Colonial Chemical

Long Chain Amphoterics

Safe, Effective Additives for Cleansing Formulations

Dennis Abbeduto – Manager, Care Chemicals






Global Handwashing Day – October 15th

- https://globalhandwashing.org/handwashing-handbook/

Enabling Sustainable Product Design

- Waterless
- Package-free
- Biodegradable
- High Biobased
- Socially Responsible
- Upcycled Ingredients
- Environmentally Benign
- Transparent Supply Chain
- Improved Consumer Safety

All About Amphoterics






Amphowhatzit?

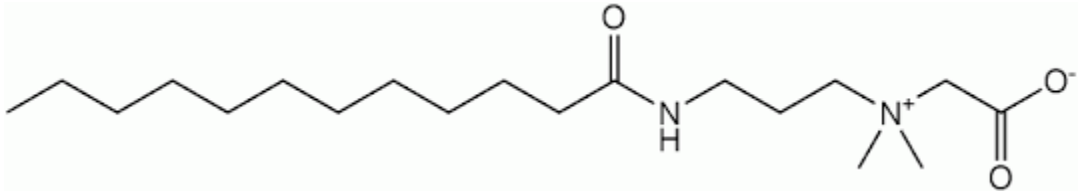
- **Amphoteric**
  - Oxford English Dictionary – *(of a compound, especially a metal oxide or hydroxide) able to react both as a base and as an acid*
- **Zwitterion**
  - Merriam-Webster Dictionary – *a dipolar ion*
- **Zwitterionic Surfactants**
  - Wikipedia – *Zwitterionic (ampholytic) surfactants have both cationic and anionic centers attached to the same molecule. The cationic part is based on primary, secondary, or tertiary amines or quaternary ammonium cations. The anionic part can be more variable and include sulfonates, as in the sultaines CHAPS (3-[(3-cholamidopropyl)dimethylammonio]-1-propanesulfonate) and cocamidopropyl hydroxysultaine. Betaines such as cocamidopropyl betaine have a carboxylate with the ammonium. The most common biological zwitterionic surfactants have a phosphate anion with an amine or ammonium, such as the phospholipids phosphatidylserine, phosphatidylethanolamine, phosphatidylcholine, and sphingomyelins.*

Amphoterics – Numerous Known Formulation Benefits

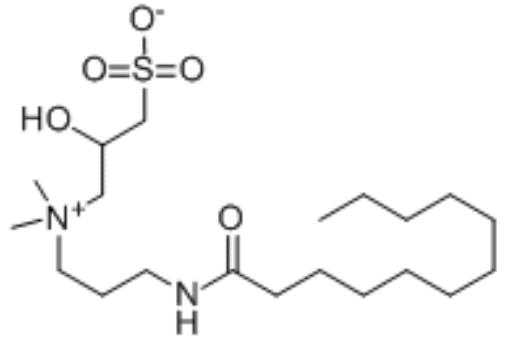
- Mitigate irritation of anionic surfactants
  - Significant synergistic reduction of irritation
  - Larger mixed micelles
  - Reduced CMC of mixture
- Increase viscosity building of anionic surfactants
  - Reduce added salt
  - Larger mixed micelles
- Improve foam
  - Reduce liquid drainage (stability)
  - Shrink bubble size (cushion)
  - Increase overall foam (volume)

Variety In Theory But Not Practice

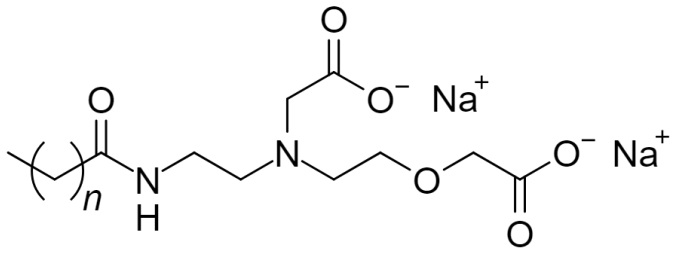
- Three “coconut” based products dominate usage
- Cocamidopropyl Betaine
  - Industry workhorse for many decades
  - Lauramidopropyl functionally mostly identical



- Cocamidopropyl Hydroxysultaine
  - Replacing betaine in many applications
  - Less negative press, fewer restrictions

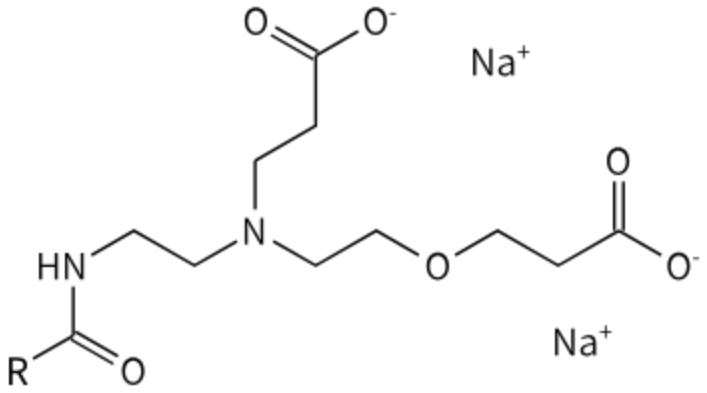


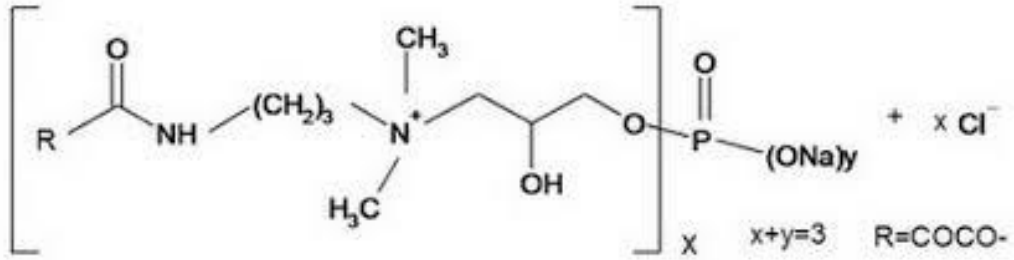
- Disodium Cocoamphodiacetate
  - Primarily used in wipes and ultra-mild cleansers

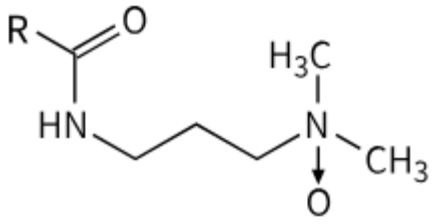


Some Additional Options

- Disodium Cocoamphodiproprionate
  - "Salt-free" amphoteric
  - Very similar structurally to diacetate
  - Different functionally, especially viscosity
- Cocamidopropyl PG-Dimonium Chloride Phosphate
  - "Phosphobetaine"
  - Structurally similar to phospholipids
  - Chemistry supports multiple "tail" groups
- Cocamidopropylamine Oxide
  - The surfactant oddball
  - Becomes zwitterionic in acid conditions, otherwise nonionic
- Many can be produced from straight tertiary amines (vs amidoamine)







Coco is Great But…

- Coconut/Lauric represents a small portion of available feedstocks
- The majority of vegetable/seed oils are dominated by C16 and longer fatty acids
- Soft oils like Safflower and Soybean are rich sources of Polyunsaturated Fatty Acids (PUFAs)
- PUFAs can be hydrogenated to Stearic Acid
- Some soft oils like Grapeseed Oil can be recovered from waste
- These oils are not expected to perform similarly to coconut/lauric, due to longer alkyl chains
- Actual performance of long chain amphoterics has not been thoroughly investigated

Long Chain Amphoterics from CCI

Trade Name	INCI	Appearance	Co-solvent	Global Clearances	ISO 16128
ColaLipid GS	Sodium Grapeseedamidopropyl PG-Dimonium Chloride Phosphate	Clear to Hazy Liquid	Biorenewable Propylene Glycol	Globally Approved, inquire for China	0.91

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ColaTeric HBS	Cannabisamidopropyl Hydroxysultaine	Clear Liquid	Propanediol	Limited, per global PC exemptions	0.87

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ColaTeric STA	Sodium Stearoamphoacetate	Yellow Paste	None	North America, Oceania	0.61

Performance Evaluation Phase 1



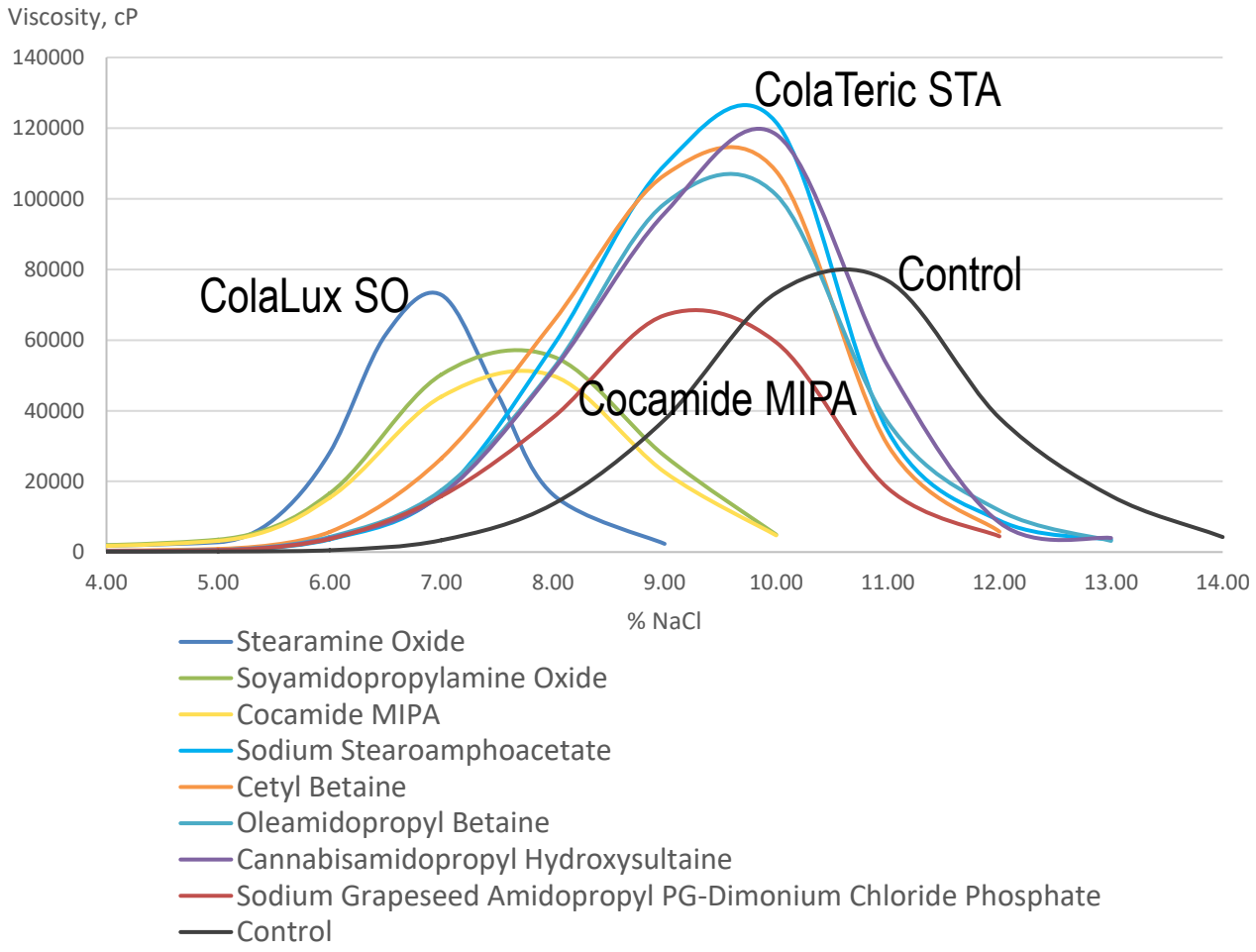



Test Formulation

Trade Name	INCI Name	A
DI Water	Water	75.85
Colonial AOS-40 UP	Sodium C14-16 Olefin Sulfonate	20.00
ColaTeric CBS	Cocamidopropyl Hydroxysultaine	4.15
Citric Acid	Citric Acid	Qs to pH 6.0
Additives	Vary	0.5% Solid Matter

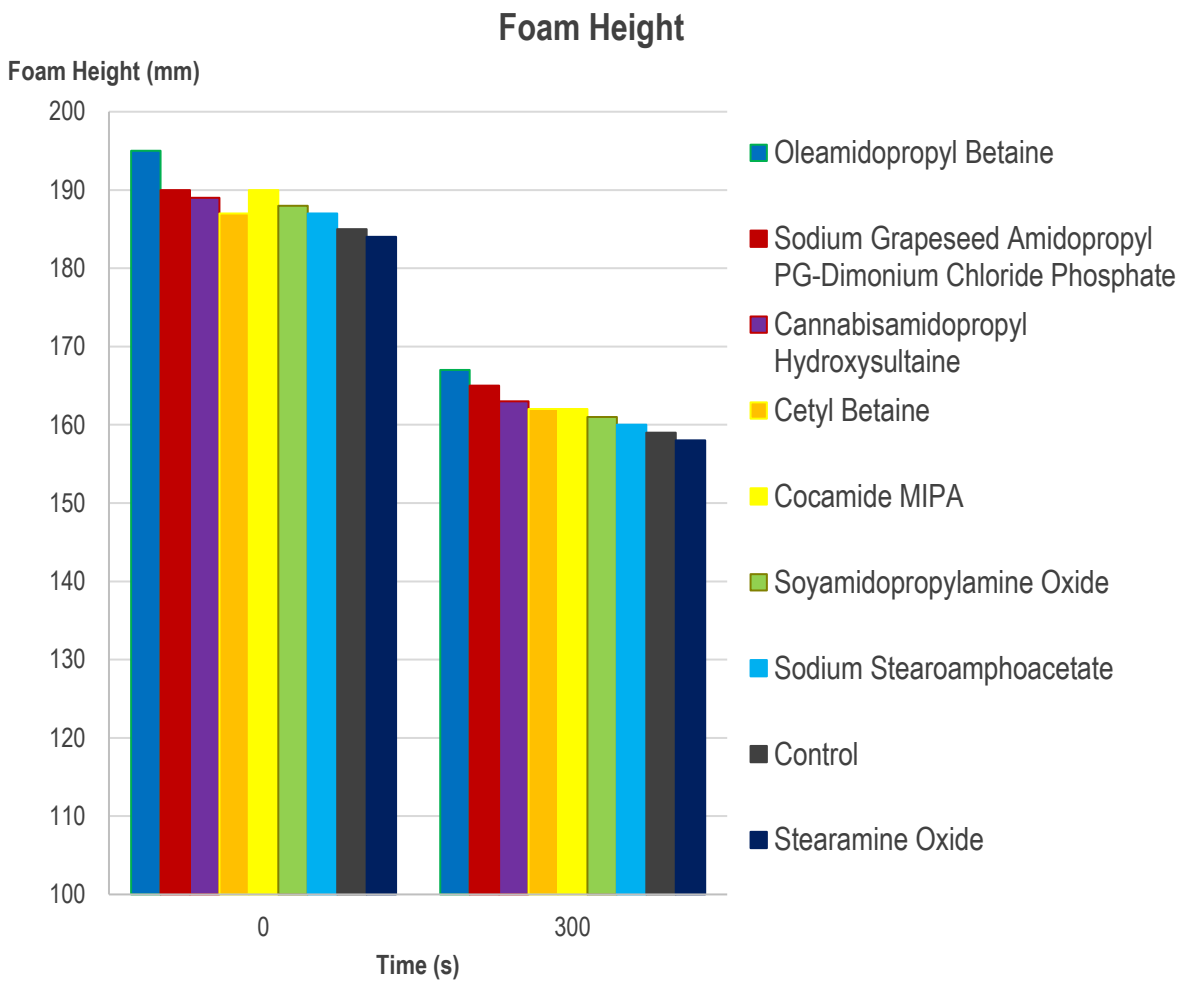
- Base formulation mimics ratios typical to traditional SLS/SLES based formulas
- Additives are evaluated at 0.5% based on pre-screening tests
- Cocamide MIPA (ColaMid CMPA) also tested as a typical additive for this system to reduce added salt required to build viscosity

Viscosity Response



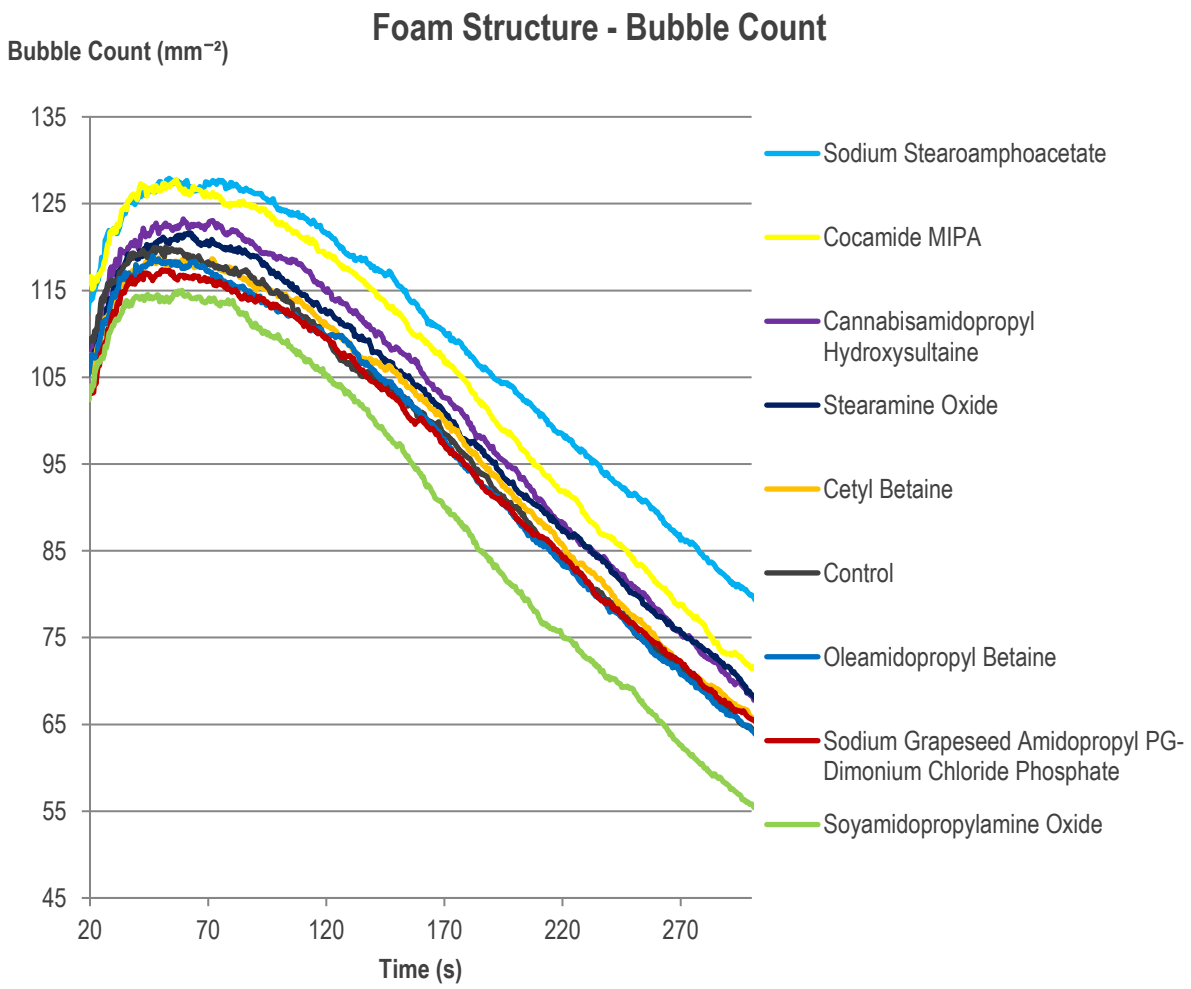
- Typical to AOS-based sytems, control performance (black) is extremely sluggish, with 11.0% salt required to achieve peak
- Standard Cocamide MIPA (yellow) reduces added salt significantly, but also decreases peak performance significantly
- Most additives improve on baseline viscosity performance, with varying impact on salt peak
- ColaTeric STA (lt blue) has largest positive impact on peak viscosity
- ColaLux SO (dk blue) decreases added salt to the largest extent

Foam Height and Stability



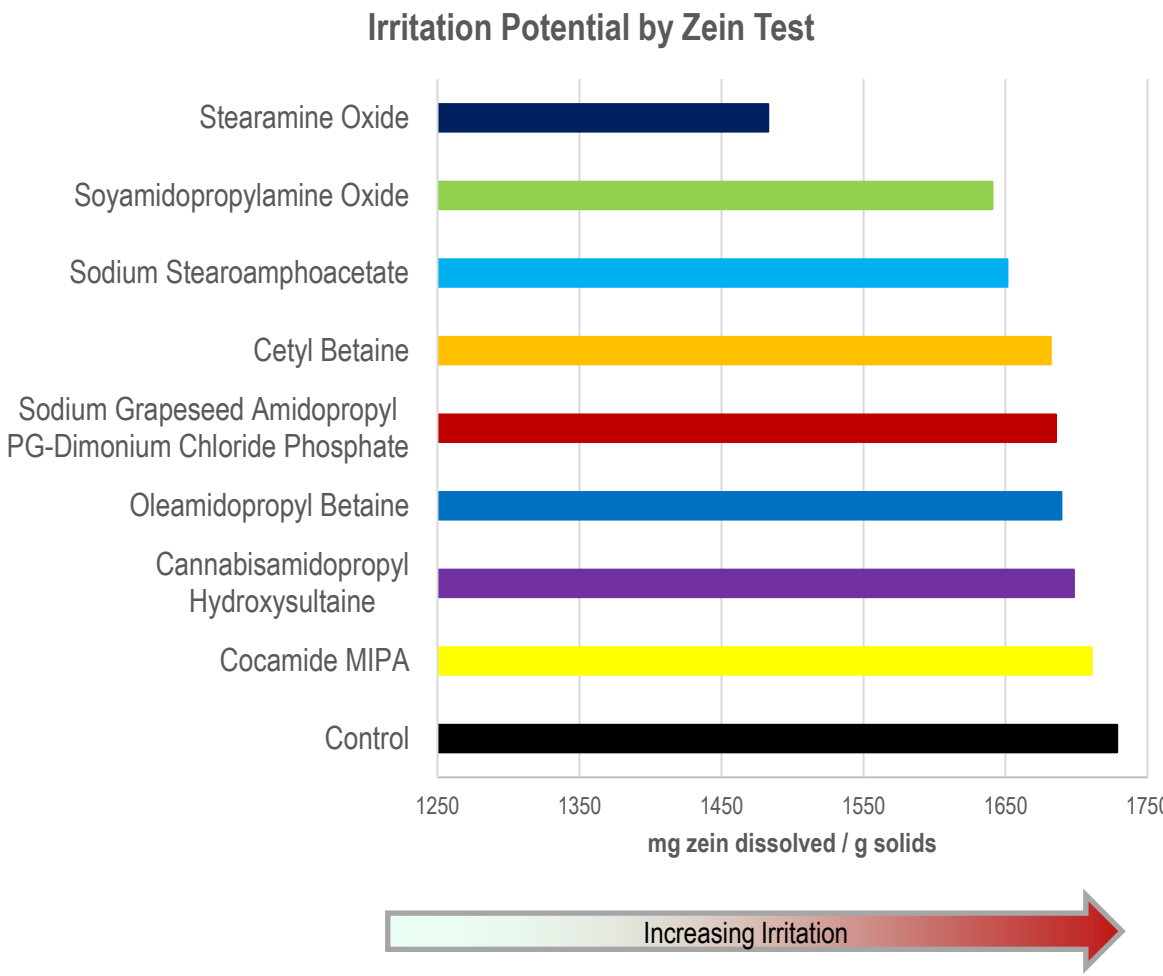
- Most additives increase initial foam height and maintain increased foam over time
- ColaTeric OAB-UP (md blue) achieves the greatest increase in initial and stable foam heights
- ColaLux SO (dk blue) initial and stable foam decrease is not significant

Foam Structure



- Bubble counts are generally considered along with foam height. Since this group of products are mostly similar, we can reasonably evaluate in isolation
- High initial counts are indicative of denser, cushiony foam
- Counts that remain high over time indicate less coalescence of foam, maintaining dense cushiony foam
- ColaTeric STA (lt blue) is a positive outlier, while ColaLux SAO (green) is a negative one
- ColaTeric STA (lt blue) and ColaMid CMPA (yellow) demonstrate significant initial improvement in density

Irritation Potential by Zein



- Most additives have a minimal impact on irritation potential
- ColaLux SO (dk blue) appears to have the greatest impact, which is significant
- ColaLux SAO (green) and ColaTeric STA (lt blue) achieve significant but less dramatic reduction

(Interim) Conclusions

- Amphoterics are essential formulation components, and variants outside of the most popular products require further investigation
- Long-chain variants demonstrate excellent performance in viscosity-building allowing for greater flexibility in formulating
  - Lower solids
  - Replacing traditional anionic surfactants
  - Reducing added salt
- Some long-chain amphoterics also show promising benefits for irritation reduction and enhanced foam texture and stabilization
- Phase 2 testing will evaluate more in-use performance benefits like skin and hair conditioning

Thank you!

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Product TDS/SDS/Formulations: https://www.colonialchem.com

Formula Girls Podcast: https://apple.co/3dUq5fh