

# Fluid dynamics in gas oil industry engineering essay



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Now days, many oil and gas companies are utilizing the predictive capabilities of the fluid flow-modeling software. CFD also called computational fluid dynamics is that branch of fluid mechanics which uses the algorithms and numerical methods for solving the real-life problems involve in fluid flow. Computational fluid dynamics gives engineers and researchers a powerful simulation tool, which helps them in understanding the performance and design of the petroleum reservoir. The application of CFD ranges from designing of reservoir injector to drilling and production of petroleum. CFD currently finds its applications in onshore, offshore and in sub-sea areas. This computer software helps the engineer to perform the numerical experiments, and thus reduces the cost and time involved in making prototype design programs. The Fluent, a CFD software package helps in stimulating the flows involve in single and multiple phases, either use with or without transfer of heat and mass (Das, 2010).

This report is based on role of Fluid Mechanics in the Gas-Oil Industries. Fluid mechanics is an important field of mechanics, theories and principals of fluid mechanics play an impressive role on industrial level. In this report industrial application of fluid mechanics are brought in light. This report discusses the concept of fluid mechanics also called computational fluid dynamics that has varied applications in oil gas industry. Various principals, theories and laws are discussed with the area and industrial processes, where these laws and theories are used. It is a well-known fact that technology and industry works together, industries cannot sustain without the technology. This report plays a great role in bringing the concept of technological dependence of the industry by studying the application of fluid mechanics in the oil gas

industry. Almost all the companies in the oil gas industry bring computational fluid mechanics and its simulation techniques in use for their effective and efficient operation. Fluid mechanics aids these companies not only for effective production techniques but also in risk management and maintenance. On the industrial level the simulation software for fluid mechanics are introduced which are much popular. This software provides the virtual environment to work, through which the computations and various decisions can be taken efficiently which saves time of testing. Fluid mechanics is also a research area in which the research is going in order to find new knowledge. As this knowledge has great industrial application and use, companies are also seemed to invest in research and development of this field. These companies mostly belong to oil gas industry. Oil gas companies are engaged in the operation on raw oil or gas petroleum products as raw material after processing this as raw material it produces more refined form. Oil and gas are fluid material therefore fluid mechanics is most important part of operation in this industry. This report is divided into three sections, first section gives introduction about the fluid mechanics and computational fluid dynamics, second section is literature review which explains the theories of fluid dynamics and also the application of CFD in petroleum industry, the and third section concludes the overall report.

## **Literature Review**

Fluid mechanics treats gases as fluid; according to mechanics anything that can flow physically from one place to another in medium is called fluid. In oil gas industry the fluid mechanics is used in the operations like measurement, flow control, pressure control and flow speed detection etc. On the same

time at the places where the operations which involves heating of gases also fluid mechanics is used because on heating the gases expands and hence the pressure increases, at this time this pressure is compare against the pressure tolerance of the container in order to avoid accidents. Here various studies and results are discussed in group (Menon, 2005).

## **Properties**

Properties of the fluid are most basic concept of the fluid mechanics used in the oil gas industry. These theories are not used alone but for any application it is used on basic level. It helps in measuring the amount of oil and gases. Also helps by characterizing gases by which the identification of the oil and gas becomes easy and comfortable. And the properties which are discussed here deals with storing the oil and gas. At the time of storing oil and gases measures like pressure at which the

## **Mass Volume Density**

Mass, volume and density are the three most basic and fundamental properties of fluid. On the behalf of which the quantity and amount of matter contained in the specific volume is measured, on the same time unique set of values, these properties at given temperature characterizes fluid.

Temperature term is used because the fluids are shrinks and expands with the volume; hence the set of values of these properties varies with time. The relationship among these properties is defined as:

$$\text{Eq. 1 Density} = \text{Mass} / \text{Volume}$$

## Viscosity

There are some more properties of the fluid like viscosity; viscosity is the friction force (which one surface offers to another surface in contact with it in order to resist its motion) offered by one layer of fluid on another during the flow. It is related to fluid flow.

## Ideal Gas

It is the concept which is not practical but theoretical forms the model for any kind of gas. It is defined in terms of an equation known as ideal equation. It is for the ideal gas but we know that concept of ideal gas is hypothetical and no gas is ideal. The ideal gas equation is used with some correction for real gases called real gas equation.

Eq. 2  $P * V = n * R * T$  (ideal gas equation)

Eq. 3  $P * V = K * n * R * T$  (real gas equation)

Where: P = pressure, V = volume, n = number of moles of gas, R = ideal gas constant, T = temperature and K = real gas constant (it varies according to gas)

## Flow control

Flow is fundamental property of the fluid, in oil gas industry it is important due to some reasons like both oil and gas flows, other than storing the oil and gas the transportation of oil and gas is also the challenge for this industry sometimes for the transportation of the oil pipeline is considered economical in this situation oil and gases are transported through pipelines. In this scenario the speed and viscosity plays an important role. The amount

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of oil and gases are measured during the flow also. For the flow pressure is also required because in order to make the liquid flow from one place to another potential difference is also required, many times this potential difference is provided by the gravity but it is the best and ideal case. In real world it is not possible so this potential difference is introduced using pressure difference, at this time this pressure is need to be managed in order to prevent damage to the pipeline in this mode of oil gas transportation the risk of damage to pipeline is high and hazardous. For the flow of fluid there are several principles and theories which have wide variety of application in oil gas industry. These flow control and management theories are not only used in transportation of the fluid but there are some more operations where these theories are implemented.

## **Application of Computational Fluid Dynamics in Gas & Oil Industry**

Computational Fluid dynamics is used in wide variety of industries and disciplines which includes automotive, aerospace, power generation, medical research, petroleum exploration, chemical manufacturing etc. Use of Computational Fluid dynamics let to reduction in the cost of process development and production. Computational Fluid dynamics also led to optimization of processes and activities of these industries by reducing down time. In these industries requirements of physical needs are decreased, increased yields and conversions, time to market is shortened and resolution of environment is facilitated due to Computational Fluid Dynamics.

Computational Fluid dynamics also have very large potential impact on oil and gas industries because the equation of motion used by Computational

fluid dynamics provides everything which is meaningful to understand the domain completely. In oil & gas industries, chemical engineers usually use Computational fluid dynamics to make assumption in the piping and process units. These assumptions lead to great simplification of complex equation of motion. With the help of Fluid dynamics, Gas & oil industries make assumption for the material that is going to be used in the chemical reactors (Sweden, 2005).

The computer software called Fluent, which helps the engineer to perform the numerical experiments, and thus reduces the cost and time involved in making prototype design programs. It is based on the concepts of Computational Fluid Dynamics, helps in stimulating the flows involve in single and multiple phases, either use with or without transfer of heat and mass

## **Conclusion**

Technology and industry works parallel, industries depends on the technology up to a large extent for its functioning. The engineering products like researches, theories, principals and instruments play a vital role in smooth functioning of this industry. Due to these tools provided by the technical field the operations of an industry becomes effective and efficient. Any industry depends up on these tools for its growth and speeding up its production on the technology. If specific parts of the technology are considered each part plays its own role in industry depending upon the type of industry. Mechanical engineering has its own place in all the industries, mechanics is further divided into various categories, and fluid mechanics which is part of mechanics plays an important role in oil and gas industry. <https://assignbuster.com/fluid-dynamics-in-gas-oil-industry-engineering-essay/>

Because this industry deals with fluid as both oil and gas are fluids. Various principals of fluid mechanics are used by the companies of this industry. These theories and principals are used for carrying out large calculation, making strategy and designing setups. The capacity of containers and machines are guessed on the basis of various laws of fluid mechanics. From measurement of amount of oil and gas to its transportation form one place to another fluid mechanics is involved in this industry. The storing of the oil is comparatively easy task but storage of gas is difficult task, here the fluid mechanics plays the real role. Other than storage transportation of the oil and gas through the pipeline which is most popular and economical way of transportation, makes use of many flow related fluid mechanics principals. In case of pipeline the speed of the flow matters which is measured using variety of laws in which Bernoulli's equation and theorem is more popular than other. Using the speed and the density of the oil flowing volume and its amount can be easily calculated. In this pipeline method the pressure difference is created between source and destination. This pressure difference is required in order to make the oil flow because in long distance transportation one cannot rely upon the gravitational potential difference. This pressure sometimes creates challenges and in order to overcome these challenges the fluid mechanics again comes in role. In oil and gas industry speed of flow which is dependent on the viscous nature of oil and gas which is considered as friction force between the layers of liquid plays important role as due to this force energy is released. In this way the role of fluid mechanics which is very important in the oil and gas industry is clear. The oil and gas industry of which the raw and finish product, both are fluid in nature fluid mechanics is an essential tool. In order to improve productivity the <https://assignbuster.com/fluid-dynamics-in-gas-oil-industry-engineering-essay/>



industry needs to develop more knowledge in this field. For this purpose the research is required in this field.