Soap Research

• Soda Ash and Other White Blemishes
• Background Chemistry
• Sulfated Castor Oil
• Jojoba Oil and its Substitutes
• The Secret Life of Soap
Acknowledgements

- Mike Lawson/Columbus Foods
- Hampden-Sydney College
  - Cole Hawthorne (soda ash/partial gel)
  - Arne Ulbrich (sulfated castor oil)
  - Avery Moncure (microscopy)
All Things White

Not every white blemish is soda ash.
Not Soda Ash

High-Water Olive Oil Soap
Not Soda Ash

Partial Gel Olive Oil Soap
Not Soda Ash

Medium-Water Palm Oil Soap Soap
Soda Ash

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Soda Ash

Medium-Water Duckbar’s Delight
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All Things White

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- Soda Ash forms a layer, like icing on a cake
- Soda Ash washes off with water
- Soda Ash is not very soluble in alcohol
Soda Ash

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  - soap un-molded too soon
Soda Ash Prevention

• Double-check the saponification values
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- Cover raw soap while it is in the mold
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- Do not un-mold soap until it is “tongue-neutral”
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- Do not un-mold soap until it is “tongue-neutral”
- Soda Ash is easily removed with water
Oil and water don’t mix.
Oil and Water
Nerds and Cheerleaders
Oil and Lye
One Soap
Two Soaps
Oil, Lye and Soap

Three Soaps and a Glycerin
Soap: A Nerdy Cheerleader
Stearic Acid, Oleic Acid
Sulfated Castor Oil

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- Made by reacting castor oil with sulfuric acid
Ricinoleic Acid, Sulforicinoleic Acid
# Castor vs Sulfated Castor Oil

<table>
<thead>
<tr>
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<th>SV (ppt KOH)</th>
<th>AV (ppt KOH)</th>
<th>Water Content</th>
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<tbody>
<tr>
<td><strong>Castor</strong></td>
<td></td>
<td></td>
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<tr>
<td>Soaper’s Choice</td>
<td>184</td>
<td>0</td>
<td>0%</td>
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</tbody>
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|                |              |              |               |
| **Sulfated Castor** |              |              |               |
| Soaper’s Choice  | 97           | 40           | 30%           |
| Southern Soapers | 95           | 23           | 29%           |
| Organic Creations| 82           | 58           | 20%           |
Castor vs Sulfated Castor Oil

Castor oil is widely used for making soap; sulfated castor oil is not. You may experiment with sulfated castor oil in soap, but you must use the appropriate saponification value.
Jojoba

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- How does jojoba differ from soapmaking oils?
Jojoba and Lye
Fatty Alcohol and Soap
Cetyl Alcohol
Jojoba Substitutes for *Soap*

- Cetyl Alcohol, $4.88/lb (LotionCrafters.com)
- Cetearyl Alcohol, $4.99/lb (LotionCrafters.com)
- Behenyl Alcohol, $8.00/lb (TheHerbarie.com)
- Oleyl Alcohol, $106/lb (ScienceLab.com)
- Beeswax, $3.98/lb (SoapersChoice.com)
- Candelilla Wax, $6.30/lb (CamdenGrey.com)
- Cetyl Esters, $6.38/lb (LotionCrafters.com)
- Carnauba wax, $6.77/lb (CamdenGrey.com)
• Delight\textsubscript{1000} = Olive\textsubscript{390}Palm\textsubscript{280}Coconut\textsubscript{280}Castor\textsubscript{50}
Delight

- $\text{Delight}_{1000} = \text{Olive}_{390}\text{Palm}_{280}\text{Coconut}_{280}\text{Castor}_{50}$
- Lye = 50.00% NaOH, 50.00% distilled water
- SSV of Delight is 150.8 ppt NaOH
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- Lye = 50.00% NaOH, 50.00% distilled water
- SSV of Delight is 150.8 ppt NaOH
- Delight \(_{1000}\) Lye\(_{288}\)
- 144/150.8 = 0.955, 4.5% lye discount
More Lyes

- Lye = 50.00% NaOH, 50.00% distilled water
More Lyes

• Lye = 50.00% NaOH, 50.00% distilled water
• Delight_{1000}Lye_{288}Aq_{0} (50.00% NaOH Lye)
  Delight_{1000}Lye_{288}Aq_{72} (41.67% NaOH Lye)
  Delight_{1000}Lye_{288}Aq_{144} (33.33% NaOH Lye)
  Delight_{1000}Lye_{288}Aq_{216} (29.16% NaOH Lye)
  Delight_{1000}Lye_{288}Aq_{288} (25.00% NaOH Lye)
More Lyes

- Lye = 50.00% NaOH, 50.00% distilled water
- Delight_{1000}Lye_{288}Aq_0 (11.18% Water)
- Delight_{1000}Lye_{288}Aq_{72} (15.88% Water)
- Delight_{1000}Lye_{288}Aq_{144} (20.11% Water)
- Delight_{1000}Lye_{288}Aq_{216} (23.93% Water)
- Delight_{1000}Lye_{288}Aq_{288} (27.41% Water)
More Lyes

- Lye = 50.00% NaOH, 50.00% distilled water
- Delight_{1000}Lye_{288}Aq_0 (Low-Water)
  Delight_{1000}Lye_{288}Aq_{72}
  Delight_{1000}Lye_{288}Aq_{144} (Medium-Water)
  Delight_{1000}Lye_{288}Aq_{216}
  Delight_{1000}Lye_{288}Aq_{288} (High-Water)
Lye Concentration

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  25-27%, 26% average
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• Susan Cavitch, *The Soapmaker’s Companion* (1997)
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  26-29%, 27% average
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- Anne Watson, *Smart Soapmaking* (2007)
  30-37%, 33% average
Temperature

- 40°C
- 60°C
- 80°C
Temperature

- $40^\circ C = 104^\circ F$
- $60^\circ C = 140^\circ F$
- $80^\circ C = 176^\circ F$
Temperature

- 40°C = 104°F (Cold)
- 60°C = 140°F (Warm)
- 80°C = 176°F (Hot)
Low-Water Soap, 80°C, 200X
Medium-Water Soap, 200X
High-Water Soap, 200X
Light Microscopy Lessons

- High-water raw soap contains lye droplets
- Low-water raw soap contains lye channels
The Secret Life of Soap

• Do you peek at soap in the mold?
The Secret Life of Soap

• Do you peek at soap in the mold?
• What is “gel” phase?
Neat soap is a lamellar lyotropic liquid crystalline phase of soap and water.
Neat Soap?

Neat soap is a lamellar lyotropic liquid crystalline phase of soap and water.

- Liquid crystalline: the molecules are free to move past one another, as in a liquid; they are arranged in ordered patterns, as in a solid crystal.
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- **Lyotropic**: the liquid crystal contains at least two kinds of molecule and its properties depend on the concentrations.
- **Lamellar**: the two kinds of molecules are arranged in sheets.
- **Neat soap** is what handcrafted soapmakers know as “gel” phase.
Neat Soap
Neat Soap
Neat Soap
Delight Phases

- Curd (solid)
- Curd + neat
- Neat (gel)
Polarized Light Microscopy

- Lye and oil will appear purple
- Small, solid soap crystals will appear black
- Neat soap will appear red/blue/yellow
Raw Soap Texture at 0 Minutes
Raw Soap Texture at 10 Minutes
Raw Soap Texture at 60 Minutes
Raw Soap Texture at 120 Minutes

- High-Water Cold
- High-Water Warm
- Medium-Water Cold
- Medium-Water Warm
Raw Soap Texture at 180 Minutes
Raw Soap Texture at 240 Minutes
Raw Soap Texture at 300 Minutes

High-Water
Cold

High-Water
Warm

Medium-Water
Cold

Medium-Water
Warm
Raw Soap Texture at 8 Hours
Gelling

Soap can be made with lye between 25% and 50% NaOH

• High-water soaps “gel” at lower temperatures
• Mid-water soaps “gel” at higher temperatures
• Low-water soaps do not “gel”
Appearance

Soap can be made with lye between 25% and 50% NaOH

- Soap that “gelled” is translucent
- Soap that did not “gel” is white and opaque
Scientific Soapmaking

Thanks to the HSMG for all the questions I could not have answered 5 years ago.
Scientific Soapmaking

Thanks to the HSMG for all the questions I may be able to answer 5 years from now.