

INGLÉS II

PRÁCTICO 5

➤ Actividades de pre-lectura

1. Encuentre y especifique a qué/ quién hace referencia:

- La fecha más reciente:-----

- La fecha más lejana: -----

2. Lea el primer párrafo de la sección titulada “Brief History” y ordene según el texto. Tache la idea que sobra.

- El agua como promotora de energía.
- Construcción de acueductos y esplendor de los mismos.
- El agua como fuente de higiene y recreación
- Necesidad de encontrar una solución a los desechos cloacales.
- Necesidad de conseguir agua.

➤ Actividades de lectura

3. A qué hacen referencia las palabras marcadas en el círculo. Clasifíquelas en anáforas o catáforas

➤ **Verificando la comprensión global.**

4. ¿Qué problema existe en la definición de mecánica fluida y mecánica sólida
Explique
5. Expanda. ¿Qué quiere decir el autor en las líneas subrayadas?
6. ¿En qué contribuyeron a la historia de los fluidos las siguientes figuras?/ ¿Cuál fue el aporte en la historia de los fluidos mecánicos de:

Arquímedes	
Leonardo da Vinci	
Navier y Stokes	
Prandtl	

7. Explique en qué consiste la Paradoja de Lambert.
8. ¿Qué dos posturas surgieron respecto a la problemática de los fluidos y su resolución?
9. Elabore un ordenamiento cronológico de los años que hayan sido bisagra en la temática de la mecánica de los fluidos.

250 B. C.: Arquímedes: principios derivados de la flotabilidad.

Luego de 1945 softwares y herramientas numéricas: gran aporte al campo

CHAPTER 1

INTRODUCTION TO FLUID MECHANICS

1.1 *What is Fluid Mechanics?*

Fluid mechanics deals with the study of all fluids under static and dynamic situations. Fluid mechanics is a branch of continuous mechanics which deals with a relationship between forces, motions, and statical conditions in continuous material. This study area deals with many and diversified problems such as surface tension, fluid statics, flow in enclosed bodies, or flow round bodies (solid or otherwise), flow stability, etc. In fact, almost any action a person is doing involves some kind of a fluid mechanics problem. Furthermore, the boundary between the solid mechanics and fluid mechanics is some kind of gray shed and not a sharp distinction (see Figure 1.1 for the complex relationships between the different branches which only part of **it** should be drawn in the same time.). For example, glass appears as a solid material, but a closer look reveals that the glass is a liquid with a large viscosity. A proof of the glass "liquidity" is the change of the glass thickness in high windows in European Churches after hundred years. The bottom part of the glass is thicker than the top part. Materials like sand (some call it quick sand) and grains should be treated as liquids. **It** is known that these materials have the ability to drown people. Even material such as aluminum just below the mushy zone also behaves as a liquid similarly to butter. After it was established that the boundaries of fluid mechanics aren't sharp, the discussion in this book is limited to simple and (mostly) Newtonian (sometimes power fluids) fluids which will be defined later.

The fluid mechanics study involve many fields that have no clear boundary between them. Researchers distinguish between orderly flow and chaotic flow as the laminar flow and the turbulent flow. The fluid mechanics can also be distinguish between a single phase flow and multiphase flow (flow made more than one phase or single distinguishable material). The last boundary (as all the boundaries in fluid mechanics)

isn't sharp because fluid can go through a phase change (condensation or evaporation) in the middle or during the flow and switch from a single phase flow to a multi phase flow. Moreover, flow with two phases (or materials) can be treated as a single phase (for example, air with dust particle).

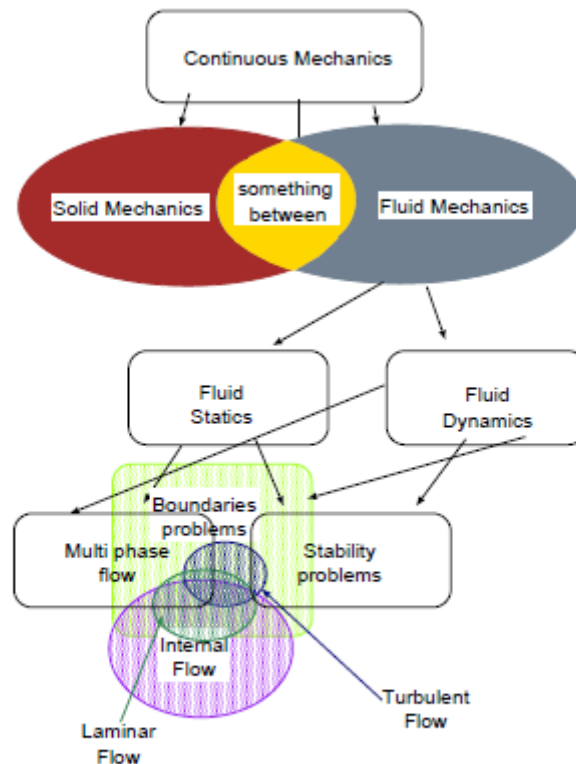


Fig. -1.1. Diagram to explain part of relationships of fluid mechanics branches.

After it was made clear that the boundaries of fluid mechanics aren't sharp, the study must make arbitrary boundaries between fields. Then the dimensional analysis will be used explain why in certain cases one distinguish area/principle is more relevant than the other and some effects can be neglected. Or, when a general model is need because more parameters are effecting the situation. It is this author's personal experience that the knowledge and ability to know in what area the situation lay is one of the main problems. For example, engineers in software company (EKK Inc, <http://ekkinco.com/HTML>) analyzed a flow of a complete still liquid assuming a complex turbulent flow model. Such absurd analysis are common among engineers who do not know which model can be applied. Thus, one of the main goals of this book is to explain what model should be applied. Before dealing with the boundaries, the simplified private cases must be explained.

There are two main approaches of presenting an introduction of fluid mechanics materials. The first approach introduces the fluid kinematic and then the basic governing equations, to be followed by stability, turbulence, boundary layer and internal and external flow . The second approach deals with the Integral Analysis to be followed with Differential Analysis, and continue with Empirical Analysis. These two approaches pose a dilemma to anyone who writes an introductory book for the fluid mechanics. These two approaches have justifications and positive points. Reviewing many books on fluid mechanics made it clear, there isn't a clear winner. This book attempts to find a hybrid approach in which the kinematic is presented first (aside to standard initial four chapters) follow by Integral analysis and continued by Differential analysis. The ideal flow (frictionless flow) should be expanded compared to the regular treatment. This book is unique in providing chapter on multiphase flow. Naturally, chapters on open channel flow (as a sub class of the multiphase flow) and compressible flow (with the latest developments) are provided.

1.2 *Brief History*

The need to have some understanding of fluid mechanics started with the need to obtain water supply. For example, people realized that wells have to be dug and crude pumping devices need to be constructed. Later, a large population created a need to solve waste (sewage) and some basic understanding was created. At some point, people realized that water can be used to move things and provide power. When cities increased to a larger size, aqueducts were constructed. These aqueducts reached their greatest size and grandeur in those of the City of Rome and China.

Yet, almost all knowledge of the ancients can be summarized as application of instincts, with the exception Archimedes (250 B.C.) on the principles of buoyancy. For example, larger tunnels built for a larger water supply, etc. There were no calculations even with the great need for water supply and transportation. The first progress in fluid mechanics was made by Leonardo Da Vinci (1452-1519) who built the first chambered canal lock near Milan. He also made several attempts to study the flight (birds) and developed some concepts on the origin of the forces. After his initial work, the knowledge of fluid mechanics (hydraulic) increasingly gained speed by the contributions of Galileo, Torricelli, Euler, Newton, Bernoulli family, and D'Alembert. At that stage theory and experiments had some discrepancy. This fact was acknowledged by D'Alembert who stated that, "The theory of fluids must necessarily be based upon experiment." For example the concept of ideal liquid that leads to motion with no resistance, conflicts with the reality.

This discrepancy between theory and practice is called the "D'Alembert paradox" and serves to demonstrate the limitations of theory alone in solving fluid problems. As in thermodynamics, two different school of thoughts were created: the first believed that the solution will come from theoretical aspect alone, and the second believed that solution is the pure practical (experimental) aspect of fluid mechanics. On the theoretical side, considerable contribution were made by Euler, La Grange, Helmholtz, Kirchhoff, Rayleigh, Rankine, and Kelvin. On the "experimental" side, mainly in pipes and open channels area, were Brahms, Bossut, Chezy, Dubuat, Fabre, Coulomb, Dupuit, d'Aubisson, Hagen, and Poiseuille.

In the middle of the nineteen century, first Navier in the molecular level and later Stokes from continuous point of view succeeded in creating governing equations for real fluid motion. Thus, creating a matching between the two school of thoughts: experimental and theoretical. But, as in thermodynamics, people cannot relinquish control. As results it created today "strange" names: Hydrodynamics, Hydraulics, Gas Dynamics, and Aeronautics.

The Navier-Stokes equations, which describes the flow (or even Euler equations), were considered unsolvable during the mid nineteen century because of the high complexity. This problem led to two consequences. Theoreticians tried to simplify the equations and arrive at approximated solutions representing specific cases. Examples of such work are Hermann von Helmholtz's concept of vortexes (1858), Lanchester's concept of circulatory flow (1894), and the Kutta-Joukowski circulation theory of lift (1906). The experimentalists, at the same time proposed many correlations to many fluid mechanics problems, for example, resistance by Darcy, Weisbach, Fanning, Ganguillet, and Manning. The obvious happened without theoretical guidance, the empirical formulas generated by fitting curves to experimental data (even sometime merely presenting the results in tabular form) resulting in formulas that the relationship between the physics and properties made very little sense.

At the end of the twenty century, the demand for vigorous scientific knowledge that can be applied to various liquids as opposed to formula for every fluid was created by the expansion of many industries. This demand coupled with new several novel concepts like the theoretical and experimental researches of Reynolds, the development of dimensional analysis by Rayleigh, and Froude's idea of the use of models change the science of the fluid mechanics. Perhaps the most radical concept that effects the fluid mechanics is of Prandtl's idea of boundary layer **which** is a combination of the modeling and dimensional analysis that leads to modern fluid mechanics. Therefore, many call Prandtl as the father of modern fluid mechanics. This concept leads to mathematical basis for many approximations. Thus, Prandtl and his students Blasius, von Karman, Meyer, and Blasius and several other individuals as Nikuradse, Rose, Taylor, Bhuckingham, Stanton, and many others, transformed the fluid mechanics to modern science that we have known today.

While the understanding of the fundamentals did not change much, after World War Two, the way how it was calculated changed. The introduction of the computers during the 60s and much more powerful personal computer has changed the field. There are many open source programs that can analyze many fluid mechanics situations. Today many problems can be analyzed by using the numerical tools and provide reasonable results. These programs in many cases can capture all the appropriate parameters and adequately provide a reasonable description of the physics. However, there are many other cases that numerical analysis cannot provide any meaningful result (trends). For example, no weather prediction program can produce good engineering quality results (where the snow will fall within 50 kilometers accuracy. Building a car with this accuracy is a disaster). In the best scenario, **these programs** are as good as the input provided. Thus, assuming turbulent flow for still flow simply provides erroneous results (see for example, EKK, Inc).

Fuente: Bar- Meir, G. (2011), Basics of Fluid Mechanics. Boston: Free Software Foundation, Inc. pp. 1- 5.