PURITY GUM® Ultra — A Revolutionary OSA Starch Emulsifier for Maximized Beverage Emulsion Productivity
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Emulsifications in Beverage Production

As oil and water are not naturally miscible, emulsions are typically used to deliver oils to enable uniform and stable beverages. An emulsion is a uniform dispersion of fine oil droplets in aqueous medium, stabilized by emulsifiers.

Emulsifiers play two roles: 1.) to reduce interfacial tension dynamically to facilitate emulsification, and 2.) to stabilize emulsions during storage, transport, and in the final beverages. Modified starches and gum arabic are the most common beverage emulsifiers due to their amphiphilicity — meaning they have affinity to both oil and water. A modified starch is hydrophobically modified with OSA (Octenyl Succinic Anhydride), and typically hydrolyzed to suitable molecular weight.

Emulsions of oil based flavors and natural colorants not only provide flavor and color to the beverage, but also turbidity, which is desired in soft drink applications. Sometimes emulsions of neutral oils (alone or with flavor oils) are used to add further turbidities to beverages.

Concentrated emulsions are typically produced in bulk quantity and shipped to bottlers to produce the final beverages, where emulsions are added to beverage syrup typically containing water and corn syrup. This practice saves companies from shipping more water than necessary, allowing their operation to be more efficient and sustainable.

Therefore, a desirable emulsifier needs to deliver both flavor (or color) and turbidity effectively, and maximize the oil load and minimize water usage in emulsion concentrates (Figure 1).

A game-changing specialty OSA-starch, PURITY GUM® Ultra, was recently launched by Ingredion. This patented technology employs an innovative process and achieves an optimized molecular structure suitable for beverage

![Figure 1: Ultimate Performing Starch for Ultimate Process Saving](image)

![Figure 2: Beckman Coulter Particle Size Distribution for an Emulsion with 6% Purify Gum® Ultra and of 24% Weighted Flavor Oil](image)

1 day at 57°C is equivalent to 8 days at 110°F (43.3°C), and both correspond to about 6 months at ambient temperature.
emulsifications. PURITY GUM Ultra offers four times the emulsifying power of traditional beverage emulsifiers. It is capable of doubling the oil load, which in turn doubles the manufacturing volume that can be produced from the same amount of raw materials, reducing processing costs dramatically. This specialty starch also reduces water by 54% in emulsion concentrate, which saves shipping and inventory costs, and reduces carbon footprint. A typical beverage manufacturer can expect to see savings of $500,000 per 1 billion liters of finished beverage.

**Challenge To Stabilize High Oil Load Beverage Emulsions**

A main limitation of traditional emulsifiers in stabilizing higher oil loads is that higher oil loads require a higher amount of emulsifiers, which causes too high of a viscosity in processing. As a result, typical oil loads for beverage emulsions are less than 15%.

Another limitation is that emulsions are thermodynamically unstable, increasing oil load and reducing the emulsifier level to make emulsions much more difficult to stabilize (Table 1).

**PURITY GUM Ultra Performance Summary**

The unique molecular structure of PURITY GUM Ultra provides lower interfacial tension, higher specific surface coverage, and steric stabilization. As shown in Figure 1, traditional OSA starch emulsions contain 12% oil and 12% starch, whereas PURITY GUM® Ultra emulsions contain 24% oil and 6% starch. At 24% oil load, neither conventional starches nor gum arabic were able to provide a stable emulsion with practical viscosity at any usage level. At 12% oil load, conventional starches and gum arabic can produce stable emulsions, but the usage level is at least four times more than PURITY GUM Ultra.

Further, PURITY GUM Ultra produced narrow particle size distribution of less than one micron. The emulsion showed excellent stability at all different aging conditions.

An independent study confirms the superior performance of PURITY GUM Ultra.* “The new type of modified starch used in this study was capable of forming stable emulsions with small droplet sizes (0.3 micron)” at oil : starch ratio of (12:3) and (24:6) (Figure 2).

At the high loading and low usage level, PURITY GUM Ultra offers additional performance solutions in addition to cost benefits as it:

- Produces equivalent beverage turbidity to gum arabic emulsions, providing a lower cost solution for beverage turbidity
- Stabilizes weighting agent-free beverage emulsions
- PURITY GUM Ultra emulsions are more compatible with high alcohol containing beverages
- Provides flexibility of formulating at different oil and starch usage levels

**PURITY GUM Ultra Benefit Summary**

PURITY GUM Ultra significantly enhances manufacturing productivity, reduces capital expenditure, and reduces environmental impact (Figure 3).

- Reduced variable manufacturing costs, less warehouse costs, reduced shipping weights
- Greater asset utilization, potentially postponing capital expenditure in concentrate production
- Reduced carbon footprint aligning to corporate sustainability initiatives
- Estimated savings compared to gum arabic: $1mn/1000 MT of beverage (based on 2011 industry average)

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