DESIGNING NEW CHEMICAL PRODUCTS

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University of Minnesota
Where the Jobs Are:
Farmers = Engrs. + 100 Years
Where the Jobs Are

1975

2005

Commodities
Products
Consult
## What Are Chemical Products?

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Molecules</th>
<th>Microstructures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
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<td>Speed</td>
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<tr>
<td>Risk</td>
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</table>
Commodities Still Improving

- Rocks
- Rashig Rings
- Berl Saddles
- Intalox Saddles
- Nutter Rings
- Sulzer
- Structured

Year:
- 1900
- 1950
- 2000

HTU, cm:
- 0
- 20
- 40
- 60
- 80
# What Are Chemical Products?

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Molecular Products: Drugs

Premarin

Penicillin
Molecular Products = Napoleon in Russia
## What Are Products?

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Microstructures: Tooth Whiteners
Microstructure Studies Estranged
# What Are Chemical Products?

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**Tools for Design?**
Current Skill Set is Good

Chemical Engineering - Empirical

- Plant Engineering
- Plant Operations
- Process R&D
- Product R&D

Equipment Design

Construction

Physics - Continuum

Chem/Bio - Molecular

USA

UK

Germany
Process Skills: **How to Make?**

**Process Design**

1. batch vs. continuous
2. input/output
3. recycles
4. separation/heat
Product Skills: **What** to Make?

**Process Design**

1. batch vs. continuous
2. input/output
3. recycles
4. separation/heat

**Product Design**

1. customer need
2. idea generation
3. selection
4. manufacture
1. Needs

Reformed as specifications
1. Needs

2. Ideas

How many frogs must you kiss . . .
1. Needs

2. Ideas

3. Selection

Cheapest Wasn’t Best....
1. Needs
2. Ideas
3. Selection
4. Manufacture
Which Step is Hardest?

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“Devices” Replaces “Commodities”
For Molecules, Selection is Hardest

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Select Molecules with Unit Ops

46 Kilos = $800M

Pyr-His-Trp-Ser-Tyr-D-Ser(tBu)-Leu-Arg-Pro-Azagly-NH₂
For Microstructures, Needs is Hardest

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Key: Convenience, Speed, Function
For Microstructures, Needs is Hardest
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Color Matching, Not Spectra Matching
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For Microstructures, Needs is Hardest
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<tr>
<th>Stimuli</th>
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<tr>
<td>Vision</td>
<td>Spectra</td>
<td>Wavelengths</td>
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<tr>
<td>Touch</td>
<td>Food, Cloth</td>
<td>Forces</td>
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<tr>
<td>Taste</td>
<td>Chemicals</td>
<td>Fluxes</td>
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Why Design Different: CIA Exam
(Culinary Institute of America)

- 4 Rabbits
- 5 Skate
- 0.5 kg Scallops
- 2 Lobsters
- Bacon

- Tomatillos
- Bosc Pears
- Dried Cherries
- Red Beans
- 1 Pineapple
Conclusion: To Add Value,

• Decide What to Make

• “Selection” Often Key

• “Needs” Microstructure Key