



# Food Packageability of K-Resin<sup>®</sup> SBC

*Technical Service Memorandum #288*

## Introduction

By virtue of its sparkling clarity, high gloss, and impact resistance, K-Resin<sup>®</sup> styrene-butadiene copolymers (SBC) are well suited for a wide variety of packaging applications. These resins are versatile and easily processed by conventional sheet extrusion, thermoforming, and injection or blow molding processes. Such versatility allows the packaging designer to maximize consumer appeal without sacrificing performance and economy. Attractive display is particularly beneficial for food products and its packaging is a major application for K-Resin<sup>®</sup> SBC. Since the package must preserve the appearance and quality of the food, certain combinations of food type, polymer, and storage conditions may prove undesirable for functional reasons. The ultimate test for suitability of a polymer for use in food packaging is the evaluation using actual conditions, which include food product for its taste and odor, the package for its performance, and representative storage conditions. This Technical Service Memorandum offers some general observations which may serve as guidelines for preliminary assessment.

## Food Packaging Considerations

K-Resin<sup>®</sup> SBC perform well in packaging many diverse foods. That variety of food products is so broad, that they are difficult to categorize and each should be studied on an individual basis. The possible adverse effects of the food on its container and the container on the food are both interrelated and highly dependent on storage conditions. It is the ultimate responsibility of the producer of the package and/or the food packager to conduct actual storage tests to verify that each specific food product is compatible with the K-Resin<sup>®</sup> copolymer-based container.

## Chemical Resistance

Like most substances, food products can be analyzed in terms of its chemical nature. Some also contain additional chemicals used in its processing or stabilization. Obviously those combinations of chemicals must not attack the package. The resistance of K-Resin<sup>®</sup> SBC to specific chemicals is detailed in PTC Report 353, "Chemical Resistance of K-Resin<sup>®</sup> SB Copolymers," but may be summarized in some general guidelines here. Water and most water-based products or powdered and granular substances do not chemically attack K-Resin<sup>®</sup> SBC. Most organic solvents such as alcohols, ketones, esters, and ethers will dissolve or soften K-

Resin® copolymers. Most oils also affect K-Resin® copolymers, but the rate and severity of their effects are highly dependent on storage conditions.

## **Stress Cracking**

As with most polymers, K-Resin® SBC will crack when stressed beyond its limits, especially when its molded geometry concentrates stress, or it contacts certain deleterious chemicals. Such chemicals include the fats and oils present in many foods. The degree of stress cracking with any given product/K-Resin® SBC combination also depends on the type of container. Thermoformed containers, especially those made from K-Resin® SBC/crystal polystyrene blends, tested with a stress crack accelerating food have cracked almost immediately at room temperature, whereas an injection molded container tested in the same manner did not crack in over a month. Stress cracking is most heavily dependent on four factors: type of container, food type, storage conditions, and molded-in stresses. Injection molded containers are more resistant than thermoformed, and fats and unsaturated oils are the greatest stress crack accelerators.

## **Permeation**

The retention of volume, which is a critical factor in the long-term packaging of liquids, is highly dependent on both time and temperature. Generally, the packaging industry considers 3 percent product loss per year a reasonable maximum. Since water permeates from a K-Resin® copolymer container at a rate of 9 percent per year, K-Resin® SBC containers may not be suitable for long-term packaging of many aqueous products. Moisture vapor and oxygen permeation through K-Resin® SBC are also relatively high which may restrict its use in certain long-term packaging applications. For some types of products, high moisture vapor transmission may be desirable to reduce condensation of moisture in the package. Some food products require oxygen to maintain their color and high oxygen permeation could be advantageous in their packaging.

## **Product Alteration**

To retain the quality of the food product, the containers must not induce a detectable change in the taste, aroma, color, or consistency of its contents. Of these criteria, taste and odor are probably the most sensitive to consumer acceptance and regulatory concern. Unfortunately, they are also the most difficult to predict without actual storage testing. The suitability of the polymer/food combination is highly dependent on the temperature and duration of storage. Each of these factors bears further discussion.

*Food Type* – Among the major constituents of food products, fats are often the most susceptible to acquiring odor and taste because so many organic chemicals are soluble in them. Noticeable changes in a total food product may be affected by the food's fat content. Foods containing more than 5 weight percent fat and/or having free fat or oil on their surface may generally be considered fatty foods. In a few foods, the fat content may be somewhat protected by the physical nature of the food, as for example oil-in-water emulsions. Packaging fatty foods in K-Resin® SBC is not typically recommended.

On the other hand, non-fatty foods are less prone to odor and taste alteration. Most non-fatty foods are economically packaged in K-Resin® SBC with functional and aesthetic success. However, fats are not the only components of food susceptible to alteration, and a few unusually

sensitive non-fatty foods may acquire a detectable odor or taste from packaging materials. Such foods are best identified by suitable storage tests.

*Polymer Type* – Most polymers contain trace amounts of some components used in their manufacture. Some of these inclusions, particularly those of high volatility, may eventually escape the polymer into the surrounding atmosphere. If so, they may be absorbed by certain sensitive products packaged in direct or even indirect contact with them. Residual volatiles in K-Resin® copolymers are usually present at such low levels that normal usage raises no recognized safety or health problems. Nevertheless, those minute traces may, under some conditions, affect the odor and taste of certain sensitive foods even when present in quantities as small as fractional parts per billion.

Blends of K-Resin® SBC with crystal polystyrene are easy to process and exhibit attractive properties and economics, so those blends are often used in food packaging. Since residual volatiles in crystal polystyrene can contribute significantly to the odor or taste of the packaged food product, we recommend that K-Resin® SBC be blended only with food grade polystyrene having low residual content of ethyl benzene and styrene monomer.

As shipped by Chevron Phillips Chemical, all K-Resin® SBC grades meet the specifications of the United States FDA Food Packaging Regulation 21 CFR 177.1640 or an effective United States FDA Food Contact Notification. Regulatory compliance does not assure product compatibility. Each application should be tested under representative conditions to assess interaction with packaged food product. Longer storage duration and elevated storage temperatures may increase packaging incompatibility.

In extraction tests at 120°F (49°C), K-Resin® copolymers do exhibit a low, but detectable, level of migration into fats and oils. Therefore, K-Resin® SBC and SBC blends should not be used in containers for long-term storage of fatty foods above 40°F (4°C). On the other hand, storage tests below 40°F (4°C) indicate that migration is extremely low. Under refrigerated conditions below 40°F (4°C), therefore, K-Resin® SBC or K-Resin® SBC/ crystal polystyrene blends may prove suitable for packaging fatty foods if storage tests indicate no alteration of the food product. Based on the migration studies, K-Resin® SBC/polystyrene blends are not recommended for packaging fatty foods without specific testing.

*Use Condition Guidelines* – Both volatility and solubility are highly dependent on time and temperature. Polymer/food combinations which pick up odor or taste rapidly at high temperatures may do so slowly at low temperatures. Thus packageability depends on both temperature and duration of contact between food and polymer.

*Immediate use containers*, such as water, soft drink or ice cream cups, are filled and served for immediate consumption (usually within two hours). Because of the short residence time of the product in the container, it is unlikely that product alteration will occur. Storage containers are defined as those not intended for immediate use and may have a shelf life ranging from several days to several years. It is essential that the producer of the package and/or the food packager conduct actual storage tests to verify that each specific food product is compatible with the K-Resin® copolymer based container.

## Summary

Clear, durable and versatile packaging made from K-Resin® SBC can enhance the consumer appeal of food products. Unfortunately, the mutual interaction of food and package cannot be predicted without testing. We recommend that the producer of the package and/or the food packager conduct actual storage tests to verify that each specific food product is compatible with the K-Resin® copolymer based container.

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