

Fluid mechanics

Instructor: Jaewook Nam

Fluid mechanics

Fluid mechanics is the *archetype* of the *analysis* and *prediction* of **change** in the physical world around us.

Everything flows!

At some rate, on some time scale, to some extent.

What is not solid is fluid:

gas, liquid, liquid crystal, plastic, or composite ...

In fluid mechanics, **convective** transport is the most obvious agent of change:
moving material carries with it (convects)
mass, momentum, angular momentum,
energy, etc ...

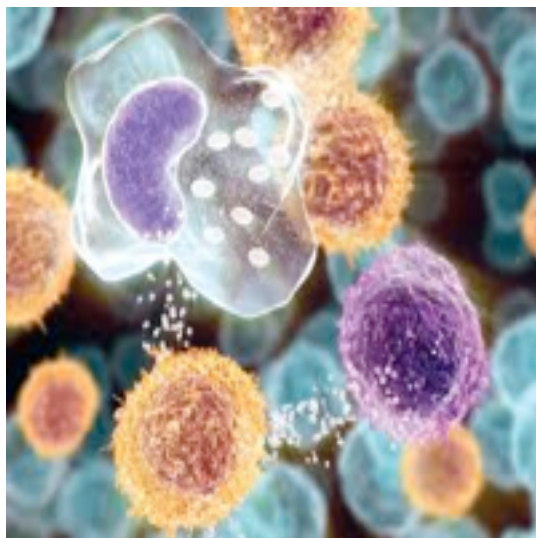


by the late L. E. "Skip" Scriven

Fluid mechanics in chemical engineering

Majority of chemical-processing are conducted either partly or totally in the **fluid phase**.

biochemical, chemical, energy, fermentation, materials, mining petroleum, pharmaceuticals, polymer, and waste-processing industries.



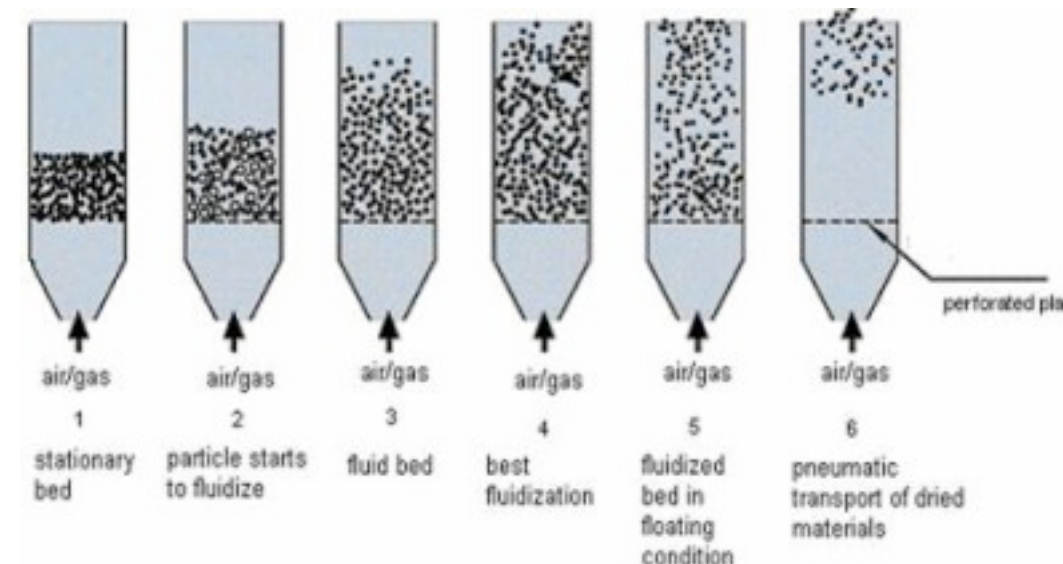
Why fluids are important in chemical engineering?

1. Enormous number of materials normally exist as gases or liquids, or can be transformed into such phase.

2. More **efficient** and **cost-effective** to work with fluids in contrast to solids.

e.g. some operating condition with solids can be conducted in a quasi-fluidlike manner:

- ◆ fluidized-bed catalytic refining of hydrocarbons,
- ◆ the long-distance pipelining of coal particles using water as the agitating and transporting medium.



Goals (I)

- I. Appreciation of the **essentials of change** in systems that are continuous except for interfaces.
- systematic **description** of change in fluid systems, mechanical change (by force or momentum fluxes)
 - developing **basic principles** from the governing equations of **fluid statistics** and **fluid dynamics**.
- We will rely on *mathematical terminology* in order to describe **equilibrium of fluids**, and then **movement** and **deformation of fluids**.

Goals (II)

But we will try to understand
the *physical* contents of
every *mathematical* statement.

- a. develop the habit of extracting
every bit of *physical meaning* out of
formal mathematical reasoning.
- b. learn how to *intuit* or *reason* about fluid systems
without undue reliance on formal mathematics.

Mathematics is Queen and

Servant to Science: Science is King.

by L. E. “Skip” Scriven

Goals (III)

2. Familiarity with
representative fluids,
representative flows,
and formulations of fluid mechanics
- idealizations of fluids and
the method of *measuring, analyzing*,
and *predicting flow phenomena*.

Idealizations and **approximations** can be quite efficient,
and they are virtually necessary (because of mathematical complexities).

3. Understanding basic fluid equipments & phenomena
for chemical engineering process.

Chemical Engineering



Chemical Engineering



Assignments

Two homeworks: week 5 and week 12

Grading weighting:

- Homework : 10 %
- Team project: 10 %
- Midterm : 30 %
- Final : 40 %
- Attendance : 10 %

Mid term and final

Mid term: 2016 Apr 25 Mon (4:30am ~ 6:00pm)

Final: 2016 June 13 Mon (4:30am ~ 6:00pm)

Grading policy

- A+ : 5 %
- A : 35 %
- B : 35 %
- <C : 25 %

There is NO negotiation on this.