are 16 and the total weight acting on the bunker is 72 lbs. The total power output can also be calculated easily by 16 x 140W

= 2.24KW, which can be generated from a bunker on an average.

Those figures assures solar energy is a dependable power source for the onshore rig sites

B. Reverse Electro dialysis

Another renewable energy source is untapped energy between the salinity gradient of sea water and river water. At the point of estuary the osmotic pressure of marine water is about 20 atmospheres. So, large amount of energy is entrained which is equal to the potential energy of water that is dropping from a height of 680 ft. There are many technologies for the production of power out of an estuary, some of them are RED (Reverse electro dialysis), Pressure Retarded osmosis, Vapour Pressure Difference method, Mechano chemical methods and hydraulic generators. According to statistical data the total salinity power on a global scenario is about 2.6 TW which compensates about 16% of total global energy needs.

This salinity power generation of will be a reliable method for producing power in the shallow offshore projects. Were the platforms are generally near to the shore. The main parameters on which this salinity power depends are

- Energy efficiency,
- The gained power related to maximal thermodynamic value, and
- Power density, (the power generated per sq. meter of membrane).

The RED technique involves the installation of alternating stack of cation and anion exchange membranes (CEM, AEM), a salt water compartment and a sweet water compartment as shown in **Figure2**. Positive ions from the seawater diffuse through the CEM and similarly the negative ions diffuse through the AEM and produce negative charge causing development of potential between the two membranes. Energy generated from this technique is on lab scale studies is about 2.5 MJ per m^3 of the river water or about 1.7 MJ per m^3 of sea water. Considering the case of River Godavari estuary in Andhra Pradesh which is having an inflow rate of about 2500 m^3 per second with an approximate width of 1- 2 kms. This could generate a large power which can be transported to nearby projects.

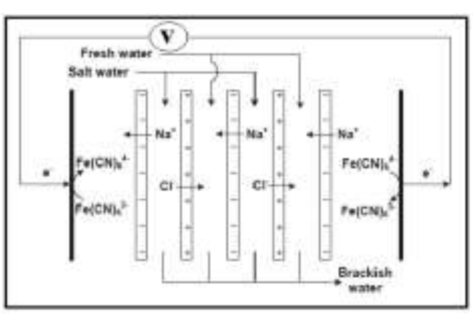

Fig. 2 Schematic diagram showing mechanism of RED process.

The power response from an RED cell mainly depends upon

1) the conductivity, selectivity, osmotic behaviour of the membrane
2) Compartment thickness and spacer type of cell
3) Operating flow rates and electrical load and residence time of the water in the cell. Even Water salinity, impurities, temperature, polyvalent ions also effect the performance but the water properties cannot be altered due to the river stream and oceanic water.

Membranes selected for this RED are generally of two types, homogenous and heterogeneous membranes. Polyvinyl chloride is an example for membrane. The total energy potential for Godavari River can be approximated by applying the simple calculations. The inflow rate of Godavari river estuary is about 2500 m^3/second on an average. The membranes installed will cut the pressure difference is assumed to be to 50% and hence the water column height will be around 135 centimetres and hence the potential developed will be $e = mg\Delta h$. Here m is given by the mass flow rate i.e. 2500 m^3/s considering the water density as 1000 kg/m^3.

Total power potential = $mg\Delta h$ = 3.375 GW.

This 3.375 GW potential is the energy that can be extracted from the Godavari river estuary which enables this as power source for not only for the drilling and also for the production and maintenance operations.

C. Wave Energy

Oceanic waves carry a tremendous amount of energy which is a clean and another viable source of renewable energy resources. The oceanic currents produce about 36 KW to 1.7 MW of potential power in a vague calculation per meter of coast. So application of this technology also helps in compensating the energy needs of an offshore project. For a simple study of power can be generated in the coast of Bay of Bengal with an average wave height of about 5 meters and wave period of 8 seconds the energy associated with it can be calculated from the formula

$$P = \frac{\rho g2}{64\Pi} x\, H^2_{mo}\, x\, T \approx (0.5 \frac{Kw}{m3.s})\, H^2_{mo}\, x\, T$$

Where P is the Wave energy flux, ρ is the water density, g is acceleration due to gravity and H is the average height and T is the wave period. By using the formula and calculating for the above case, power output is about 36 KW. This is not a negligible amount.

The wave energy can be generated on the offshore platforms by attaching a mechanical arm and buoy assembly, which will be able to float on the sea floor. The up and down motion of the buoy will pump hydraulic fuel into a chamber and this mechanical energy is transformed to a rotary motion that drives a generator for the power generation.

II. CONCLUSIONS

In this paper we came to a conclusion that we have lots of renewable energy which we can use to supplement the energy needs in Exploration and production of hydrocarbons. Even though there are some demerits like these instillations cannot meet 100% energy requirement in the field. We can attain 20 to 30% energy needs by these installations which will reduce the emission of green house gases. The percentage of required energy generation depends on the size of installation. Here we disused about the energy needs up to shallow offshore platforms. In Deep offshore platform also we can use wave energy but there are some complications in designing this due to the effect on Structure stability. So, more research should be carried out to modify the platform structures which help in producing renewable energy.

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