Applications of Fluid Mechanics in Different Engineering Fields

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Abstract: Fluid mechanics is an ancient science that alive incredibly today. The modern technology requires a deeper understanding of the behavior of real fluid on other hand mathematical problems solved by new discovery. Fluid mechanics played a special role in this work by incompressible viscous flow. The aim of this logical statement is to furnish some result in different areas (i.e. civil, mechanical, biotech &chemical engineering), that are linked by the some general scope in that areas of giving new in site in field mechanics.

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Introduction: A pragmatic if not scientific knowledge of fluid flow was exhibited in design of arrows, spares, boat and hydraulic project for fluid protection and water supply [1]. The fundamental principle of hydrostatics was given by Archimedes work on floating bodies. Archimedes develop the law of bouncy that states when a body immersed in a fluid experience a force that is equal to the weight of fluid ,it displaces when in equilibrium is equally pressed in all direction[2]. the effect of friction and viscosity is diminishing the velocity of running water, the hypothesis in this course should investigate that the velocity at any stratum of the vertex is an arithmetical mean between the velocity of the strata enclosed it, that the velocity of a filament of water moving in a pipe is an arithmetical mean between the velocity of filament which surrounded it[3]. In 1738 denial Bernoulli published his hydrodynamic a text book, communicated to the academy of st. Petersburg 1726 was founded on to comfortable supposition, which appeared to him comfortable to experience he suppose that the in a vessel the surface of the fluid which is emptying itself by an orifice remain always horizontal and if the fluid mass is concaved too be divided to an infinite number of horizontal strata of the same bulk the velocity inversely proportional to their width or too the horizontal section reservoir[4].

$$V = 1/B$$

Where,

V=velocity of fluid and B=width of orifice.

The continuity equation of fluid mechanics before discussing it with respect to cardiovascular system the mass of moving fluid does not change it flows that leads to an important quantitative relationship called the continuity equation[5]. Consider a portion of flow between two stationary cross section with area A1 &A2 at that section velocity V1 & V2 respectively[6].

The mass flowing in to the tube across A1 and time dt is

$dm_1 = \rho A_1 V_1 dt$

Similarly the mass flow the across A2 in the same time

$dm_2 = \rho A_2 V_2 dt$

in steady flow the total mass in tube is constant

$dm_1 = dm$

$\rho A_1 V_1 dt = \rho A_2 V_2 dt$

Continuity equation for incompressible flow

$A_1 V_1 = A_2 V_2$

The product of AV is volume flow rate dv/dt

$$dv/dt = AV$$

Molecular behavior of fluids: At the molecular level, particles of fluids tend to be defining in their arrangement is random and molecules are close in proximity, the fluid take place the shape in which it takes. Liquid molecules move at moderate speeds and exert a moderate attraction on each other. A liquid will disperse in response to impact its force determining the area over which the total volume of liquid is distributed. The response of fluid to pressure is one of most significant aspect of fluid behavior and plays an important role with in both statics and dynamics sub disciplines of fluid mechanics [7].

Application of fluid mechanics in field of civil engineering

Wind tunnel: The scenario of wind flowing through a room described a rudimentary wind tunnel, a wind tunnel is a chamber build for a purpose examine the characteristics of air flow in contact with solid objects such as aircraft and automobile. The wind tunnel represent a safe and judicious use of the property of fluid mechanics it purpose to test the interaction of airflow and solids in relative motion the first wind tunnel was built in England is 1871 and years later aircraft pioneers Orville construct (1871 to 1948 and Wilbur 1867 to

1912) wrights used wind tunnel to improve their plans by the let 1913 the US national advisory committee for aeronautics (NASA) was building wind tunnels capable of creating speeds equal to 300 mph (480km/h) [8].

Syphon: A syphon is a long bent pipe is use for carrying water from a reservoir at a higher level to another reservoir at a lower level when the two reservoirs are separated by a hill or high level ground.

- To take out water from one reservoir to another reservoir sepreted by a hill or ridge.
- To drain out water from a channel without any outlet.
- To take out the water from a tank this does not have any out let.

The syphon works on the principle of Bernoulli's, the flow through syphon then remains continuous till pressure in syphon pipe remains negative but less than separation pressure [9].

Hydraulic: Hydraulic is a branch of practical science with the practical application of fluid primarily liquid in motion it is related to fluid mechanics which in large part provides its theoretical foundation hydraulic deals with such matter as the flow of liquid in pipe reverse and channels and their confinement by dams and tanks some of its principle apply also to gases the scope of hydraulic extend to such mechanical device as fans and gas turbines and pneumatics control system liquid in motion or under pressure did useful works for man for many centuries before French scientist, pressure in a liquids transmitted equally in all direction that is when water is made to fill a closed container ,the application of pressure at any point will be transmitted to all sides of the container in the hydraulic pressure. Pascal law is used to gain an increase a small force applied to small piston in a small cylinder is transmitted through a tube to a large cylinder where it pressure equally against all sides of the cylinder including the large piston [10].

Hydraulic power system have become one of the major energy transition technology utilize by all faces of industrial agricultural and difference activity. Modern air craft for example use hydraulic system to activate their control and to operate landing gars & brakes, virtually all missiles as well as their ground support equipment utilize fluid power uses hydraulic power system in their transition brakes and steering mechanisms [11].

Application of fluid mechanics in field of mechanical engineering

Creating a draft: Among the most application of Bernoulli's principle is its used aerodynamics

$$P/\rho g + v^2/2g + Z = constant$$

and he is discussed in the context of aerodynamics, according to Bernoulli's principle for instant explain why a shower certain tends to below in word, when the water is turned on in addition it shows why an open window create a draft [12]. Suppose one is in a hotel room where the heat is onto high and there is no way to adjust the thermostat outside however the air is cold thus by opening a window one can presumably cool down the room but if one open the window without opening the front door of the room there will be a little change in temperature the only way to cool will be standing next to the window with the door closed the room constitute an area of relatively high pressure compare to the pressure of the air outside the window because air is fluid.[13] ,it will tend to flow in to the room but once pressure inside rich a certain point it will prevent additional air from entering the tendency of fluid is to move from high pressure to low pressure areas not the other way around as soon relatively high pressure air of the room flows in to the low pressure as a result the air pressure in the is reduced and the air from outside can now enter soon a wind will began to blow through the room [14].

Pumps: Pump is a device for moving fluid and it does so by utilizing a pressure difference causing the fluid to move from an

area of higher pressure to one of lower pressure its operation is based on accepts both of Pascal and Bernoulli's principle though a course human were using pumps many of years before[15] .a syphon hose used to draw gas form car fuel tank is a very simple pump shucking on one end of the hose creates an area of low pressure compared to the relatively high pressure area of the gas tank. The piston pump slightly more complex consist of vertical cylinder along which a piston rises and fall near the bottom inlet valve through which fluid flow into the cylinder and an outlet valve through which fluid flows out one of the most the fluid being pump which pushes the piston up & down.[16]

Turbo machine: Turbo machinery device inject life in to fluid principle of turbo machinery from the primullary design tool in design of them consider the turbo machine and axial turbine a centrifugal machine are peloton wheel you can predict performance of all of these from same turbo machinery fundamentals .if the channel is rotating at an angular velocity 'w' power required to maintain the fluid flow will be torque multiplied by angular velocity [17].

$$Torque*w = m(R2V2-R1V1)*w$$

So power required for this fluid flow will taken as,

$$Power = (U2V2-U1V1)$$

Air jet weaving machine: The air jet weaving machine are the weaving machine with the highest insertion performance and are considered the manufacturing of light to medium weight fabrics preferably main fibers these machine for those who want to produce built quantities of customized fabrics styles the weaving width range generally from 190 to 400cm[18].

Application in chemical engineering:

Process industry: Continuum mechanics one of our most successful physical theories is radically application to the process industry .In continuum mechanics, the existence of molecule is ignored and matter is treated as a continuous medium. The

continuum hypothesis is valid provided the equation of continuum mechanics are applied at sufficiently large scale that the property molecules are noticed the mapping of the large of mass momentum and energy conservation the continuum result in field equation that describe the dynamics of the continuum these field equation variably known as the equation of motioned .continuum mechanics is the mechanical analog of classical electrodynamics in which a set of field equation describe the dynamic relevant variable of the electrical and magnetic field where as Maxwell equation are linear on less the constitutive behavior is non linear the equation of continuum mechanics are non linear regardless of the constitutive behavior of material of interest [19].

Computational fluid dynamics for oil and gas industry: Computational fluid dynamics is a tool that can be use effectively in a variety of onshore & offshore petroleum industry application that geosciences and engineering division at south west research institute has extensive CFD experience performing detail at simultaneous of complex engineering and natural system and providing clients with optimized designed solution get integrated multi disciplinary approach uses code costuzmation analytical model development and application and experimental investigation to accurately and defectively solve complex problem in the following area.

Unsteady turbulent flow analysis:

- Acoustic analysis
- Nozzle flow application
- Code customization
- Atmospheric gas dispersion
- Hydrodynamic analysis
- A logrithium development

Natural hazard analysis and environmental fluid flow:

- Simulation of land slide generates Tsunami.
- Free surface flow evaluation using volume of fluid technique

Mesh free smoothed particle hydrodynamics code capable of modeling flow with large deformation.

Fire dynamic simulation:

- Leak rapture and spill related fire analysis
- Smoke propagation assessment
- Use of NIST fire dynamic simulator and commercial code [20].

Fluid dynamic for medical research and bio medical device:

A world leader in fluid dynamic is active in fundamental medical research on the development of medical device technology

Service from science:

- Development of bio medical device
- Proto type testing and development
- Development of electronic , microelectronic and micro fluidic device

- Development of new bio medical plastic/ materials with support from material capabilities within CSIRO materials science & engineering division
- Design of original devices

Out comes:

We have successfully applied our fluid dynamics capabilities to innovative projects such as

- A new oxygen air mixing device with a radically different design to current technology
- New design for instant graph used for the treatment of aneurysm
- Remote sensing technology to develop a device to Minotaur psychological parameter from within the body.
- Electronic fluid flow detector to measure fluid flow in a hospital setting

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Facilities:

Our facilities include highly specialized and complex measuring equipment such as

- Pulse tile flow rig simulating the pressure and flow profile from the heart
- Micro particle image velocimetry
- Laser Doppler velocimetry system
- Phase Doppler particle analyzer
- Experimental rigs
- Medical power injector
- Medical ultrasound scanner
- Micro fluid laborites

Other facilities include wind and water tunnels for physical modeling visualization and flow measurement [21].

Summary & Conclusion:

Molecules are spaced further apart they attract each other with a small intermolecular cohesive force, when they easily move and change their relative position. They continuously deform that is flow under the action of shear force, no matter how force are small or large. Fluid mechanics is involved nearly all areas of civil, mechanical, chemical, biotech engineering either directly or indirectly some example of direct involvement are those were we are considered with manipulating field: Sea and river defenses, Water distribution/sewage network, Hydraulic design of water/ sewage treatment work, Dams irrigation, turbine and water retaining structure, Siphon, airfoils, pumps, drafts.

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