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Overview of Liquid Fabric Softeners Used in Home Laundering

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1. Background on Fabric Softeners

1.1 While AATCC and other testing and development groups have used standard reference detergents since the 1960s, there has been no standard reference for fabric softeners. In 2017, about 80% of U.S. households regularly use fabric softeners in their laundering process. The most popular methods of applying softeners to textiles in the home are rinse cycle softeners and dryer sheet softeners. Rinse cycle softeners are used in more than 40% of U.S. households while dryer sheets are used in more than 60% of households, with some households using both forms. This monograph provides information on liquid fabric softener used in home laundering.

1.2 Household liquid fabric softeners were developed in the 1960s to maintain the original pleasant feel of clothes on skin. With repeated laundering, clothes lose some of their original mechanical properties because of the intense stress they experience during laundering, and the textile fibers tend to entangle. Through the drying process, the fibers remain entangled and clothes become stiff. Items made with manufactured fibers tend to get charged with static electricity during tumble drying causing static cling. Industry experts indicate that the use of liquid softeners in home laundering helps minimize these issues.

2. Fabric Softener Attributes

2.1 Softness. Liquid fabric softeners function by depositing cationic active compounds or ingredients onto fabric surfaces during the rinsing cycle. Dialkyl quaternary softening agents consist of a positively charged amine group and fatty chains. Once the quaternary active attaches to the fabric, the fatty chains orient themselves perpendicular to the fabric

surface. This helps prevent fibers from becoming entangled creating a thick, full density. Full fiber lubrication creates less friction on the surface and in between fibers providing a soft hand to fabrics. A softener's active ingredient or compound deposition in the rinse cycle can be very high, approaching 90% in some cases. The rinse deposition provided by a liquid fabric softener provides an advantage over dryer sheet softener deposition, as liquid softeners have greater exposure to the fabric surfaces, thus deeper penetration potential to provide a softer hand. Softer garments provide consumers with the perception of increased tactile comfort during wear.

2.2 Static. Static is an imbalance of electrical charge, or electrons, on textile surfaces. Dissimilar materials brought into contact and separated can transfer electrons, leaving a charge imbalance. Friction and low moisture content enhance this process. For example, when clothing is dried in a tumble dryer, items made of fibers that naturally contain some moisture—like cotton—can dissipate charges better than items made of manufactured fibers like polyester. Fabric softeners reduce friction by lubricating fibers, which helps to minimize static buildup in the dryer. In addition, due to the better conductivity properties of fabric softeners' active compounds or ingredients, their use can help neutralize electric charge build-up in a dryer from mixed fiber content loads.

2.3 Fabric Scent. Most fabric softeners (except the unscented or "free" versions) provide freshness to fabrics by fragrances incorporated into the formulations. These generally provide a fresh dry fabric scent that in some cases can last for several days. Many consumers correlate a fresh wet and dry fabric scent with an impression of cleanliness.

2.4 Appearance/Color. The use of liquid fabric softeners usually results in better color appearance of laundered fabrics. The deposition of the softening component lubricates fibers and yarns, which reduces fabric abrasion and helps prevent

fibers from becoming entangled. This, in turn, helps maintain fabric appearance and may extend the life of the fabric. Fabric abrasion may cause surface disruptions, such as fuzziness and/or pilling, that can contribute to a faded, worn appearance.

2.5 Wrinkle Reduction. Due to the fiber lubrication and reduction in fiber-to-fiber friction from deposited softener active ingredients, liquid softeners help reduce fabric wrinkling.

2.6 Flammability. Liquid fabric softeners are not recommended for use on children's sleepwear or garments labeled as flame resistant as the softener may reduce flame resistance.

3. Trends in Liquid Fabric Softeners

3.1 All effective home laundry liquid fabric softeners contain a cationic surfactant—a quaternary ammonium compound. Liquid softeners were developed in the early 1960s as simple dispersions of distallow dimethyl ammonium chloride (DTDMAC), fragrance, electrolyte, colorant, and water. A softener's active compound or ingredient is highly water insoluble and exists as a vesicle, a bilayer structure, in water. DTDMAC was very effective as a softening and antistatic agent and was cost effective. In the mid-1980s, manufacturers converted many liquid softeners to compacted "ultra" formulas by concentrating the active level about three times, resulting in smaller, more convenient bottle sizes. To maintain the desired softness performance, manufacturers used combinations of DTDMAC with amidoamine quaternary active ingredients, imidazolinium quaternary active ingredients, or imidazolines.

3.2 The softener market will continue to evolve as the demands of the consumer constantly change. Softeners of the future will be impacted by many factors, including the desire for rapid biodegradability, water conservation efforts, raw material costs, new performance benefits, improved freshness, and other consumer needs.