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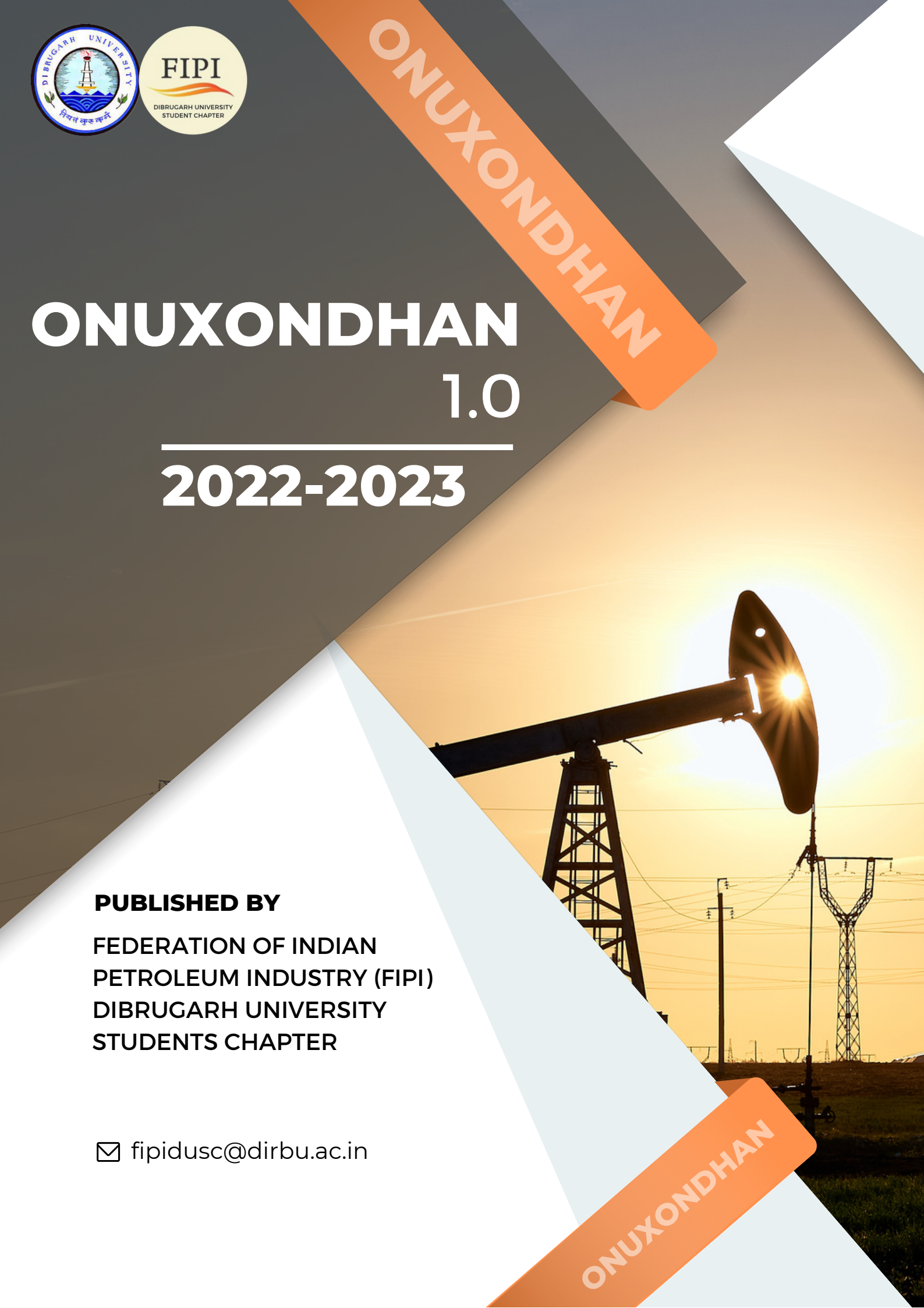
ONUXONDHAN

# ONUXONDHAN 1.0

## 2022-2023



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ONUXONDHAN

# MESSAGE FROM FACULTY ADVISOR

I am thrilled to announce the launch of our very own E-magazine "ONUXONDHAN 1.0". This publication has been the effort of the members of the FIPI DU SC and I am proud of the hard work and dedication that has been put into it. The magazine is a great platform for you to showcase the knowledge and passion for the industry, and I am confident that it will be well-received by both the university community and industry professionals.

As the faculty advisor, I would like to extend my congratulations and gratitude to the editorial team and all members of the chapter who have contributed to the magazine. Your efforts have truly paid off and I look forward to seeing the magazine grow and evolve over the years.

Best regards,

**Dr. Borkha Mech**
Faculty Advisor
FIPI DU SC

# MESSAGE FROM THE TEAM

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**Junayed Khan**
E-magazine Team

We are excited to welcome you to the first-ever FIPI DU SC E-magazine. We have put together a publication that is packed with informative articles, industry insights, and the latest developments in the world of petroleum. Our goal is to provide our readers with a comprehensive understanding of the industry and its many facts. We hope you find our magazine informative and engaging. Thank you for your support and we look forward to bringing you more in-depth coverage in the future.

Best regards,

**Editorial Team**
**ONUXONDHAN 1.0**

# CONTENT

# Gas Lift Design using IPM Prosper

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Different gas lift installations contain different combinations of downhole equipment: gas lift valves, packers, mandrels, and subs, etc. The type of gas lift installation is mainly governed by the type of lift used: continuous flow or intermittent lift. Equipment selection is based on original well conditions but should provide for the necessary flexibility to reduce the number of future workover operations. A proper gas lift installation design, therefore, assures trouble-free operation for the entire productive life of a well. The usual gas lift installation types are classified in two broad categories: tubing flow and casing flow installations. In a tubing flow installation, lift gas is injected in the casing-tubing annulus, and production occurs through the tubing string, whereas a casing flow installation allows gas injection through the tubing string, and the well is produced from the annulus. The following sections present detailed discussions of the most common versions of gas lift installations. Tubing Flow Installations In these cases, lift gas from the surface is injected down the casing-tubing annulus, and liquid production takes place up the tubing string. Except in wells with extremely large liquid production rates, tubing flow installations are generally recommended because of their many advantages: no corrosive and/or abrasive liquids flow in the casing string, well killing is easily accomplished, etc.

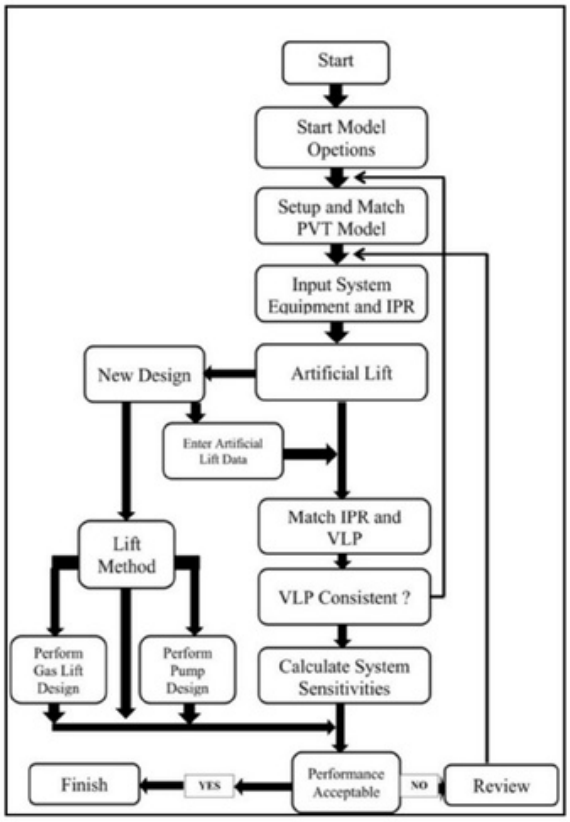



Fig. Flow sheet for prosper Gas lift matching

# Gas Lift Modelling done using IPM - PROSPER Software

The steps to be followed in Prosper software are as follows;

- Input Well details (location, well name, company details, operator details) → Done.

- Input PVT data (*Solution GOR, oil API gravity, gas gravity, water salinity) → calculate → enter (Temperature & Pressure details and no. of steps required to validate and for regression) → Calculate → Tables → Main → Match Data → transfer → Done.

- To match PVT.
  - Go back to PVT input data → Regression → Match → PVT MATCHED.
- Equipment Data (*deviation Survey, Downhole Equipment, Geothermal Gradient, Average Heat Capacities)
  - After entering data → Done→ Summary→ Downhole.

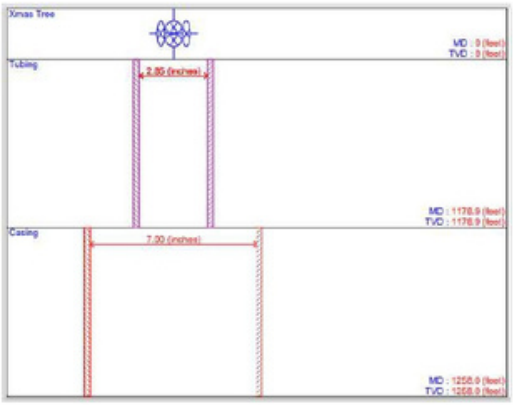



Fig. Downhole example

- IPR Data (Reservoir pressure, temperature, water cut, total GOR) & input data (PI → Productivity index)
  - Plot → IPR plot (mark AOF, Pr, PWF) → Main page→ calculations→ system (IPR+VLP) → 3 Variables (*Add data & check for different correlations for IPR & VLP) →4 Variables (*Add data & check for different correlations for IPR & VLP) → arrange the parameters and check for variations using multi correlation.

- Go to Step 1 → Select Artificial Lift → Continuous gas Lift → Main Page → system → Gas Lift Data → enter parameters.

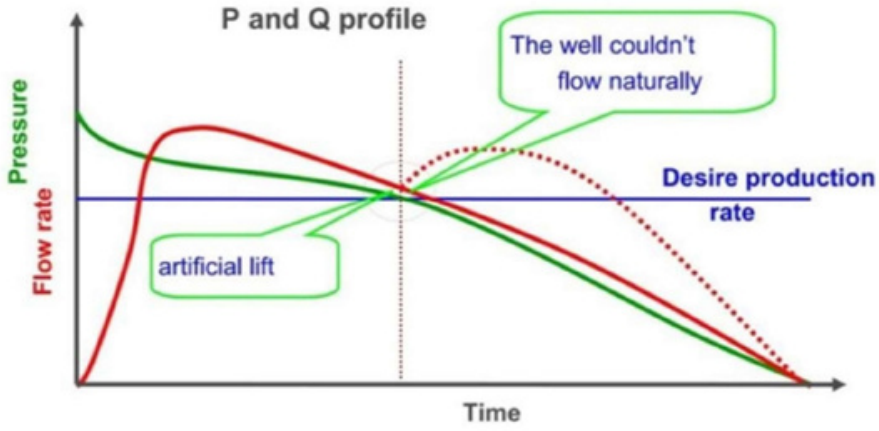
*(Gas lift gas gravity, keep injected gas rate as 0 for initial stage because we are going to optimize the new injection rates and valve spacing)

- Main page → Design → gas lift→ New well→ enter data →maximum liquid rate→ valve type → current valve types (gas lift valve data base→ valve 1→R 20→ Monel) → continue → Ger rate → Plot (Gas injection rate) → Design → Plot (*gas lift valve depth correlation) → results → Done.

- Enter the calculated gas injection rate in the gas lift data → enter valve depth → operation pressure → enter these correlations in IPR 3 variables → validate → plot → DONE.

## TO OPTIMIZE THE PRODUCTION

Well, is modelled in PROSPER program, through entering raw field data of both reservoir fluids properties and well testing data required for PVT matching and generating IPR + VLP. Wells are modelled in PROSPER step by step.
For VLP correlation comparison, Petroleum Expert-2 is found very close to well test data for all vertical/tubing performance.
For matching pipe correlation Beggs and Brill correlation is found the best fit correlation for production and flow line test.
Design injection pressure is used as input based on the available source supply and considering bubble point pressure as well.
Most of the wells are completed at a depth that should flow for a period after they begin put in production. This will not be continuous because the energy will be spent and at some time there will not be sufficient drive force to lift the fluid to the surface. Consequently, the well ceases to flow and the operating company will be tempted to put the well on one of the forms of artificial lift to provide a good lifting energy.
(Lake, 2010).

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Consequently, the well ceases to flow and the operating company will be tempted to put the well on one of the forms of artificial lift to provide a good lifting energy.
Through looking at this figure, wells normally can produce by their own reservoir pressure only for a specific period.
(Lake, 2010).

Periodically,
the required quantity of oil will not be achieved at the surface facilities, mainly because of the following factors:

- Low reservoir pressure.
- Heavy oil (high density fluids).
- Scale liquid around the wellbore.
- Skin damage around wellbore.
- Poor completion and reservoir rock properties.
- Water conning.

Therefore, the company will be tempted to optimize the production through the stimulation or by artificial lift systems, for example, gas lift system.
(Hadiaman, 2011).

## GAS LIFT METHOD

Gas lift is one of artificial lift methods, through which high pressure gas is injected continuously or intermittently into the well through casing and U-Tubed to tubing. Thus, resulting in the reduction of the hydrostatic pressure of the heavy column of the fluid and reducing bottom-hole flowing pressure. The purpose of gas lift installation also to bring hydrocarbons to the surface at a desirable quantity while keeping the bottom-hole pressure at a value that is small enough to provide high drawdown pressure within the reservoir. (Beggs, 2003).

Thus, gas lift method is where relatively high-pressured gas is used as lifting agent through a mechanical process. The installation of the gas lift system is required when the pressure of the reservoir is not quite enough to maintain the oil production with sustainable economic return. This system is widely applicable for the oil fields where the increasing water cut or decreasing reservoir pressure eventually causes well to cease its natural flow.
(Ahmed and McKinney, 2004).

## GAS LIFT WELL PERFORMANCE ANALYSIS

Nodal analysis is used to analyze the gas lift well performance, the following processes should be done to analyze the system.

- Select the operating gas lift to be analyzed.
- Select the node location that is most sensitive to change.
- Develop the relationship between the inflow and flow of the node.
- Calculate pressure drop versus flow rate for all components.
- Determine the effect of changing characteristics of the selected node (gas lift valve).
- Optimize the production system.

To follow the above-mentioned steps, it is more convenient to allocate gas lift working valve as the position of the node.

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# PULSED ARC PLASMA SHOCKWAVE: A NEW TECHNOLOGY TO ASSIST DRILLING

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## INTRODUCTION:

The most crucial part of oil and gas extraction is drilling, and drilling costs make up a sizable portion of the overall cost. After years of progress in the petroleum sector, drilling has moved to unconventional oil and gas resources since traditional reservoirs have been exhausted. Deep, ultra-deep formations and deep seas, which have complex geological conditions, high densities, poor rock characteristics, and high abrasiveness, have been the focus of crude oil exploration and production. The hard formation's length makes about 20% of the overall well depth in deep and ultra-deep well drilling operations, but its cost makes up 70% of the total. Because of this, bit wear is high and the rate of penetration (ROP) is low when drilling these formations. How to improve the rock breaking efficiency and mechanical drilling speed of deep wells and ultra-deep wells is one of the key issues facing the development of deep oil and gas resources. So researchers and engineers have been looking for ways to increase drilling speed to reduce costs and improve efficiency.

There are two strategies—conventional procedures and unconventional methods—for raising the ROP (rate of penetration). The drill bit and wellbore trajectory are optimized using conventional techniques, and downhole turbo drills and mud motors are used to apply an axial compressive force to the drill bit and rotate it under the control of a turntable or downhole power-drilling tool, shattering, crushing, and impacting the rock. In order to increase the ROP, the wellbore trajectory is improved, the drill bit is chosen based on the formation, turbo drill is utilized to increase bit speed, and so on. In addition, underbalanced drilling technology has also been applied, by making the drilling fluid pressure lower than the formation pressure, negative pressure is formed in the wellbore to change the stress state of the rock and improve the rock crushing efficiency.

Unconventional methods, also referred to as non-contacting drilling methods, include high-pressure water jet drilling, laser drilling, and electrical plasma drilling, among others. High-pressure water jet drilling uses high-speed jets to impact rock and form cracks. High-pressure water jet drilling also needs to improve energy efficiency .The energy efficiency of high-pressure water jet drilling must also be increased. This technique can be used as an additional drilling technique in combination with rotary drilling.
Laser drilling exposes the rock surface to a powerful high-energy laser beam, raising the rock's local temperature and melting and gasifying the rock in the process. The technology of rotary drilling is fully abandoned by laser drilling and electrical plasma drilling, which have the issue of conveying cuttings. According to the experimental findings, the laser drilling speed in sandstone can reach 137.2 m/h. Rock that has been spalled by thermal stress and heated to extreme temperatures is directly sprayed with thousands of degrees of high-temperature plasma. At extremely high temperatures (more than 5000 ° C) produced by specific mechanisms, the rock is spalled, melted, and evaporated. Conventional drilling techniques, however, are unable to considerably increase the ROP and drilling efficiency in hard formations due to the drill bit's severe wear and the drill's limited ability to transfer axial and radial pressure. Because the PDC bit will be destroyed and the downhole sensors' performance will be affected by the high temperature created by the unusual procedures. The unconventional methods are still not used in the field, despite having a high efficiency and faster drilling speed in the test.
The need for energy among people is really great. To boost the ROP, standard drilling techniques are mainly used today. If a specific technology is created, it can be used in conjunction with traditional drilling techniques to overcome the drawbacks of other new drilling techniques and speed up drilling, which will have a positive impact on society.

## FANDAMENTALS OF PULSED ARC PLASMA SHOCKWAVE TECHNOLOGY:

Pulsed Arc Plasma Shockwave Technology, a new drilling assistance technology, is introduced to help develop unconventional gas resources more effectively and more affordably (PAPST). It has been demonstrated that this method can eliminate rocks and enhance the ROP (rate of penetration)[2]. Here, using fluid mechanics and bubble dynamics, this technique transforms electrical energy into mechanical energy to produce dynamic load shock waves, which is powerful enough to split even the hardest rocks. Up to 1-10 GPa of shockwave pressure can be produced in liquid by the PAPST. This technology has been used in well cleaning, extracorporeal shockwave lithotripsy, and discharge machining and underwater sound sources. With the use of shockwaves, the rocks at the bottom of the well can be fractured, or cracks and micro cracks can be produced. It improves drill capability and rate of penetration (ROP)[5].

## MECHANISM OF PULSED ARC SHOCKWAVE TECHNOLOGY:

This technology has two important parts. They are: the discharge electrode system and the high voltage pulse power supply. Upto 10 killowatt volts can be generated by high voltage pulse power supply. This high power is then applied to both the ends of electrodes. The discharge electrode system consist two electrodes needle. One is anode and the other is grounded cathode.

Then these two electrodes are submerged in the drilling fluid, and the electric field intensity exceeds dielectric strength of the liquid, so that the liquid is electrical breakdown and streamer bridges the two electrodes, at this point, the current in the circuit increases rapidly forming an arc plasma channel. The electrical energy is then quickly injected into the plasma channel, causing the internal temperature and pressure of the channel to increase dramatically in a very short time. As the pressure and temperature, increases the volume of the channel start to expand rapidly and propagate outward waves pushing the surrounding water to generate shock waves, which are called Plasma Shock Waves (PSW)[3]. There are many researches on the application of electro hydraulic wave. However, there is no widely accepted theoretical formula for calculating the shockwave pressure. Because the duration of electro hydraulic effect is short, and involves complex physical and chemical reactions. However PSW(plasma shock wave) has a high pressure (1-10GPa in the center of channel) far beyond the range of the most advanced pressure sensor, so cannot be directly measured at a close distance, a very short rise time (a few microseconds), and can cause fatigue damage or direct damage to the rock. Moreover, the size of the channel is on the order of centimeters and the duration of the high temperature is short, the drill bit or other downhole tools will not be destroyed by the high temperature[1].

As soon as the plasma shockwave is generated, vapor bubble will appear between the electrodes. The high-pressure gas inside the bubbles will drive the surrounding fluid to spread outward at a speed less than the local speed of sound and the internal pressure will decrease. When the internal pressure of the bubble is equal to the surrounding liquid pressure, the bubble wall continues to expand outward due to inertia until the bubble wall velocity decreases to zero. At this time, internal pressure of the bubble is lower than the surrounding liquid pressure, and the bubble shrinks under the external pressure. When the bubble volume shrinks to a minimum, the internal pressure of the bubble sharply increases to much greater than the surrounding liquid pressure, thereby radiating the pressure wave outward. This process is referred as a **pulsation cycle** [1]. Usually the bubble will pulsate for multiple cycles until the energy is completely consumed. The pressure wave generated during the first pulsation cycle is 10%-20% of the peak value of the shockwave. However, its duration is far beyond the duration of the shockwave, and its momentum is close to the shockwave, so the destruction effect of pressure wave cannot be ignored. In addition, when the bubble is annihilated, cavitation erosion will also occur, causing damage to the rock[3].

## DAMAGES CAUSED BY THE PLASMA SHOCKWAVE UNDER VARYING ENERGY:

This method can generate radial cracks, secant cracks and collapse pits on the rock, and cause the rock to suffer different kinds of damage, which is beneficial to improve the drill ability of the rock[3]. The damage to the sample increases as the energy increases. This is mainly due to an increase in energy resulting in an

exponential increase, in the peak pressure of the PSW. However, when the energy rose to a certain extent, there was a gradually decrease in the growth rate of damage [2]. The study demonstrated for the first time that a concrete sample damaged internally by the PSW was anisotropic. This may be crucial when developing drilling instruments since the bit may drill in this direction because the PSW may damage rocks more severely in one direction. It was established that the samples were struck, resulting in numerous circular holes and cracks, and that the damage to the samples grew as the energy did. However, the growing rate of harm steadily decreased when the energy level increased to a certain point[2]. In addition, it was found that the amplitude attenuation coefficient measured at different locations was different for the same sample, which indicated that the internal damage of a concrete sample produced by the PSW was anisotropic[4]. Finally, the average drill ability was improved after the sample was subjected to PSW impact. Overall, the degree of damage of the sample increased as the energy increased and the destruction of the sample is not the result of the direct application of electrical energy to the sample. It is the plasma shock wave that causes the cracks and holes to be generated. Therefore, the higher the peak pressure of PSW, the more severe the rock is damaged.

## CONCLUSION

The rate of penetration is very low during the development of unconventional gas resources such as tight gas and marine shale gas, owing to high rock hardness and strength as well as heterogeneities at all scales[1]. To improve the efficiency and reduce costs of developing unconventional gas resources. A new technology pulsed arc plasma shockwave technology is proposed to assist drilling (PAPST). An electro-thermal-shockwave conversion method is used in the PAPST (Pulsed arc plasma shockwave technology). The generation of a high-temperature, high-pressure arc plasma channel and the expansion of the channel to push the surrounding water to create a powerful shockwave happen when a high voltage is put across the electrodes. Rock is destroyed by the pulsed arc plasma shockwave technology through radial stress and secant crack through tensile tension[4]. The mechanism of rock breaking suggests that PAPST will be effective since the compressive strength of rock is typically substantially greater than its tensile strength. Furthermore, the shockwave will concentrate tension at the corners, which will result in rock failure. Since particles and bedding are typically present in the interior of genuine rock, the tension will focus there, contributing to rock damage. Shockwaves shattered every rock sample, proving that PAPST can be utilized for drilling.

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# Russian-Ukraine War: Upshot on Global Oil Business

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Russia's invasion of Ukraine has had a significant impact on people, the economy, and business. Along with supply chains, industries, and economies, it has disrupted people's lives and way of life. Like all other industries, the energy sector is currently undergoing uncertainty. Even before the war fully escalated, oil prices were increasing all over the world. But after Russia invaded Ukraine, the cost of crude oil on the international market soared, rising from about $76 per barrel at the beginning of January 2022 to more than $110 per barrel on March 4 of that same year.

Russia is a major producer of oil and natural gas. It also produced 10.5 million barrels of liquid fuel products per day on average in 2020. The invasion of Ukraine impacted global energy markets, particularly in Europe, which remains Russia's primary market for oil and gas due to a lack of these energy sources in European countries. As a result, Europe is also Russia's primary source of revenue, and the European Union recognizes its reliance on the Russian hydrocarbon industry. However, after Russia invaded Ukraine in February 2022, President Biden signed an executive order on March 8, 2022, prohibiting imports of Russian oil, natural gas, and coal. The United Kingdom quickly followed suit, announcing its intention to prohibit Russian hydrocarbon products. The European Union also announced a two-thirds reduction in Russian oil imports. The invasion of Ukraine, as well as the subsequent reactions from Western countries, sent oil and gas prices skyrocketing. As economies reopen and enter recovery phases, demand for hydrocarbons has increased. Prior to Russia's invasion of Ukraine, hydrocarbon output was stagnant due to low demand and stalled economic activity caused by the COVID-19 pandemic. Economic sanctions and foreign policy directives issued by Western countries harmed this output even more. The current situation illustrates another important factor affecting the prices of oil and gas: international relations and geopolitics, as well as the foreign policies of influential countries.

The disruption in global oil and gas supply caused by the Russia-Ukraine war affected not only the prices of these commodities, but also all economic activities that rely on hydrocarbons. It is a well-known fact that countries and their economies are inextricably linked in terms of their reliance on one another for various things such as oil, trade, services, investments, and so on. Using stock returns from a sample of 94 countries over the period from 22 January to 24 March 2022, we document a negative relationship between the Ukraine–Russia war and world stock market returns. As a result, any major geopolitical event in any part of the world could have an impact on markets in other countries as well. Stock exchanges in different markets also sank, including exchanges in Germany and France, the FTSE 100 in London and the Dow Jones and S&P 500 in

the U.S.. Several European Union leaders have rejected the idea of prohibiting Russian hydrocarbon imports. German Chancellor Olaf Scholz stated that the EU purposefully exempted Russia's hydrocarbon industry from sanctions. The Netherlands' Prime Minister, Mark Rutte, admitted that his country is still reliant on Russia for energy. As the conflict between Russia and Ukraine has escalated in recent weeks, Asian markets have been volatile, and oil prices have risen. If the situation does not improve in the future, the market is likely to suffer further losses as oil prices remain high. Rising crude prices cause the Indian rupee to depreciate, increasing the likelihood of inflation and fiscal deficit. According to estimates, a 10% increase in crude prices reduces GDP growth by 20 basis points, increases inflation by around 40 basis points, and increases the current account deficit by around 30 basis points. The most important point of contact, in regard to the war is inflation and as commodity prices have started rising, various resources like metals, gas and edible oils have become more valuable. It is pertinent to note that, Russia is a key supplier of energy globally and Europe relies on Russia for about a quarter of OTS oil supplies and one third of its gas supply. Moreover, Ukraine and Russia account for 90% of India's sunflower oil imports and hence this news is not a good sign for the economy. The Indian stock market has been taking a hit over the last few weeks because of the potential tightening of policy measures in regards to the Russia-Ukraine war. The shares of Tata Motors, Motherson Sumi Systems, Dr. Reddy's Laboratories etc. slumped owing to the tension between Russia and Ukraine in the past few weeks. The stock market presently has been gradually coming back to normalcy; however not much difference can be seen until now.

Oil prices and supply are concerns for importers. Even the availability of vessels and shipping routes are subject to multiple constraints. OPEC Basket crude oil price was trading at $92.5 per barrel on 18 February 2022 just before the Russia-Ukraine war. As of Wednesday, 22 April 2022 the OPEC basket crude price was selling at $107.6 per barrel, about $15 higher than the pre-war level. Crude oil price is expected to operate above the $100 per barrel mark in the coming months. However, the predicted economic slowdown and expected lockdown in China may negatively impact oil price escalations to a certain extend. As reported by Fortuneindia.com, "India's exports to Ukraine during April-December 2021-22 were worth $372 million. The imports stood at $1.98 billion during the same period. In 2020-21, the value of India's total trade with Ukraine was $2.59 billion with imports alone accounting for $2.14 billion. The report further read that India-Ukraine trade during April-December 2021-22 touched $2.35 billion and the bilateral trade for the whole year was expected to be close to the all-time high of $2.73 billion registered in 2018-19. According to data reported by Economic Times, India exports goods worth $2.5 billion to Russia and nearly $1.5 billion to Commonwealth of Independent States (CIS) countries as per the industry figures. Moreover, India mainly imports mineral fuels, i.e. 34 per cent of the total imports, natural pearls and semi-precious stones (14 per cent), fertilizers (10 per cent), petroleum oils and crude (5.6 per cent) from Russia, as further reported by the publication. The prices of these items are projected to rise in the short-term, if the same situation continues in the upcoming days. It has become quite tough to predict, what will be the bottom of the market in the present phase of such an uncertainty. The effects of slowing growth, rising inflation and weakening rupee will highly affect corporate profitability. Disruptions in supply of commodities can affect various industries like automobiles

and other manufacturing sectors. On the contrary, the Indian IT industry could benefit from the shift of business from Ukraine and Eastern Europe. In terms of investor decisions, the best course of action for most retail investors is to keep calm, buy on dips and stay invested. According to experts, the best strategy in the current situation is to not panic and hold your investments for better results in the future. One can in fact buy high quality stocks in a staggered manner to avail the benefits of the scenario.

To address the impact of the Russia-Ukraine conflict on global oil and gas prices, several strategies have been implemented. According to the World Economic Forum's Maciej Kolaczkowsk, members of the Organization for Economic Cooperation and Development are releasing 60 million barrels of oil from their strategic reserves into the global market, which is equivalent to 12 days of Russian exports. To combat rising gasoline prices, the United States is also drawing on its strategic reserves. Putting pressure on oil and gas producers to increase output to meet global demand is another strategy. Countries that rely on Russian hydrocarbon imports are looking for alternatives. Their energy security policies and energy mix have also been influenced by the situation. Countries will be trying to figure out how to reduce their reliance on Russian energy while mitigating the economic consequences of doing so in the future.

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# Enhanced Oil Recovery in thin stacked heterogeneous reservoirs using CMG simulator.

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## INTRODUCTION

Recovery of oil by natural mean is around 15% during the initial primary recovery phase for conventional reservoirs. With the help of secondary recovery, around 30% of the OOIP (original oil in place) can be recovered using water flooding techniques. Oil recovery mainly depends on the reservoir rock properties as well as the property of oil inside the rock.

- Petroleum industry faces tremendous challenges in recovering heavy oil which is viscous in nature from thin stacked pay zones.
- As it affects adverse mobility ratio effect in the primary recovery method,
- Heterogeneity in the reservoir or in the formation, then it gives birth to several problems related to recovery of oil. Now in case when we focus mainly on the recovery of heavy oil, then pay zone formation must have good permeability. But in case of stacked pay zones with heavy oil, having heterogeneity problems, Water flooding fails as water breaks through the heavy oil due difference in the density and viscosity. which lead to the water fingering and decreases sweep efficiency
- It becomes difficult to use thermal EOR methods for the recovery of heavy crude.Where tertiary recovery fails, Hence there is need to find some alternative methods of tertiary recovery which will not cause problems to thin stacked pay zones. Hence Chemical EOR methods are used in such cases.
- chemical flooding is the best option for increasing the incremental oil recovery effectively by the means of enhanced oil recovery method. With the help of chemical flooding recovery of oil can be more than 47 % as in case of (ASP) **[NaOH]** alkalisurfactant-polymer flooding initially, a surfactant-polymer (SP) **[L-38]** flooding solution is injected after water is pre flushed. After the surfactant polymer **[PUSHER 1000]** solution is injected in the formation in order to improve the performance of oil production and increase the recovery of oil a buffer solution is injected in the reservoir apart from using water flooding

## 2. GEOLOGICAL DESCRIPTION

This moment forth the production rate kept deteriorating, subsequently the reservoir was subjugated by waterflooding, that too turned out to be not sufficient economically. Before the well is to be subjected for EOR methods some compatibility screening criteria eventuated and a decision of commencing EOR technique with (ASP) flooding.

## 3 ANALYSIS

Since there are 8 cores from which the experiment runs, no. 1,2,3,5,6 was polymer flooded and the rest were ASP flooded. The illustrates the remaining oil saturation over and above waterflood as well as ASP/ Polymer flood. Polymer flooding gives higher efficiency i.e., has less remaining oil saturation compared to experimental run no. 2,3,5,6. On the other hand experimental run no.7 has left less remaining oil saturation compared to experimental run no.4 & 8

**Polymer-** Waterflooding jobs incorporated with polymer flooding to minimise cost and effectively enhance productivity of oil. since it gives maximum efficiency by the application ofboth polymer and waterflood.

**ASP -** Fig justifies displacement efficiency of ASP flooding over and above waterflooding and Polymer flooding. Effective displacement efficiency than Experimental run no. 7 but after considering the above-mentioned parameters experimental run No. 7 turns out to be the successful ASP flooded core.

### C. RF and RRF

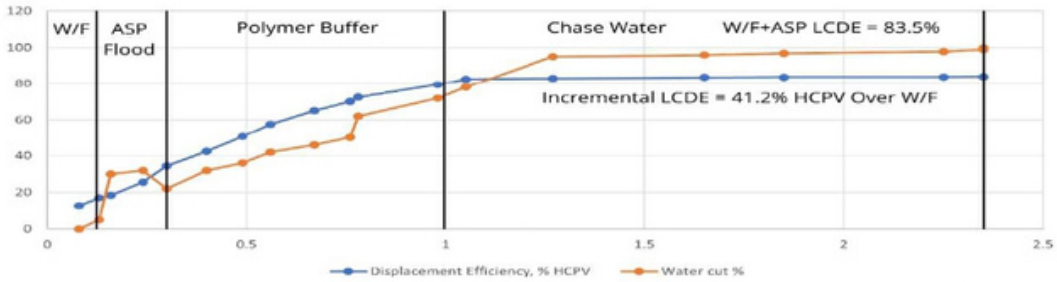
The relationship between RF and RRF of polymer flooding goes hand in hand because as the polymer adsorption increases the mobility ratio decreases. As the polymer adsorption reduces permeability of the core, the effects of polymer adsorption in terms of RF and RRF. the RF & RRF is significantly less than the other 4 experimental runs. This states that the polymer used is considered to be a reliant one compared to the other four as its adsorption properties are less effective to core.

### D. Injected vs Displacement

As the illustrates the amount of volume injected with respect to the displacement efficiency, for experimental run no.1 the amount of polymer injected is more than the displacement efficiency received (above 60%). While on the other hand the amount of ASP volume injected is kept equal to that of polymer injection (experimental run no.1) with increase in displacement efficiency (above 80%).

### E. cumulative oil production & water cut for ASP flooding.

ASP Flooding is segregated into four contiguous results. In the first Part waterflooding was conducted, water cut was found to be less than oil productivity. This waterflooding formulated a smooth path for ASP flooding, the flooding was proceeded which gave a higher watercut than the water flooding done earlies which is a sign of successful areal displacement efficiency subsequently after receiving a little less water cut during asp flooding polymer buffer was introduced to the core where appreciable oil production rate was obtained with decrease in water cut followed by this chase water was flooded which




gave a constant production rate of oil as well as water.Therefore, ASP Flooding experimental is simulated on CMG STARS.

### 4. Reservoir Simulation using CMG.

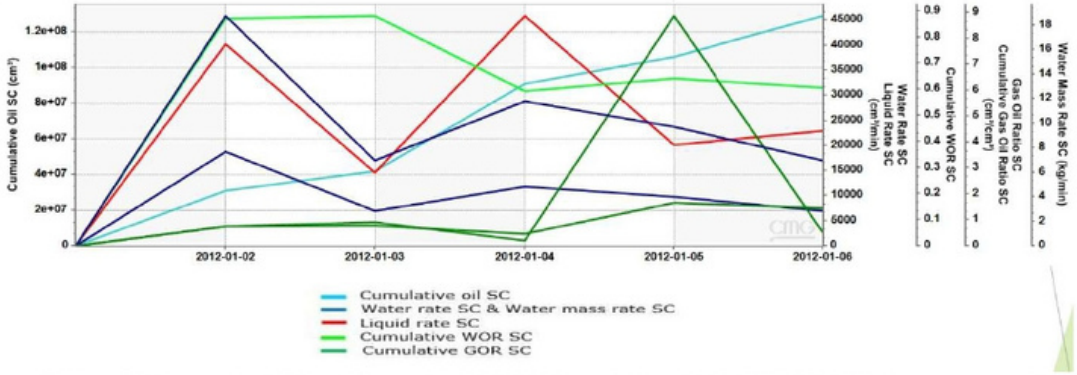
As Lab results were commendable for flood job no 07, it was simulated on CMG Stars. In order to forecast reservoir's productivity as a result of lab experiment As shown in fig there were 3 major steps involved for simulating a reservoir. In 1st step the data was generated via lab as well as field, relying on the data given by respective offset wells in the reservoir and lab step 2 was commenced, this step took place in CMG STARS Builder module wherein a reservoir grid was created on Cartesian lines it was considered as foundation subsequently reservoir components, Rock/Fluid properties, types and number of wells their initial conditions were specified. step 3 the lab and field and the model prepared in CMG STARS was scrutinised in CMOST for history matching. There, CMOST verified and interpreted the condition of the reservoir and determined its forecast productivity.

### CONCLUSION

Illustrates that the application of ASP flooding for this reservoir is most effective and feasible, whereas use of Polymer flooding gives less oil production and adds up to the total cost of the process.

The viscous nature of oil caused undesired mobility ratio due to which despite having good permeability and hydrostatic pressure, water cut increased sharply in the early phase of production resulting in low (10%) primary recovery. With the objective to improve recovery, application of EOR was conceptualized. After detailed laboratory investigation on feasibility of chemical EOR processes, ASP was found to be the most feasible chemical EOR technique. ASP flooding is quite effective in thin, stacked pay zones with highly viscous heavy oil, where it's difficult to use thermal EOR techniques. Further, as is the common practice pilot project of ASP flooding is recommended in the field for three years followed by polymer buffer for two years.

## 5. Results & Discussion.




**Cumulative oil SC and Water rate SC, Liquid rate SC, GOR SC, Cumulative GOR & WOR SC, Water mass rate SC vs Time.**

While comparing the 2 EOR Processes (ASP & Polymer flooding) CMG has yield a graph representing the effective process for the reservoir.

The viscous nature of oil caused undesired mobility ratio due to which despite having good permeability and hydrostatic pressure, water cut increased sharply in the early phase of production resulting in low (10%) primary recovery. With the objective to improve recovery, application of EOR was conceptualized. After detailed laboratory investigation on feasibility of chemical EOR processes, ASP was found to be the most feasible chemical EOR technique. ASP flooding is quite effective in thin, stacked payzones with highly viscous heavy oil, where it's difficult to use thermal EOR techniques. **Further, as is the common practice pilot project of ASP flooding is recommended in the field for three years followed by polymer buffer for two years.**

This work has lead in advancement of knowledge where heavy oil pay zones with heterogeneity creates problems in recovery of heavy oil. Hence, ASP / polymer flooding is applicable to this payzone in the field for recovery of heavy oil from all production wells present in this region. The overall percentage recovery of hydrocarbon was increased from selected chemicals used for ASP flooding. In case of a heavy oil bearing sand-shale reservoir laboratory core studies and simulation studies were carried out for water flood, PF and ASP flood with various combinations. In general, above studies are recommended to decide flood plan for improving recovery of oil. **The optimized concentration of fluids in injection water could be decided only after that.**

# Safety in Petroleum Industry from Industry 4.0 and Artificial Intelligence Perspective

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**Abstract**

The Petroleum Industry accounts for safety regulations to be followed in all the phases right from hydrocarbon exploration till refining of raw crude and gas. The recent oil inferno at Baghjan in the northeastern part of India also draws the attention of all the stakeholders to ponder upon improvised measures and implementation of advanced technologies to ensure integrity as well as safety in the workplace in Oil and Gas Industry. The need of the hour is to take into collaborative, innovative approach of all the stakeholders across the globe. Artificial Intelligence, Data Science, Machine Learning are the upcoming technologies to tackle hazard in such industries. The present scenario encapsulates the amalgamation of Information Technology and Oil industries to set forward creative and feasible solutions to deal with safety aspects. This paper primarily focuses on a comprehensive representation of Industry 4.0 and other automated technologies to prompt the alarm of awareness and quick response to emergency conditions in the industrial and adjacent premises with a prime motive to reduce loss of lives and properties. Moreover, the study emphasizes a critical review to assess the associated failure of inspection which led to the occurrence of major accidents in the Petroleum Industry worldwide and propose digitalized solutions in upstream, midstream and downstream sectors so as to enhance risk management system in order to ensure wellbeing of the workforce.

## 1. Introduction

The present day scenario of safety in Petroleum Industry is a major area of concern for all the stakeholders as it deals with highly inflammable raw material and products at every stage right from hydrocarbon extraction till refining of petroleum products. The Industry is subdivided into three major sectors- upstream, midstream and downstream **(Verma et al., 2021)**. These subdivisions are primarily based on the raw materials, modes of operation and products. The upstream sector involves the stage of exploration till production of hydrocarbons through tubulars, midstream sector currently involves processing of petrochemicals and polymeric products from crude while that of downstream **(Ambituuni et al., 2014)** basically deals with the separation and refining of hydrocarbon products to be released for humanitarian use. The energy majors already have in place strategic regulations and code of conduct to ensure safety standards in the workplace. However, despite of such stringent regulations, incidents such as Baghjan oil inferno calls upon the reader's attention to the safety issues in Oil and Gas Industry which ended up with huge loss to the environment and lives. The era of digitalization has also grasped its roots in the Oil and Gas Industry with the advancement in technology to reduce uncertainties and reduce associated risks **(Kapoor, 2020)**. Likewise, Internet of Things (IoT) sensors enable the Health, Safety and Environment (HSE) managers to get real time data so as to improvise monitoring of assets and avoid accidental chances within the designated premises **(Ventulett & Villegas, 2019)**. The world of automation and virtual reality (VR) are some of the efficient tools which could aid the managers to control systems and instruments of refineries as well as exploration and production sites. The World Economic Forum's Digital Transformation Initiative estimates the potentiality to create over 1 trillion in value for oil and gas companies with the incorporation of automotive technologies, remote operation commands and robotics **(Dekker & Thakkar, 2018)**. This paper primarily aims at describing digitalized solutions for Oil and Gas safety operations with the implementation of concept of realization of Industry 4.0 to tackle emergencies and reduce dependency on manual operations especially from HSE concern with special context to upstream, midstream and downstream industries.

### 1.1. Challenges in Petroleum Industry

The upstream oil industry specifically deals with the exploration and partly the developmental stage of hydrocarbon extraction. There are various challenges encountered during the extraction of oil and gas from the perspective of safetyof crew members and the surrounding nature. The exploration of different hydrocarbon bearing sites at remote locations involves the clearing of forests or workforce to be deputed in unknown locations which is a pose of threat for the crew members from different wildlife activities. Most of the incidents related to leakage or burst out of hydrocarbons in drilling rigs may be accounted to the phenomenon of blowout which refers to sudden blow of hydrocarbons to the surface due to the formation pressure greater than the hydrostatic pressure of the drilling fluid (mud). As reported by US Department of Labor- Occupational Safety and Health Administration (OSHA) database (1997-2003), the likely oilfield fatalities by incident have been reported to be 47 % by struck conditions, 16 % by explosion or fire in the assets, 14% because of fall of workers from height during heavy duty operations, 7% by caught in between equipment, 6% by electrocution, 3% by drowning and 7% due to other associated injuries which has demonstrated in **Figure 1**.

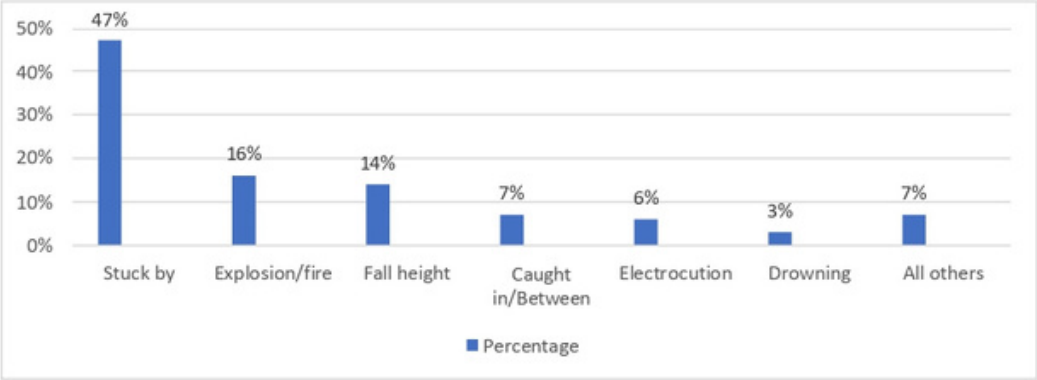


**Figure 1. Analysis of oilfield fatalities based on incidents**

A number of incidents in the midstream industry have taken place till date and it seems to be increasing over the past few decades. Human errors have mainly been the reason for such incidents while machine malfunctioning has also played a major role in such catastrophic incidents. Several incidents associated with midstream industry over the last decade has resulted in 2,500 injuries, 548 fatalities and over $ 8.5 billion in financial damages. Since 2010, there have been reportedly more than 3,300 incidents of LPG leak, crude leak and ruptures of pipeline in the United States. In 2009, Jaipur, India, Transfer leak and Vapour Cloud Explosion (VCE) in a refinery led to 12 fatalities and 200 injuries **(Elvidge, 2016)**. Theaccidents that occurred in downstream industries are analyzed as a function of time which reported a significant increase in the last few decades. Forinstance, the BP Texas refinery fire in 2005 resulted in 15 fatalities and 180 injuries. After, investigation the main factor causing the incident was attributed to human negligence in safety **(Nwankwo et al., 2021)**. Similar is thecase for oil transport via pipeline or tankers wherein there is a high risk of handling such highly inflammable products.

**Table 1. Major Accidents in Oil and Gas Industry**

| Sl. No. | Year | Country | Investigated Reason | Fatalities |
|---|---|---|---|---|
| 1. | 2000 | UAE | Jack-up rig collapse | 4 |
| 2. | 2001 | Brazil | Fire Explosion | 11 |
| 3. | 2004 | Belgium | Natural Gas Pipeline Explosion | 24 |

| | | | | |
|---|---|---|---|---|
| 4. | 2007 | Saudi Arabia | Fire During Pipeline Maintenance | 40 |
| 5. | 2010 | Gulf of Mexico (Deepwater Horizon) | Fire Explosion and Oil Spill | 11 |
| 6. | 2012 | Nigerian Delta | Explosion | 2 |
| 7. | 2020 | Baghjan, India | Blowout | 3 |

### 1.2. Digitalized solutions for implementation in Petroleum Industry

Many researchers have come up with diversified solutions focused on various approaches to evaluate and analysis safety prospects such as risk-time analysis governed by real time input data and high frequency update, dynamic methodological approach and operational analysis to provide continuous sustenance to safety critical operations proposed by risk analysis. Recent studies have found out Frequency Modification Methodology according to American Petroleum Institute (API) API 581 standard base on Technical Operational and Organisational factors (TEC20) as proposed by Landucci *et al* **(Landucci & Paltrinieri, 2016)**. Use ofUnmanned Air Vehicle (UAV) consisting of navigation sensors position detection, remote sensors for communication, optical sensors to get visual images and detection sensors for gas leakage detection have been proved useful in onshore as well as offshore drilling industry. The UAV is designed in such a way that it sends radio signals of 802.11b, 802.15.4 and 802.11a respectively so as to establish communication with ground control operator which enables the operators in oilfields to monitor all the onshore field activities while sitting at one place to reduce risk of leakage etc. The concepts of Gathering Line Systems (GLS) and Trunk Lines (TL) have been proposed to enhance safety standards in midstream industry. GLS is the first receiver of hydrocarbons before they are processed and transported. Operators typically record only volume and pressure data available from the Lease Automatic Custody Transfer (LACT) units as there tends to be a limited appetite to sensorize such a huge network: even the limited access to rights-of-way can act as a barrier to install sensors **(Rossomando, 2010).** For instance, Enbridge worked with a leading technology company and Finger Food Studios to first integrate 132 discrete sets of pipeline data [collected by in-line inspection tools, strain sensors, Light Detection and Ranging (LiDAR) remote sensors, etc.] along with terrain information, to create a 3D rendering of the pipeline network by processing the vast quantity of data in real time. The contribution AI, IoT and real time data analytics softwares potentially can offer better management of transportation of hydrocarbons as well as maintenance of refineries. Keeping the track of preventative and corrective maintenance, as well as real-time hazard analysis and risk assessment in rapidly changing weather conditions and corporate changes is a real challenge but with recent developments, capturing multiple data streams of information from specific vessels, pumps, and compressors will drastically enable the energy technocrats to handle a situation with the control located far away from the assets. Additionally, a reduction of downtime during hydrocarbon transport also reduces the probable. Another researcher developed a system called *"RoboGas Inspector"* where the robot's sensor head is built of various remote sensing instruments based on the working principle of Tunable Diode Laser Absorption Spectroscopy. It can detect leaks in pipes and oil spills on the ground using passive infrared thermographic imaging. Objects or places can also be scanned with the Pan-Tilt Unit, and anomalous gas concentrations can be detected **(Soldan et al., 2012)**.

### 1.3. Industry 4.0 and Artificial Intelligence in Oil and Gas Sector

Industry 4.0 tools such as big Data, industrial internet of things, digital twin and blockchain technologies have enabled energy majors to gear up seismic exploration at remote places, setting up of intelligent refineries and intelligent and smart oilfield concepts and many more at a faster pace. Artificial Intelligence (AI) is slowly grasping the world of oil and gas in all the phases including upstream to downstream. The risk factors present in hydrocarbon industries right from heavy equipment handling, high pressure high temperature operations, dealing with belligerent chemicals etc. needs special attention for mitigation at first hand. One of the significant branch of AI is deep learning wherein pattern recognition enables the incharge of the field or station to keep track on the worker's safety using live video streaming. Predictive analytics is a boon in the sector of machinery and equipments providing records of their condition thereby enabling proactive actions to prevent a tragedy **(Koroteev & Tekic, 2021)**. Additionally, Control of Substances Hazardous to Health (COSHH) describes the correlation between factors of chemical risk assessment and control measures. COSHH tools include specified HSE AI Assistant messaging board which includes input variables and decision which are interpreted using Natural Language Processing (NLP) and Natural Langauge Generation (NLG). Chatbox enable engineers or manpower resource to communicate with users via video, imaging etc. Moreover, HSE AI Assistant utilizes an amalgamation of artificial intelligence and machine learning **(Rueckert, 2017)**.

### 1.4. Conclusion

The article primarily focused on three subdomains of the age old Petroleum Industry namely upstream, midstream and downstream alongwith their associated safety concern. The following conclusion may be drawn based on critical analysis of the multidisciplinary approach to ensure safety at workplace.

- There are many challenges in the oil and gas industry right from exploration till refining and transportation of petroleum products safely. Exploration, drilling, production and refining require safe concern in eachand every stage to reduce the risk of major accidents.
- Upstream petroleum industry involves exploration phase, drilling and production. Initiatives are in progress for implementation of Wireless Sensor Network, Frequency Modification Methodology and Unmanned Aerial Vehicle is a few to take into account for safe operations in oilfields.
- Initiatives such as Gathering Line System and Trunk Line concepts have also grasped the midstream industry to enhance harmless transportationof petroleum products and the inbuilt sensor systems will definitely ease the compressor or gas station operations in petrochemical processingsector.
- Downstream industry have seen some advances in the recent time withthe implementation of robotics (*Robo Inspector* concept) in some parts of the world for efficient monitoring of safety standards in the entire refining process.
- Industry 4.0 (more effectively is termed as Oil and Gas 4.0 in this context) accounts for amalgamated big data analytics, IIoT, automation, augmented and virtual reality based technologies to manage highly inflammable products in the industry in a safe manner.

Lastly, the operations in heavy duty industries such as oil and gas should always consider the HSE prospect in an effective way to reduce destruction to the nature due to hydrocarbon exploitation.

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TECHNOLOGY NOW

# OIL NEWS

## LATEST DISCOVERIES

- Turkish Petroleum discovers oil worth 12 billion dollars in Mount Gabar, Turkish Petroleum (TPAO) has discovered 150 million barrels of oil in Mount Gabar Area, southeast Turkey. Turkish President Recep Tayyip Erdogan announced the findings during an cabinet meeting on December 15, 2022 .

- Egypt makes 53 new oil and gas discoveries in 2022, Egypt has witnessed a spike in its energy reserves in 2022, with 53 new oil and gas discoveries according to a report by the country's Ministry of Petroleum and Mineral Resources. The new discoveries include 42 oil wells, and 11 gas wells in the Western Desert, the Suez Gulf, the Mediterranean Sea, and Nile Delta .

## TECHNOLOGICAL ADVANCEMENTS

- New data Lab to Tackle Oil and Gas, Greenhouse Gas Emission accounting. The Energy Emission Modelling and Data Lab will establish accurate assessments of greenhouse gas emission across oil and gas supply chains. Data and analysis from this new endeavor will help both public and private institutions develop climate strategies and actions.

- ONGC to rely more on advanced tech, says Sushma Rawat, Director (Exploration). Oil and Natural Gas Corporation will drill more, drill deeper and increase reliance on advance technologies and tech-savvy younger minds to boost chances of making major discoveries.

- Out of this world technology could help oil sands take giant leap forward in reducing CO2 emissions--- A Calgary company's leading edge technology, originally used by NASA to search for life on Mars is coming down to earth to help reduce greenhouse gas emissions in the oil sands. Impossible Sensing Energy edged out competitors from around the world in a Pathway Alliance global challenge to find a key piece of measurement equipment that will help accelerate the widescale use of steam-reducing technologies in oil sand operations.

TECHNOLOGY NOW

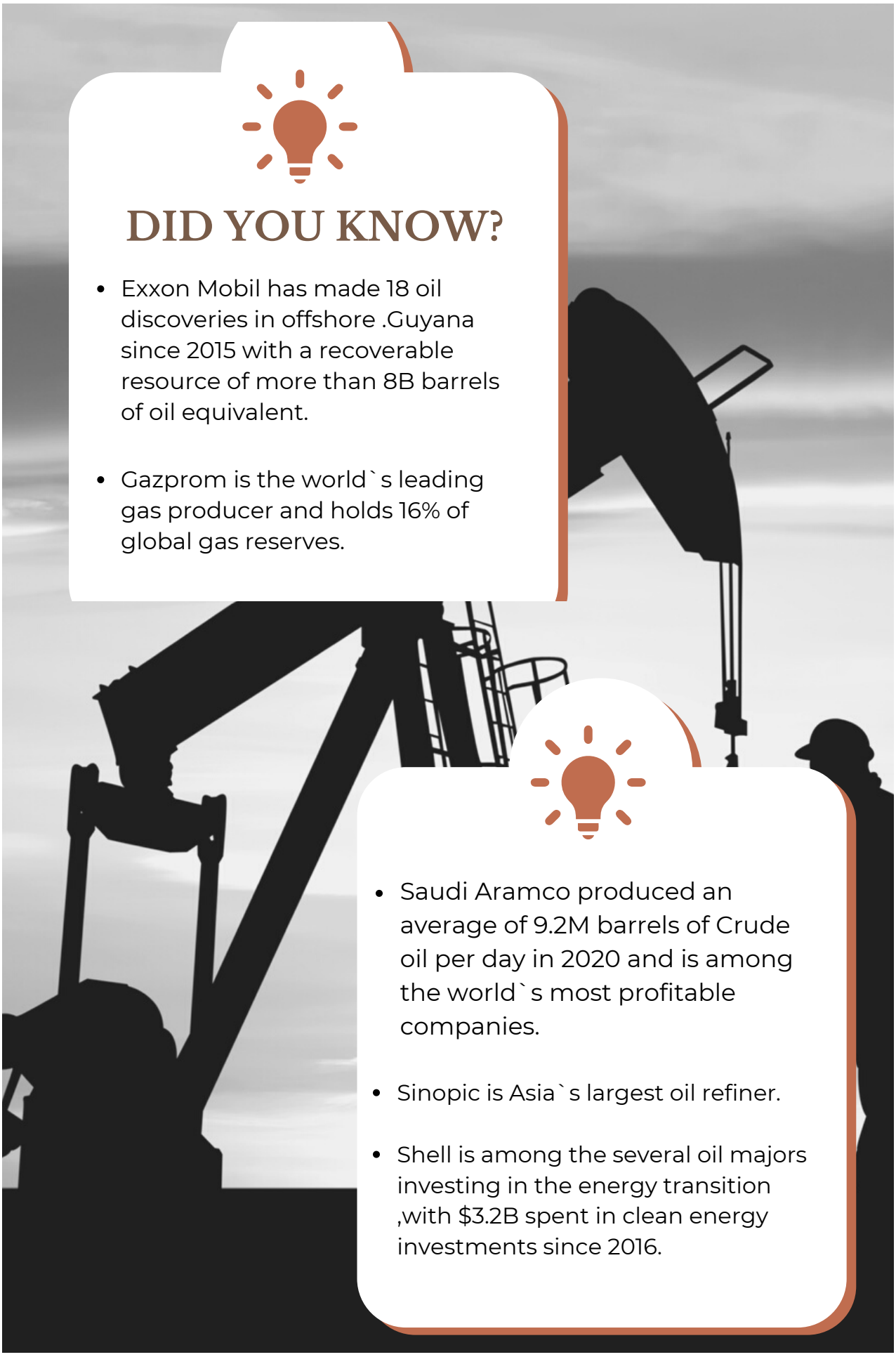
# OIL NEWS

## ECONOMICAL TRENDS

- Huge energy profits--- Oil and Gas companies are receiving record profits, some of the biggest ever, while our bills are going through the roof. The big oil and gas producers in Russia, America, some in Europe, Saudi Aramco, 40 billion dollars just in the second quarter which is extraordinary. Chevron and Exxon have received between 10 and 20 billion dollars .

- IIFL securities Harsvardhan Dole shares his insights on oil and gas sector--- Recently we have upgraded the oil estimates for this year and the upgrades for OIL and ONGC have been in the region of around 20-40%. The stocks of all the companies that have underperformed in the last two months partly because the global sentiments are such that there is possibility of government intervention in the form of tax .

- UN Secretary General told governments to windfull taxes to energy companies making scandalously high profits, the money should be used to help the most vulnerable. The largest energy companies are guilty of greed and harming the environment .



# DID YOU KNOW?

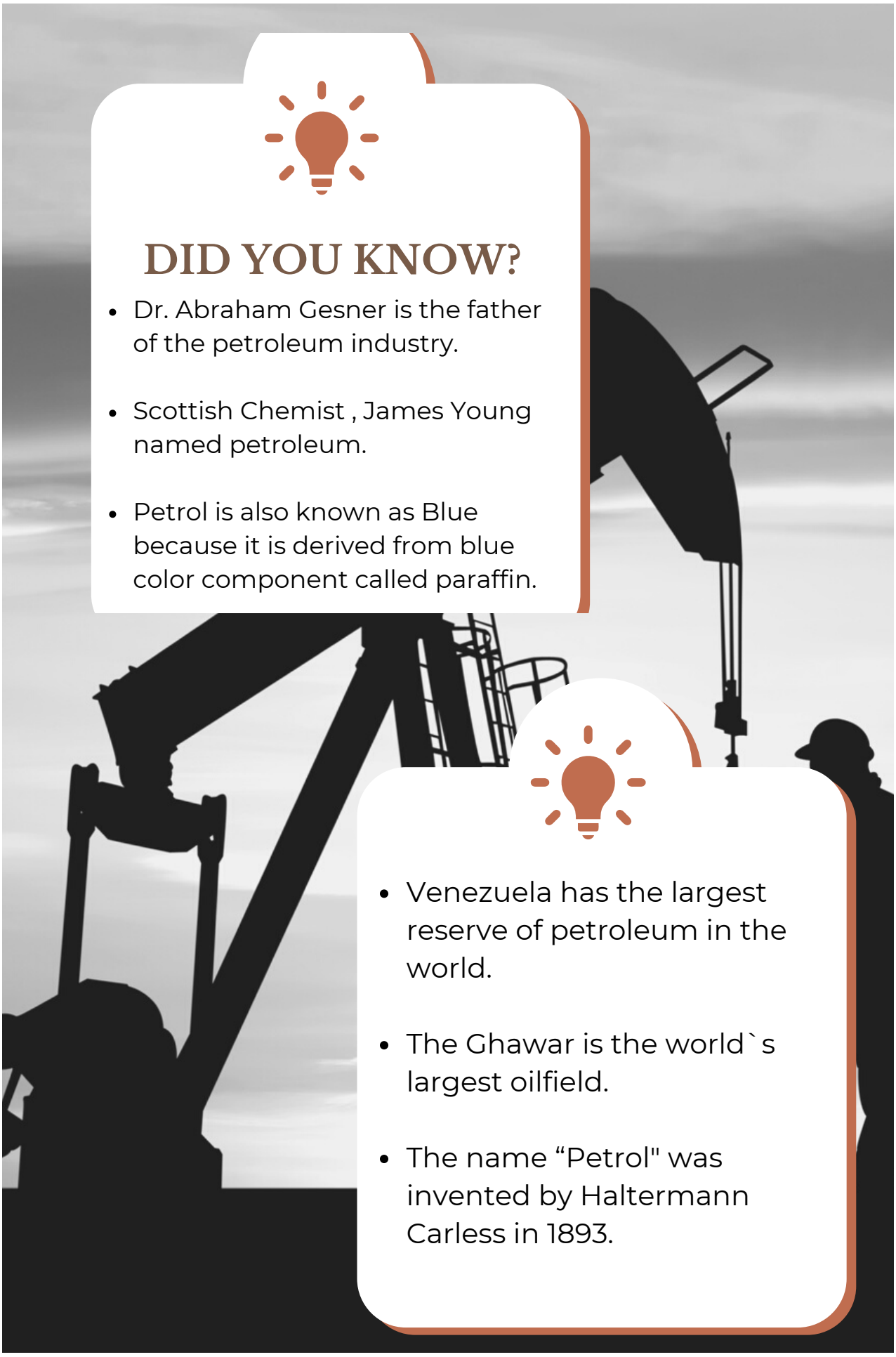
- Exxon Mobil has made 18 oil discoveries in offshore .Guyana since 2015 with a recoverable resource of more than 8B barrels of oil equivalent.

- Gazprom is the world`s leading gas producer and holds 16% of global gas reserves.

- Saudi Aramco produced an average of 9.2M barrels of Crude oil per day in 2020 and is among the world`s most profitable companies.

- Sinopic is Asia`s largest oil refiner.

- Shell is among the several oil majors investing in the energy transition ,with $3.2B spent in clean energy investments since 2016.



# DID YOU KNOW?

- Dr. Abraham Gesner is the father of the petroleum industry.
- Scottish Chemist , James Young named petroleum.
- Petrol is also known as Blue because it is derived from blue color component called paraffin.

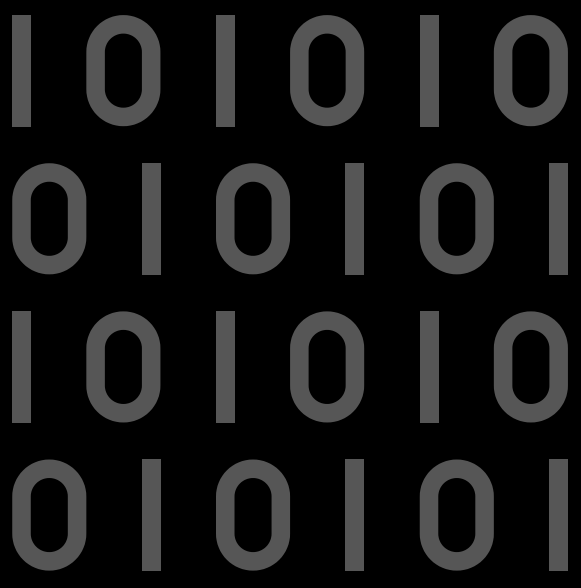
- Venezuela has the largest reserve of petroleum in the world.
- The Ghawar is the world`s largest oilfield.
- The name “Petrol" was invented by Haltermann Carless in 1893.

# CAN YOU CRACK THE CODE ? </>

Pond Sizes: You have an integer matrix representing a plot of land, where the value at that location represents the height above sea level. A value of zero indicates water. A pond is a region of water connected vertically, horizontally, or diagonally. The size of the pond is the total number of connected water cells. Write a method to compute the sizes of all ponds in the matrix.

EXAMPLE

Input:
0 2 1 0 0
0 1 0 1 0
1 1 0 1 1
0 1 0 1 1
Output: 2, 6, 1 (in any order)



umeed
maan ki umeed

UMEED as an organisation aims at building the base of anyone who needs help and assistance. We don't really like to limit ourselves to one particular activity or be vocal for only a cause when so there are just so many which needs to be talked an out and needs our immediate attention. One of our main aim is to provide PRIMARY EDUCATION for the kids living in slums or kids from the poorer background. We believe education is one of the most powerful tool which do have the potential to change one's future and these kids do deserve to have this.


We formed this organization with four goals in mind; Education, Employment, Empowerment and Service. We believe that over the course of 365 days, we were able to affect hundreds of families in a positive light and on the occasion of our anniversary; we pledge to continue our honest work. Umeed is just a connecting link between different people trying to develop a beneficial relationship between the donor's heart and the receiver's heart.

Thank you each and every one of you for being with us on this journey. We hope to make you feel proud in future as well.

umeed
maan ki umeed

# ADOPTION OF A KID

Is another new concept which I came up with for these young innocent kids. You can adopt a kid, if you wish too. You can be an active donor or take the responsibility to help the kid. This way you will be financial donor of the kid and this little one will get a chance to change his /her life. We do understand things can get really costly and we are just teenagers how can we fund so much, but we take charge of that to make sure that everything is in an amount which we do believe you can afford. Through this little organization, I am trying to build a happy safe for people who want to help and people who need help.