Degumming and Centrifuge Selection, Optimization and Maintenance

IUPAC-AOCS Workshop on Fats, Oils and Oilseeds Analysis and Production

Andrew Logan
Alfa Laval Copenhagen A/S
Purpose of Degumming

- Commercial Lecithin production
- Prevent crude oil settling during storage or transport
- Waste water (prevent acidulation of gums)
- Physical Refining
- Reduction in neutralisation losses
Physical Refining

Feedstock Parameters

• Seed Oil (Soybean, Rapeseed, Sunflower)
  – FFA \leq 2\%
  • higher FFA indicates low quality oil and may not be suitable for physical refining
  – Phosphorous \leq 5\ ppm, \leq 2\ desired
  – Iron \leq 0.2\ ppm
Chemical Refining

Feedstock Parameters

• Seed Oil (Soybean, Rapeseed, Sunflower)
  – FFA ≤ 3%
  – Phosphorous ≤ 1200 ppm, ≤ 200 ppm desired
Water Degumming Process Steps

- Heat oil to 60 - 70 °C
- Water addition and mixing
- Hydration mixing 30 minutes
- Centrifugal separation of hydrated gums
- Vacuum drying of degummed oil
- Gums - dried for edible lecithin or recombined in meal
Water Degumming

Diagram:
- Water
- Crude oil
- Heater
- Mixer
- Reactor
- Separator
- Gums
- Vacuum dryer
- To storage
- Steam
- Vacuum

Flowchart:
1. Water enters the system.
2. Steam is added to the water.
3. The mixture is heated.
4. Water and steam are separated in the separator.
5. Gums are removed from the output.
6. The vacuum dryer removes moisture.
7. The product is stored.
Water Degumming

Target Results:

• Phosphorous in oil - 50 to 200 ppm max.
• Al% in dried gums - 65 to 70%.
• Moisture in dried oil - < 0.1%.
Acid Degumming Process Steps

- Heat oil to 60 - 70 °C
- Acid addition and mixing
- Hydration mixing 30 minutes
- Centrifugal separation of hydrated gums
- Vacuum drying of degummed oil
- Gums - recombined in meal
Acid Degumming

Crude oil → Heater → Steam → Water → Mixer → Acid Separator → Gums → To drying/storage
Acid Degumming

Target Results:
• Phosphorous in oil - 20 to 50 ppm max.
• Al% in dried gums - 65 to 70%
• Moisture in dried oil - < 0.1%
Major Deep Degumming Methods

- Alfa Laval Special Degumming
- Super/Uni Degumming
- TOP Degumming
- Organic Refining Process
- Soft Degumming
- Enzymatic Degumming
Deep Degumming

• Deep degumming utilizes a reagent like acid to chelate Iron, Calcium, and Magnesium away from the NHP complex. Once the Iron, Calcium, and Magnesium are removed from the NHP complex the phosphatide becomes hydratable.

• Enzymatic degumming utilizes an enzyme to modify the NHP into a hydratable form.
Alfa Laval Special Degumming

- Heat oil to 60 °C
- 0.05-0.2 % Phosphoric Acid with intensive mixing
- Partially neutralise with dilute lye (hydration water)
- Gentle mixing and holding for 60 minutes
- Gums centrifugation
- Optional water wash step for lower phosphorous
- Oil drying
Alfa Laval Special Degumming

Crude oil

Heater

Steam

Mixer

Acid

Lye

Water

Oil temperature trimmer

Reactor

Cooling water

Steam

Separator

Gums

To drying/storage
Alfa Laval 2-stage Special Degumming

Crude oil

Heater

Steam

Mixer

Mixer

Reactor

Cooling water

Steam

Mixer

Separator

Gums or soap-stock

To drying/storage

Waste water

Neutralising route

Water

Oil temperature trimmer

Separator

Acid

Lye

Separator

Waste water

Temperature trimmer

Steam

Steam

www.alfalaval.com
Alfa Laval Special Degumming

Target Results:

• Phosphorous in oil - 20 to 30 ppm max.
• Phosphorous in oil - 8 to 10 ppm max. with washing
• AI% in dried gums - 50 to 60%
• Moisture in dried oil - < 0.1%
Disc Stack Centrifuges

Alternative name: High Speed Separators (HSS)
Gravitational to Centrifugal Force

1. Centrifugal separation vessel with disc-stack

2. 1 g

3. >5000 g www.alfalaval.com
Clarification

• Removal of solids phase from a mixture of liquid and solids
Concentration

- Liquid/liquid separation (also solids if present)
- Maximum cleaning of the heavy phase
- Therefore holes in disc-stack closer to the centre
Purification

- Liquid/liquid separation (also solids if present)
- Maximum cleaning of the light phase
- Therefore holes in disc-stack closer to the periphery
HSS – Bowl Development

1890

1948

1993