In 1915 Frandsen used the word *stabilizer* to designate a group of substances that at that time were generally referred to as holders, colloids, binders, and fillers (Frandsen and Markham 1915). The primary purposes of using stabilizers in ice cream are to produce smoothness in body and texture, to retard or reduce ice crystal growth during storage, and to provide uniformity of product and resistance to melting. Stabilizers function through their ability either to form gel structures in water or to combine with water as water of hydration.

An emulsifier is a substance that will produce an emulsion of two liquids that do not naturally mix. The function of an emulsifying agent in the manufacture of ice cream lies mainly in improving the whipping quality of the mix, producing a smooth texture, giving a dry stiff product at the time it is drawn from the freezer, and obtaining more control during the various manufacturing processes.

Excellent ice cream can be made (and considerable amounts are made) without the use of a stabilizer or emulsifier. Since milk and milk products contain natural stabilizing and emulsifying materials (milk protein, fat, lecithin, phosphates, and citrates) mixes of certain composition and processing treatment may be stabilized by the effect of these natural materials.

**THE USE OF STABILIZERS**

It is known that the water in ice cream is never completely frozen. When the temperature rises some of the ice crystals melt; conversely, when temperatures drop more water is refrozen into ice crystals. This fluctuation in temperature and slow freezing results in texture changes. Stabilizers absorb or hold some of the water freed by melting, thereby preventing the formation of large ice crystals if refreezing occurs.

The amount and type of stabilizer needed in ice cream varies with the conditions; the composition or kind of mix; the ingredients used; processing times, pressures, and temperatures; storage periods; and many other factors. Usually 0.1–0.5% stabilizer is used in the ice cream mix.

Mixes with higher fat or higher TS (40%), chocolate mixes, or ultrahigh-
temperature (220°F or above) pasteurized mixes require less stabilizer. Mixes with lower TS (37%), high-temperature–short-time (HTST) pasteurization (175°F, 25 sec) mixes, or ice cream expected to endure long storage periods require more stabilization. When modified whey solids are used as an ingredient in the mix, the gum-type stabilizers with microcrystalline cellulose seem best to provide the desired body and texture, meltdown, and storage and handling characteristics.

**KINDS OF STABILIZERS**

Among the stabilizer substances that are permitted and used in the making of ice cream are agar; algin (sodium alginate); propylene glycol alginate; gelatin; gum acacia; guar seed gum; gum karaya; locust bean gum; oat gum; gum tragacanth; carrageenan; salts of carrageenan; furcellaran; salts of furcellaran; lecithin; pectin; psyllium seed husk; and CMC (sodium carboxymethylcellulose). Algin derivatives and CMC have gained important places as basic stabilizing materials for ice cream.

Most stabilizers used in ice cream are of natural origin, but some are chemically modified natural products, such as propylene glycol alginate and sodium carboxymethyl cellulose, which are polysaccharides from botanical sources. Gelatin, on the other hand, is an animal protein. Proprietary stabilizers contain a combination of various stabilizers and include emulsifiers. These combinations may be even more effective than the stabilizer material used alone. Other materials that perform valuable functional effects when used in conjunction with stabilizers include microcrystalline cellulose, calcium sulfate, and other salts.

There are many early references in the literature on the use of stabilizers in the manufacture of ice cream and related products.

The first report of gelatin being used in ice cream seems to have been Alberts (1905), and it was the only material used extensively until after World War I. Pectin and carrageenan were used somewhat later. Sodium alginate as an ice cream stabilizer was introduced in the 1930s and studied by Mack (1936). During one period it became the most widely used of all stabilizer materials for ice cream.

A product containing a mixture of an emulsifier and a stabilizer (monoglyceride and gelatin), which gave superior whipping properties, was introduced to the industry and studied by Lucas (1941). In 1945 the use of carboxymethyl cellulose (CMC) was evaluated by Josephson and Dahl (1945) as a stabilizer for ice cream.

The mono- and diglycerides of edible fatty acids and polyoxyethylene sorbitan monooleate or tristearate in the late 1940s and early 1950s were introduced for use in stabilizer–emulsifier products to produce a mix with good whipping properties and a dry, stiff finished ice cream.

The change to different mix pasteurization methods after HTST standards were approved in 1953 also led to a change in stabilizers. The HTST system required about 25% more stabilizer and a material with cold-water solubility.