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Bag-in-Box Taste Protection: Tygon S3™ B-44-3 Offers Superior Flavor Integrity

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Bag-in-Box (BiB) systems have become ubiquitous in the soft drink dispensing industry due to their affordability and syrup delivery accuracy. The syrup, mixed with chilled, carbonated water, maintains flavor consistency in soft drinks despite the fountain's geographical location. While BiB systems aim to uphold flavor integrity, the tubing used to transport flavoring has potential to compromise the quality of the final product.

Beverage quality can be affected by means of flavor absorption into the tubing wall, followed by subsequent flavor release between soda changeovers. If a citrus flavor such as orange or lemon-lime is pumped through the tubing first, it can impact the taste of cola pumped in sequence, altering the quality of the final product.

Beverage quality can also be affected by off-notes imparted by suboptimal tubing materials. In a beverage transfer application, soft, flexible tubing materials are susceptible to releasing oils and additives over time, which can dull aromatics, disrupt flavor profiles and leave an unpleasant plastic aftertaste. This gives the consumer a perceived 'garden-hose water' flavor rather than the taste experience of their favorite soda selection. In order to keep customers happy, the soft drink dispensing industry must aim for the highest organoleptic standard: preserve the original beverage quality by minimizing any change in flavor, odor or aftertaste imparted from the tubing.

The Saint-Gobain Solution

Saint-Gobain's bio-based Tygon S3™ B-44-3 flexible tubing for beverage transfer is the gold standard in the food and beverage industry due to its ability to minimize impact to the taste or odor of products it transfers. As a phthalate-free solution, it also has excellent non-wetting properties that facilitate complete drainage and permit simple flush-cleaning. As a lightweight and flexible tubing solution, B-44-3 is easy to handle and can be put into service quickly.

In a recent test performed by experts in a leading organoleptic and sensory properties lab[1], Tygon S3 B-44-3 was compared to a competing multi-layer beverage transfer product and put through strict taste and odor testing criteria. Phase 1 of testing aimed to determine if a popular cola syrup would display any adulteration after being circulated through both tubes. This syrup was circulated with a peristaltic pump for 30 hours, drained from the tubing and then diluted to the final soft drink product using recommended ratios from the cola syrup manufacturer. The lab then evaluated the final product by a trained, representative sensory panel following the quantitative sensory method established by Arthur D. Little. In order to emulate real-world factors, blind tastings were conducted by a diverse sensory panel, 20% of which were smokers. This was arranged to meet the global percentage of smokers according to the World Health Organization's most recent adult survey.[2]

In this first phase, the lab concluded that Tygon S3 B-44-3 allowed "...flavors to come through, while the syrup pumped through the [competitor] tubes was notably more dull [sic] in both aroma

and flavor. There was also an after taste [sic] noted with the [competitor] tubing that was not present with the Tygon tubing."[3]

Summary of Phase 1 Results[4]

Tygon S3™ B-44-3	Competitor
Not as crisp as soda syrup control	Plastic (PET) taste
	Is a bit sour at the end
	Leaves an aftertaste
	Dulls the aromatics and flavor profile

Plastic or other aftertastes can erode consumer confidence in a soda brand and in establishments where dispensed soda is sold. Consumers throughout the world expect their favorite cola to taste the same no matter where they are. Ensuring flavor integrity is of the utmost importance to BiB providers.

Phase 2 of this taste protection testing tackled the issue of cross-flavor contamination that BiB users are familiar with. Flavored soda solutions, specifically lime and apple were chosen for Phase 2 because they are commonly used as food flavors in soda and candy. In addition, these flavors are historically problematic for BiB providers and contain easily identified molecules when analyzed via High Performance Liquid Chromatography. These flavored soda solutions were each circulated using a peristaltic pump for 18 hours and then drained. Following this, cola was pumped through the same tubing with the intent to pick up any residual flavor that the tubing wall may have previously absorbed. This "tainted" cola was evaluated by a representative sensory panel which found that: "Tygon S3 B-44-3 has the advantage [over the competitor] due to its complete lack of a plastic note. Aside from the previously mentioned flavor notes in Phase 1, there were no new off notes detected with the Tygon tubing."[5]

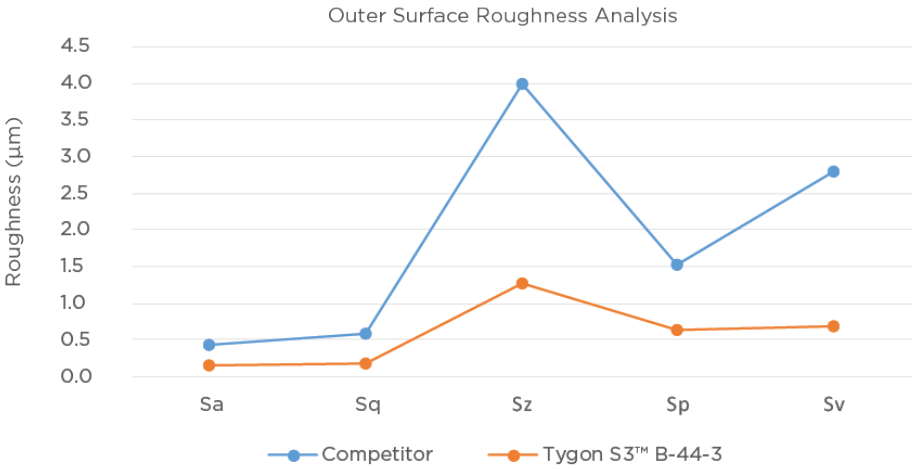
Flavor Crossover Results[6]

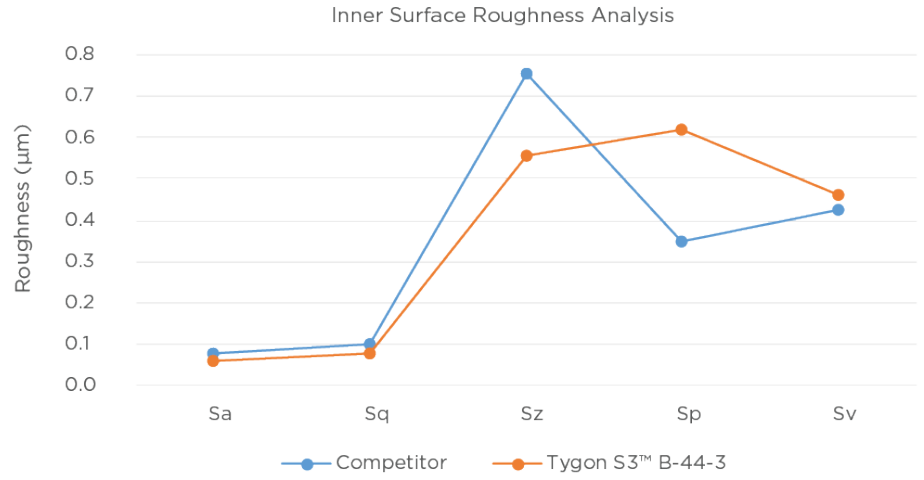
Flavor	Potential Crossover	Tygon S3™ B-44-3	Competitor
Lime	Flavor Crossover?	No	No
	Aroma crossover?	No	No
	Plastic off-taste?	None	Slight
Apple	Flavor Crossover?	No	No
	Aroma crossover?	No	No
	Plastic off-taste?	None	Slight

Further, the lab found that "based on our own independent study (February 2019) simulating the use of one tube for the dispensing of multiple soda syrups, we concluded that the average consumer will not detect any sign of flavor retention from a previous syrup flavor in the use of the following Saint-Gobain tubing in soda syrup dispensing: Tygon S3 B-44-3."[7]

Tubing Flexibility and Smoothness

Surface Roughness of Inner & Outer Analyzed Surfaces[9]





KEY

Sa	*Average surface deviation*
Sq	*RMS average of the surface deviation*
Sz	*Average deviation between the 5 highest peaks and 5 deepest valleys*
Sp	*Maximum surface peak deviation*
Sv	*Maximum surface valley depth deviation*

Two important factors when considering BiB tubing are tubing flexibility and smooth surfaces. Both impact BiB operation and taste in different ways. Flexibility applies mostly to the ease of installation and consistent performance. An observation by a Saint-Gobain testing technician noted that "it is more difficult to insert/remove fittings in the [dual-durometer competitive tubing] compared to the B-44-3."[8] Supplementing the concern of the technician, there is a higher risk of delamination with a dual durometer construction such as that of the competitor product, giving the homogenous tubing material of the Tygon B-44-3 another market advantage when it comes to ease of assembly. Proper tubing installation is paramount to successful operation and consistency.

As for surface smoothness, the lab found that in comparison, Tygon S3 B-44-3 has smoother inner and outer surfaces than the competing food and beverage tubing. The smoother surfaces of the Tygon B-44-3 tubing may contribute to the favorable organoleptic results of less plastic

off taste and flavor absorption documented by the third party lab, though further testing would be needed to confirm whether this is a dependent correlation. The smoother tubing surface of the Tygon product helps to minimize the risk of material entrapment and may also suggest that the Tygon tubing production production process is superior to the competitive tube.

Final Conclusions

Taking factors such as flavor integrity, flexibility and surface smoothness into account ensures BiB system providers are protecting drink quality. Plastic off-notes or aftertastes can erode a consumer's confidence in a brand and the beverage dispensing industry should strive to eliminate this risk by choosing appropriate tubing. BiB providers can count on the trusted and tested Tygon S3 B-44-3 beverage transfer tubing to maintain taste of soda syrups, protecting their brand and relationship with soda brands.

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Footnotes

[1] Zuccarello, John. Siena Development Lab; 253 Cortland St. Lindenhurst, NY 11757. 2019. Citations

[2] Geneva: World Health Organization. *WHO Global Report on Trends in Prevalence of Tobacco Smoking 2000–2025*, second edition; 2018. WHO Global Health Observatory Data Repository, Prevalence – most recent adult survey data by country, http://apps.who.int/gho/data/node.main.TOB1249?lang=en.

[3-7] Siena Development Lab. T*esting of Hose Materials for Suitability for Soda Syrup Usage with HPLC Testing; Testing of Hose Materials for Suitability for Soda Syrup Usage: Flavor Retention with Cola and Organoleptic Analysis*; 2018.

[8] Kenepp, Jessica. Comparative Minimum Bend Radius. Internal Saint-Gobain Report #2468-47: unpublished. 2018.

[9] Golub, Charles. Tube ID and OD Profiles. Internal Saint-Gobain Report #181128-0056: unpublished. 2019.

About Saint-Gobain

Saint-Gobain *designs, manufactures and distributes materials and solutions which are key ingredients in the wellbeing of each of us and the future of all. They can be found everywhere in our living places and our daily life: in buildings, transportation, infrastructure and in many industrial applications. They provide comfort, performance and safety while addressing the challenges of sustainable construction, resource efficiency and climate change. With 2017 net sales of more than $49 billion, Saint-Gobain operates in 67 countries and has more than 179,000 employees.*

Saint-Gobain's Performance Plastics *business is headquartered in Solon, Ohio, and employs 6,000 people in 22 countries. It is a world leader in high-performance plastics, including flexible tubing, seals, coated fabrics, foams, window film, barrier/release films, tapes, medical components, fluid handling systems and bearings.*