Introduction to Chemical Engineering

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Presented by
Steve Mackay PhD
Dean of Engineering

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Objectives

- Understand the background of chemical engineering field;
- Grasping the impact of chemical engineering in industrial development;
- Explaining the concept of unit operations;
- Familiarization of the role of chemical engineers;
- Appreciate the ten major achievements in chemical engineering .

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Chemical Engineering Defined

At first, chemical engineering was related to trades involving chemicals.

In the latter half of the 18th century, chemical engineering began to earn the status of an independent division of knowledge.

In 1772, J. Beckman, Professor of the Gottingen University, coined the term ***'Chemical Engineering'***. He was also instrumental in compiling the first ever book on chemical engineering.

Chemical Engineering Defined

The foundation of Chemical engineering is based on

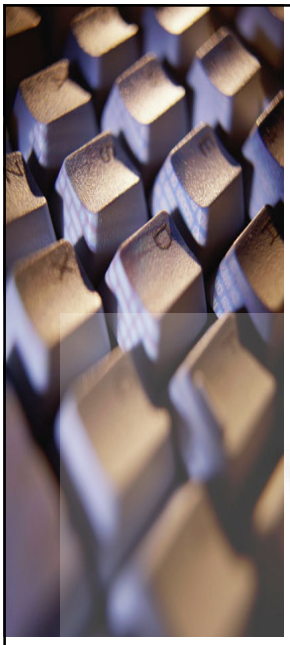
- Physical, Organic, and Inorganic chemistry
- Thermodynamics
- Chemical kinetics
- Momentum, heat & mass transfer
- Just like an electrician is not an electrical engineer, a chemist is not a chemical engineer

History

- Chemists and Alchemists and their work
- Industrial Age
- Separation from Mechanical Engineers as formal discipline
- War time contributions

The Struggle for Survival

- The chemical engineering profession began in 1888.
- To survive, chemical engineers had to claim industrial territory by defining themselves and demonstrating their uniqueness and worth. With this objective in mind, the American Institute of Chemical Engineers (AIChE) was formed in June of 1908. The old (since 1876) and powerful (5000 members) American Chemical Society (ACS) had already laid claim to all realms of American Chemistry, both pure and applied.
- British Institution of Chemical Engineers (IChemE) formed in 1922
- Most Australian chemical engineers are members of IChemE



Chemical Engineering Today & Tomorrow

- Of the traditional "Big Four", engineering fields which comprises of civil, mechanical, electrical, and chemical engineers, chemical engineers are numerically the smallest group.
- Chemical engineers concern themselves with the chemical processes that turn raw materials into valuable products.
- Chemical engineering science utilizes mass, momentum, and energy transfer along with thermodynamics and chemical kinetics to analyse and improve on these "unit operations."

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Consider this pipe – Mech Engineer

- Pipe designed to applicable codes, specifications, and standards

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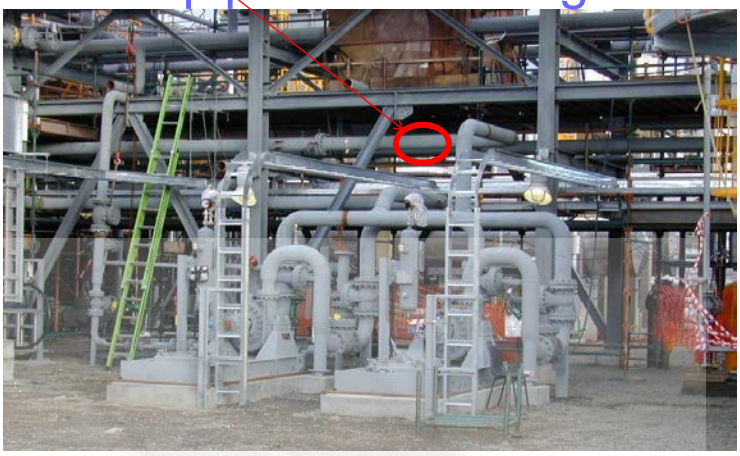
Consider this pipe – Struct Engineer



- Pipe supports holding pipe up designed to applicable codes, specifications, and standards

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Consider this pipe – Civil Engineer

- Concrete supporting pipe supports holding pipe up designed to applicable codes, specifications, and standards

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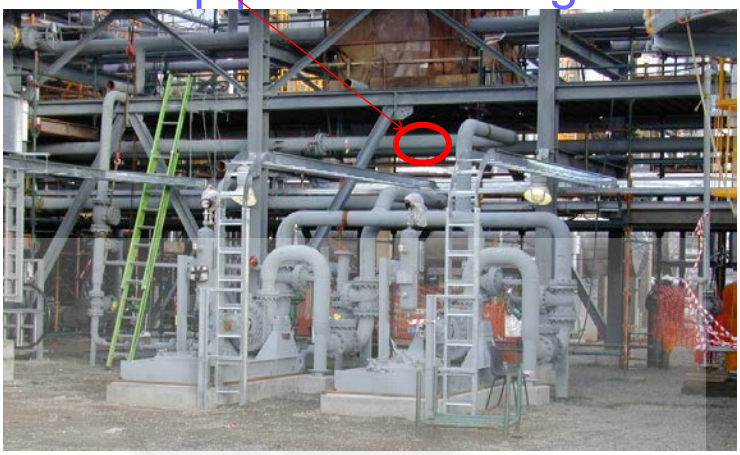
Consider this pipe – Elect Engineer



- Lights illuminating pipe designed to applicable codes, specifications, and standards
- Do you see a pattern?

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Consider this pipe – Chem Engineer

- What is in the pipe?

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Fields of Operation

- Manufacture of Chemicals
- Food Processing
- Pharmaceuticals
- Fertilizers
- Healthcare
- Petrochemicals
- Mining
- Textiles etc.

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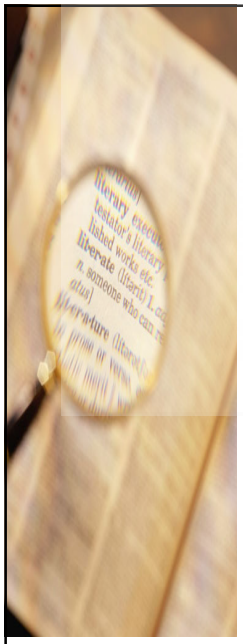

Chemical Engineer – Scope & Responsibilities

- The chemical engineer draws upon (mainly) chemistry and (to a lesser extent) physics, biology, and mathematics to deal with plant-scale production and to solve a wide range of technical problems.
- Base designs, technical designs, unit design and process design, some using reaction kinetics
- Optimising procedures
- Process control instrumentation
- Debottlenecking
- Application of fluid mechanics
- Heat & mass transfers
- Thermodynamics
- Mathematical calculations
- We deal with the “stuff” inside the pipe

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Achievements

- Splitting the Atom (quantifying isotopes)
- Plastics
- Human Reactor (unit operations)
- Pharmaceuticals (yield/cost)
- Synthetic fibres
- Liquefied air
- Environment (catalytic converters)
- Food (fertilizers)
- Petrochemicals (catalytic cracking)
- Synthetic Rubber

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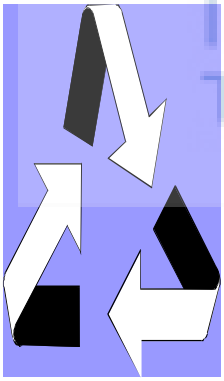
Unit Operations - The "Big Stick" of Chemical Engineering



The unit operations are largely used to

- Conduct the primary steps of preparing the reactants
- Separating and purifying the products
- Recycling unconverted reactants
- Controlling the energy transfer into or out of the system.
- Important: Unit operations are applicable for any fluid. The principles of pumping chocolate are the same for pumping sewerage, crude oil, and liquefied natural gas

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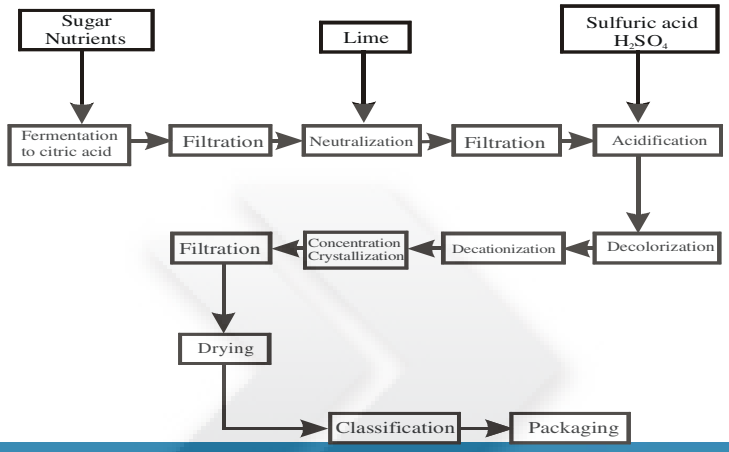
Sample Industrial Unit Operations



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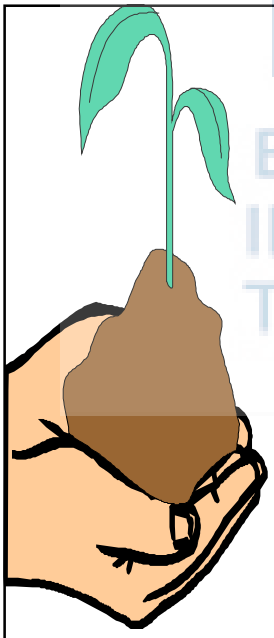
A Century of Contributions



- Unit operations concept
- Thermodynamics
- Chemical kinetics
- Mathematical competence
- Process control
- Changing educational emphasis
- Catalysis
- Harnessing Combustion
- Electrochemical engineering
- Polymer technology
- Food processing
- Biotechnology

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Developments in Chemical Engineering

- The acquisition of alternative energy sources and the control of pollution in the biosphere
- Expansion of the availability of hydrocarbon feedstock and petrochemicals
- Production of chemical reactants and alternative fuels
- Increased emphasis on nuclear power and heat generation
- The integration of chemical engineering and nuclear power generation
- Intelligent use of the biosphere and its protection against harmful processes
- Evolving better ways and means of industrial waste disposal and control

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