Beauty Beyond Conventional Chemistry: A sustainable ingredient with market meaning

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Partnership for a Sustainable Future

SCT

SUSTAINABLE SCIENCE FOR THE WHOLE WORLD™

Our polysaccharide chemistries replace traditional non-renewable products with innovative, environmentally friendly solutions, allowing companies to decrease their non-renewable carbon footprint and improve the customer experience

Integrity Bio-Chemicals (IBC)

- IBC develops unique polysaccharide-based biopolymer products that are:
  - manufactured to a zero-waste standard
  - Upcycled from previously underutilized raw materials for advanced applications
  - free from generating primary or secondary waste streams
  - supplanting non-renewable-resource-based products
- IBC converts their patented bio-surfactant technologies to provide solutions that are functional, scalable, and cost-effective

"We have gone through and are going through a transformation from being a pure-play energy producer to more of a specialty chemical company." –Mike Suver, EVP Integrity BioChem from The Chemical Show with Victoria Meyer

We live in a regulatory driven space though we often overlook or underestimate it early in the development process

Regulatory is necessary but is currently hindering innovation

Truly Transparent innovation is costly due to the high cost of compliance

- Safety/Environmental testing
- Global regulatory status/addition (EU REACh being the worst)
- Lack of non-animal tests for things like aquatic toxicity
- Avoiding animal testing completely

Launches in this space need to be novel enough to warrant the expenses, i.e. non incremental

Executive summary: Without some of these things you won't get past the first conversation

Let's make a statement, the annoying kind

Biodegradation

Food Allergens

1,4-Dioxane

Animal Labor

Allergens

Animal Testing

Free Amine

Composition

Solvents

Latex

Ethical Trade

Irradiation

Nano-materials

BSE/TSE

EU Cosmetic

Free From...
Gluten, GMOs
Human Blood, PEG
Phosphates, Sulfates

California...
SB258, Prop 65

Melamine

Formaldehyde

Global Inventory Status

CMR

Kosher/Halal

Elemental Impurities

Raw Material Sourcing

Maltodextrin Laurate: True Innovation?

Objectives:

- Material Background
  - Supply Chain
  - Regulatory
  - INCI Designation
- Sustainability Metrics
  - RCI
  - Principles of Green

Chemistry

- Eco-Friendly Manufacturing
  - Low Carbon Footprint
- Market Meaning
  - Practical Consumer

Applications

Maltodextrin: History in Personal Care

Has been used widely in PC for some time

- Typical uses include use as an absorbent, binder, emulsion stabilizer, film former, hair conditioning agent; skin-conditioning agent - miscellaneous, suspending agent - nonsurfactant, binding, emulsion stabilizing, film forming, hair conditioning, and skin conditioning

  (source: "Maltodextrin". *EWG.ORG Retrieved 2021-3-18*)

This ingredient is already present in 2.5% of cosmetics

(source: "Maltodextrin". *INCI Beauty Retrieved 2022-8-15)*

- Foaming bath and salts (12.73%)
- Anti-aging night face cream (8.69%)
- Eyeshadow (8.49%)
- Deodorant stick (7.51%)
- Deodorant spray (6.93%)

In 2002, a patent filed by Unilever, reveals that Maltodextrin enhances the anti-aging activity of weak acids and reduces skin irritation sometimes caused by other acids.

(source: "Maltodextrin". INCI Beauty Retrieved 2022-8-15)

EWG rating is favorable at a 1 out of 10, 10 being the worst

Current Market Products Based on Maltodextrin from INCI Dictionary

INCI Name	Function	What it is
Hydroxypropyltrimonium Maltodextrin Crosspolymer	Dispersing Agents -Nonsurfactant	a crosslinked polymeric quaternary ammonium salt prepared by the reaction of maltodextrin and glycidyltrimethylammonium chloride with epichlorohydrin.
Corn Starch/Maltodextrin Crosspolymer	Film Former	a copolymer of Zea Mays (Corn) Starch (q.v.) and Maltodextrin (q.v.) crosslinked with Citric Acid (q.v.)
Glyceryl Dimaltodextrin	Humectant	reaction product of Glycerin (q.v.) and Maltodextrin (q.v.).
Maltodextrin Hydroxypropyltrimonium Chloride	None listed, presumably a conditioning agent akin to cationic guars	quaternary ammonium salt formed by the reaction of Maltodextrin (q.v.) with 2,3-epoxypropyltrimethylammonium chloride (same reactant as the crosspolymer).
Maltodextrin/VP Copolymer	Film Former	copolymer of Maltodextrin (q.v.) and N-Vinyl Pyrrolidone (q.v.).
Sodium Dimaltodextrin Phosphate	Dispersing Agents - Nonsurfactant	sodium salt of a complex mixture of diesters of Maltodextrin (q.v.) and phosphoric acid

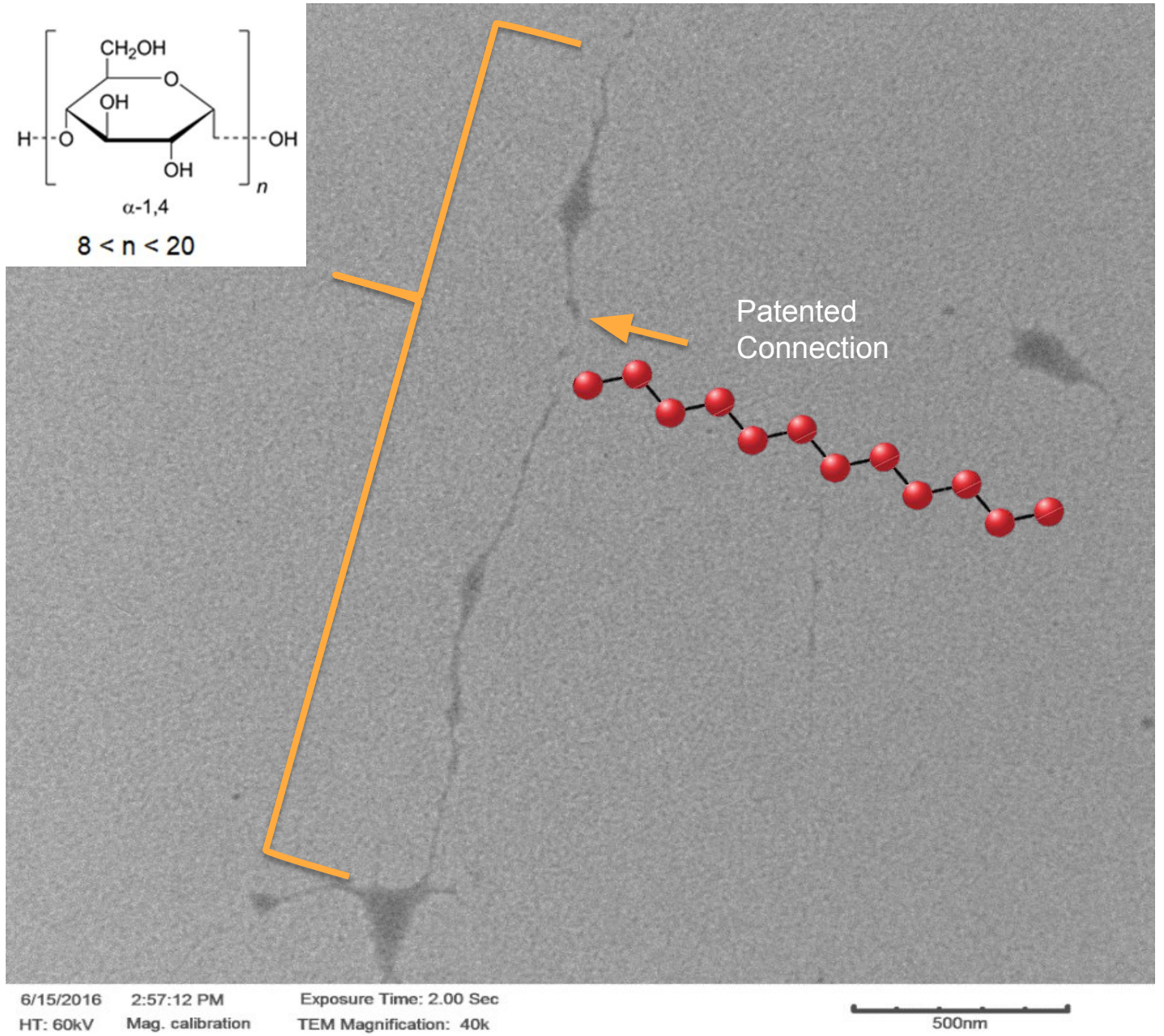
Add one more to that list:

INCI Name	Function	What it is
Maltodextrin Laurate	Surfactant – Cleansing Agent, Foam Booster, Emulsifying Agent, etc.	Maltodextrin Laurate is the product obtained by the esterification of Maltodextrin (q.v.) and Lauric Acid (q.v.).

- 100% Bio-based
- 100% RCI
- Scalable, low energy process
- Uses North American up-cycled feedstocks, does not disrupt food supply chain
- Non GMO - Starting material produced from “identity preserved” corn that has not been genetically modified

Regulatory Status: Maltodextrin Laurate meets the requirements for polymer exemption for US TSCA, EU REACh, Health Canada, Australia (AICS), China (CIRS), etc.

Let's take a closer look



Part 1: Sustainability

RCI: how valuable is it?

100% RCI Surfactants are well known to the industry

- Glucosides have led the market
- Esters-focused to skin care, i.e. no surfactant properties
- Sulfates like SLS and SLES (if bio derived EO is used) are generally frowned upon in “Natural Formulas”
- Amphoterics are generally bio derived but are hard to find at RCI higher than 90% and most run 70-80%

How is RCI displayed in Consumer Messaging?

- ISO16128 (1):
  - Guidelines on criteria for natural and organic cosmetic ingredients and products
  - uses RCI as metric to quantifying
    - % Natural
    - % Derived Natural
- You may have seen products on the shelves that call out % Naturally Derived
- Some brands even explain their substantiation to consumers
- Helps guide consumers towards larger brand endeavors such as carbon footprint and zero waste initiatives

How Maltodextrin Laurate Manufacture Complies with Key Principles of Green Chemistry

- **WASTE PREVENTION** Maltodextrin Laurate is manufactured to a zero-waste standard; all the raw materials are used, reused or recycled for other applications and products.
- **LESS HAZARDOUS CHEMICAL SYNTHESIS** Inherently safer chemistry for accident prevention
- **SAFER SOLVENTS AND AUXILIARIES** Maltodextrin Laurate is manufactured and produced with water-based processes
- **DESIGN FOR ENERGY EFFICIENCY** Manufactured at low temperatures and pressures
- **USE OF RENEWABLE FEEDSTOCKS** Maltodextrin Laurate is built from renewable naturally occurring agricultural products
- **REDUCE DERIVATIVES** Maltodextrin Laurate is produced in a simple one step functionalization process

Part 2: Eco-Friendly Manufacturing

A Survey of Biosurfactant Energy Consumption and Carbon Footprint

Traditional Fermentation (2)

- Fermented biosurfactants are known throughout the industry (i.e. Sophorolipids and Rhamnolipids) are 100% RCI and rightfully being pursued for commercialization
  - Low overall toxicity, quantified biodegradation and water-based synthesis
  - Fermentation produces reaction products from organic substrates via the metabolic processes of bacteria, enzymes, etc.
- Hurdles: Lower final product volumes, longer production times and higher capital/unit costs compared to common, commercially scalable water-based reaction chemistries
- Our market needs immediately scalable solutions with stable supply chains that do not break the bank

Traditional Fermentation vs. Traditional Surfactant Processing

	Traditional Fermentation Processing	Traditional Surfactant Processing
Total Capacity	1,000-100,000	1,000,000+
Expansion CAPEX and Timing	High	Low
Batch Duration	Days	Hours
Batch Size (gallons)	<5,000	>5,000
Product Consistency	Process-dependent	Consistent
Product Actives/Solids %	5-15%	30-70%

Part 3: Addressing Market Meaning with Practical Consumer Applications

#State of the Trends

- Many trends begin with food—consumer buy-in of health benefits
  - Sustainability efforts have cross-fertilized between industries

- *"The benefit of ingesting products for a healthy lifestyle is gaining a growing impact in the consciousness of individual possibility to promote beauty from within." Faria-Silva et al.* (3)
  - Feeling healthy and feeling good looking healthy and looking good

- Consumers have a product expectation that has been shaped by performance of traditional non-renewable synthetic chemistries


Product Performance
Sustainability Claims

The Sulfate-Free Sustainability Challenge

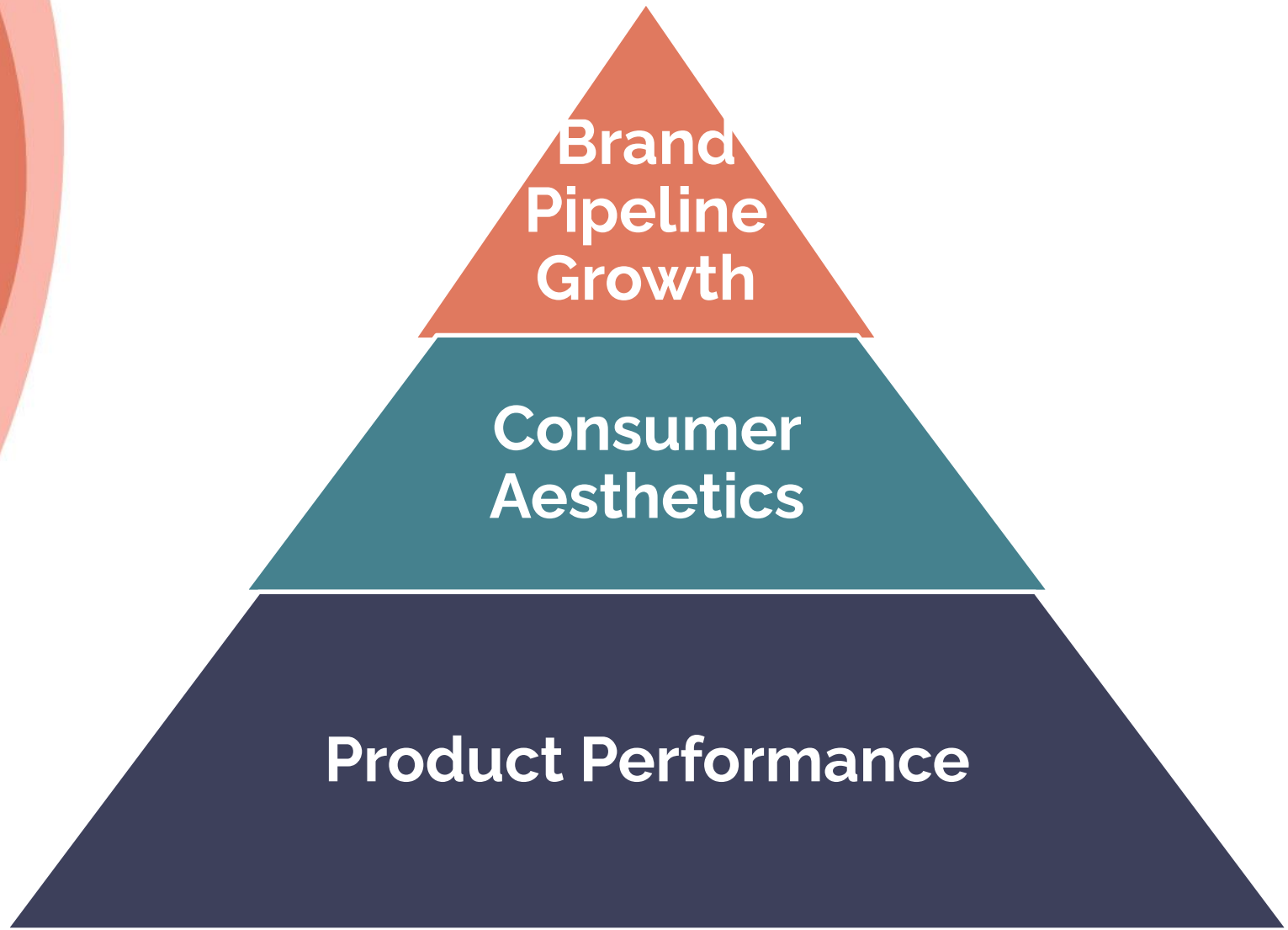
Petro-derived Shampoo Systems

- ✔ Economical
- ✔ Flash Foam
- ✔ Salt-thickening
- ✔ Clean-Rinsing
- ✔ Pleasant After-Feel
- ✔ Robust
- ⊘ Not Sustainable

Sulfate-Free Shampoo Systems

- ⊘ Expensive
- ⊘ Lower Flash Foam
- ⊘ Polymer-Thickening
- ⊘ Long-Rinsing
- ⊘ Heavy After-Feel
- ⊘ Lower Stability
- ✔ Sustainable, …Unless AOS Based

Consider All Functional Aspects to New Product Development (NPD)

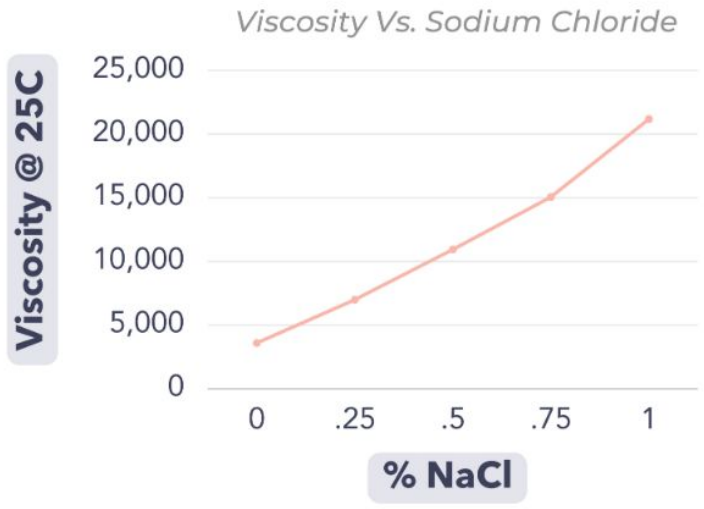


Product Performance

- Ingredients must prove:
  - demonstrative performance in formulation and
  - stability in the exploratory phases of product development

  Bonus star ingredient plays a role in making the formula work, increases RCI of the system
- Maltodextrin Laurate paired with amphoteric surfactant mixture yields traditional anionic surfactant thickening response to salt.

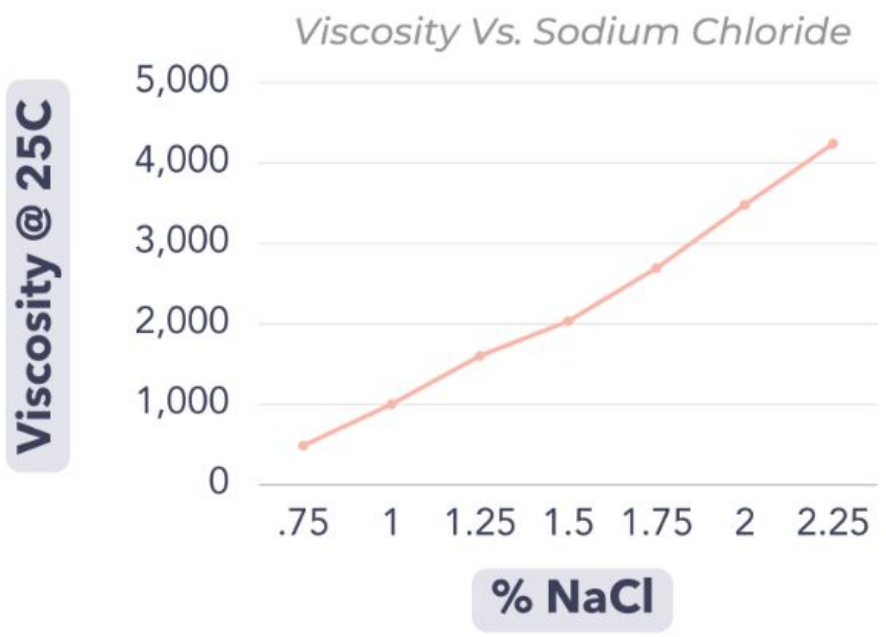
Disodium Lauryl Sulfosuccinate



Sodium Cocoyl Glycinate

Product Performance (cont.)

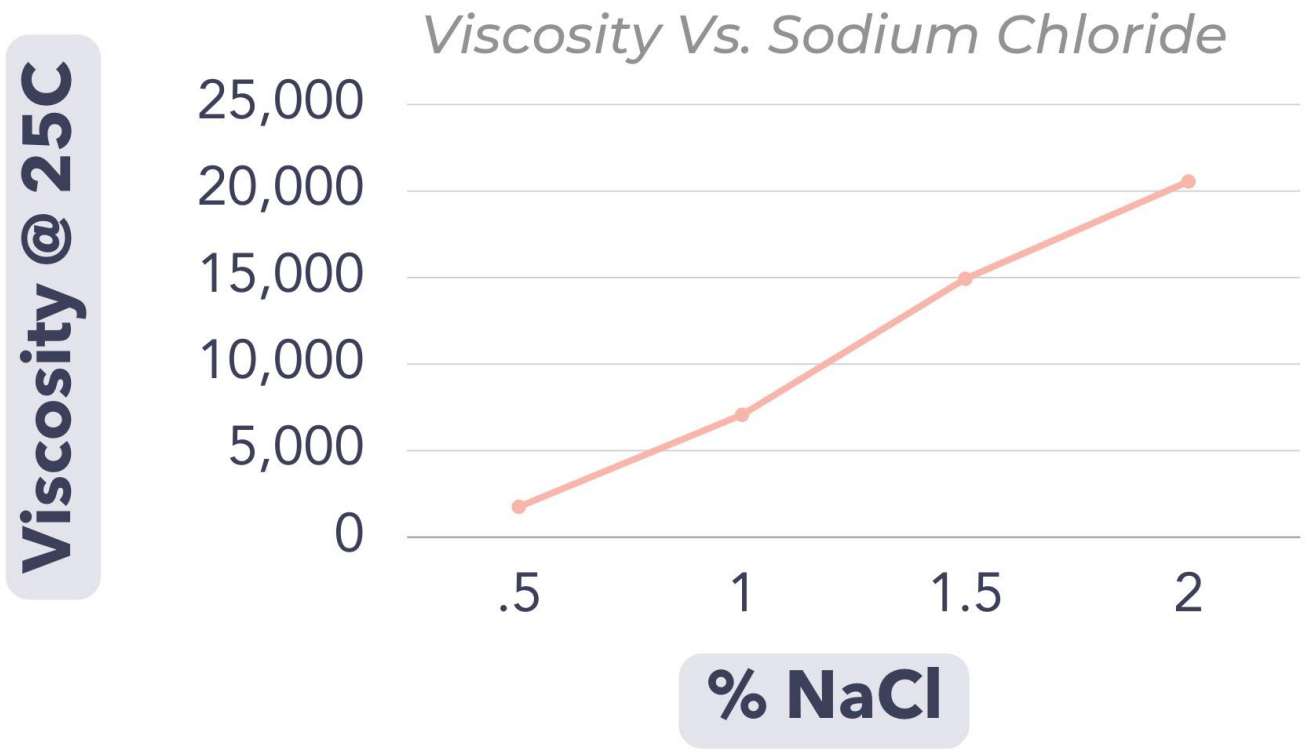
Potassium Cocoate



Sodium Methyl Cocoyl Taurate

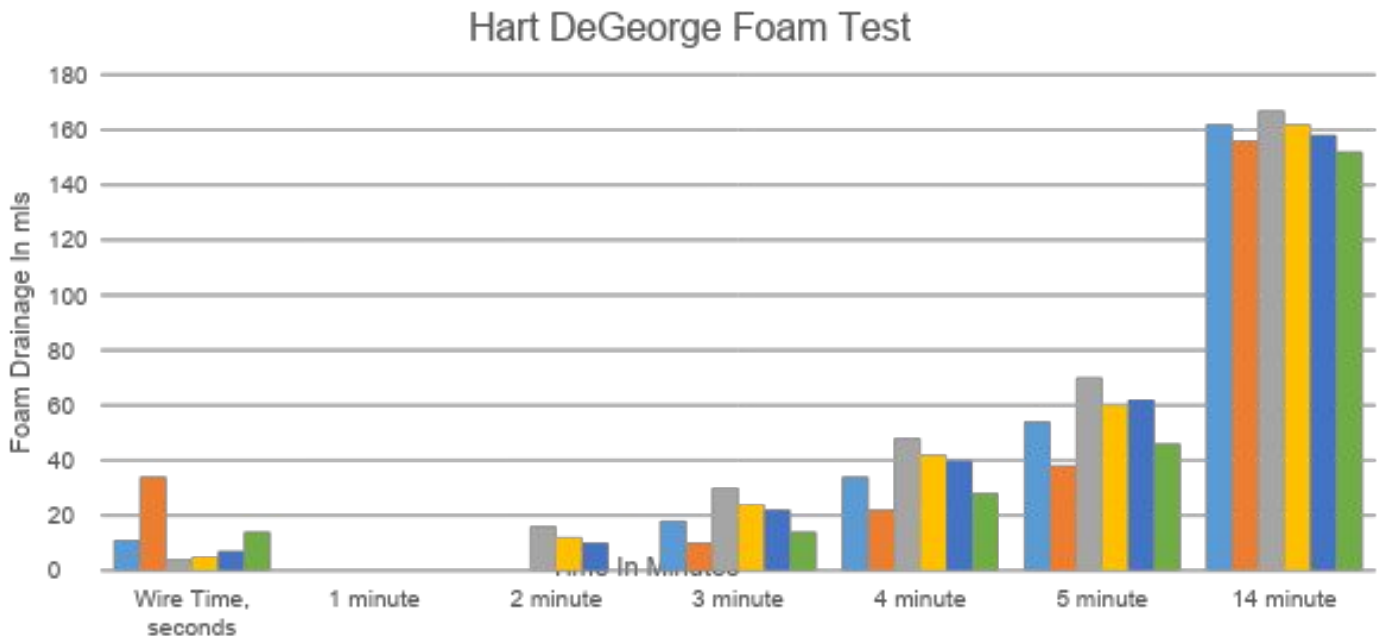
Product Performance (cont.)

Sodium Cocoyl Isethionate



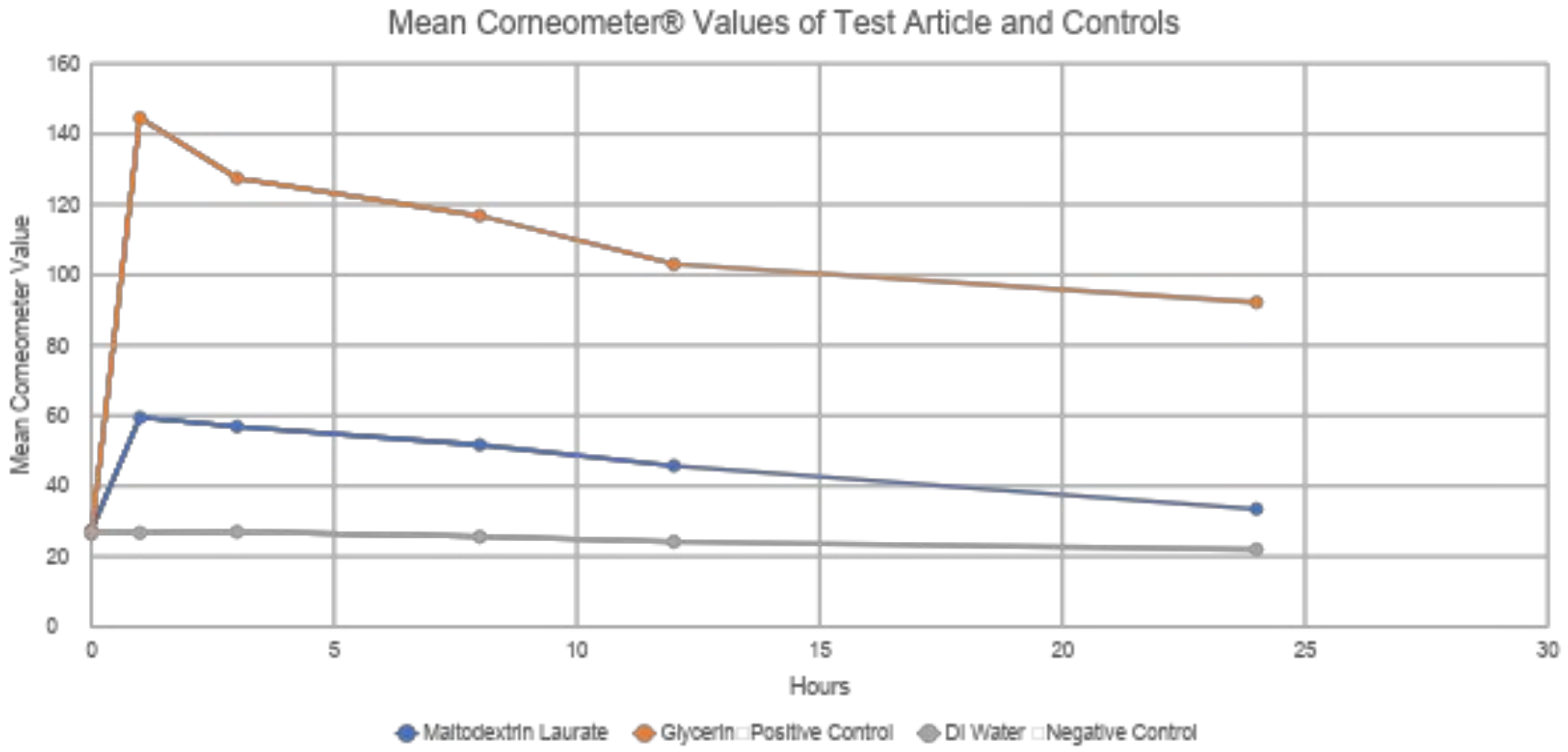
Consumer Aesthetics

- SLS, SLES, CMEA, CAPB
- K+ Cocoate + Maltodextrin Laurate, Amphoteric Blend
- Sodium Methyl Cocoyl Taurate +Maltodextrin Laurate, Amphoteric Blend
- Disodium Lauryl Sulfosuccinate + Maltodextrin Laurate, Amphoteric Blend
- Sodium Cocoyl Isethionate + Maltodextrin Laurate, Amphoteric Blend
- Sodium Cocoyl Glycinate + Maltodextrin Laurate, Amphoteric Blend



Consumer Aesthetics

Skin Moisturization Study



Brand Pipeline Growth

- ✔ Stable Formulation Chassis that meets target product profile
- ✔ Passes all the consumer testing
- Harmonize consumer trends to your brand vision to hit on future claims

The future exploratory for Maltodextrin Laurate may include:

- Microbiome, based on polysaccharides study (4)
- Leave-on applications
  - Advanced skin actives
- Conditioning
- Odor Control

Reference Slide

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