



COLONY GUMS
Hydrocolloid & Stabilizer Systems

Guar Gum





Guar Gum

SOURCE & PROCESSING

Guar Gum is derived from the ground endosperm of the guar plant, *Cyamopsis tetragonolobus*, family Leguminosae. This is a hardy and drought-resistant plant which grows 1-2 m. high with vertical stalks. The seed pods grow in clusters on the vertical stalks. The pods are about 15 cm. long and hold six to nine seeds about 2-3 mm. diameter. Roughly, 14-16% of the seed is the hull. 38-45% represent endosperm and 40-46% germ. This annual plant is an ancient one and is presently grown extensively in Pakistan and India for human and animal consumption. It is also grown in the semi-arid, southwestern United States. The growing season is about 20 to 25 weeks. It needs little surface water for growing, and the pods must be harvested in the fall, preferably after the first frost and definitely before the next rain. If not, some of the seeds wither, die, and turn black. If these colored seeds are not removed, the quality of the gum is very poor.

In commercial processing, a variety of methods are used to efficiently separate the guar endosperm from the hull and germ. The hull can be loosened by soaking in water and then removed by multistage grinding and sifting or by charring the hull by flame treatment. The differential grinding is used to separate the germ from the endosperm, since there is a difference in hardness of each constituent. Attrition, hammer, or roller mills may be used. The separated endosperm, containing about 80% galactomannan, is finally ground to a fine particle size to be sold as Guar gum. This is a white to yellowish-white, nearly odorless powder.

SOURCE

Derived from the ground endosperm of the guar plant, *Cyamopsis tetragonolobus*.

QUALITIES

- ~ Stabilizing
- ~ Thickening
- ~ Controlling

USES

- ~ Food & Beverages
- ~ Paper & Textile
- ~ Mining & Derivatives
- ~ Water Treatment
- ~ Pharmaceutical
- ~ Cosmetic
- ~ Tobacco
- ~ Petroleum



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USES

Guar gum uses are based primarily on thickening aqueous solutions and controlling the mobility of dispersed or solubilized materials in the water as well as the water itself.

Dairy

The water-binding and rapid hydration of Guar in cold water to form a viscous colloidal sol is its most important characteristic. These properties are utilized in ice cream stabilizers, especially in high temperature, short-time processes, where conditions call for 80° Celsius, for 20-30 seconds. Guar binds the free water without disturbing the viscosity characteristics of the mix. Guar imparts body, texture, chewiness, and heat-shock resistance to ice cream. In combination with calcium sulfate and an emulsifier, it gives a dry and stiff ice cream with a retarded meltdown. Guar is also used with sodium hexametaphosphate and sodium citrate as a stabilizer of ice cream mixes. It is included in the ice cream standards and the food chemicals code. Guar is also used in the stabilization of popsicles and sherbets for similar reasons applying to ice cream. In addition, it retards color migration, and is very stable in this acidic media. Guar is used in soft cheese to improve the yield of curd solids. It gives curds of soft, compact, and excellent texture, which separated whey that is very limpid. Cheese spreads are made by mixing 1-2% guar, melting, and then cooling the homogenous mixture..

Bakery

Guar, when added to dough while kneading, increases the yield, gives greater resiliency, and a drier, less flabby appearance. The baked products have a better and softer texture and retain freshness longer. In cake and biscuit dough, Guar gives a softer and moister product that is easily removed from molds and easily sliced without crumbling. Guar at 1% added to doughnut batter, imparts binding and film-forming properties that retard grease and fat penetration into the yeast-fermented dough. Guar is used to prevent frozen pie fillings from dehydrating, shrinking, and cracking. It is used in icings for its water binding properties.

Meat

Guar binds to all free moisture and retards shrinkage when used at 0.2 - 0.5% based on meat weight in sausage and pet foods. In addition, it acts as a lubricant in the sausage stuffing operation, and decreases loss of weight during storage.

Beverage

Fruit nectars, consisting of pure fruit puree, artificial fruit juices, sugar, ascorbic acid, and citric acid and about 0.2 - 0.8% of total weight. It has replaced Tragacanth in many pickle and relish sauces where rapid cooling is used.

Paper Industry

Over ten million kilograms of gums (Guar, Locust Bean, and Tamarind seed gums) are used annually by the paper industry as wet end additives. The gum is added to the pulp suspension at the suction side of the fan pump just before the sheet is formed on either a Fourdriner or cylinder machine. Along with the lignin removed in the

pulping process, much of the natural hemicelluloses (mannans and xylans) are removed. Guar replaced and supplements these hemicelluloses in paper bonding with many advantages, which include improved sheet formation with a more random distribution of pulp fibers (fewer fiber bundles), increased mullen or burst strength, increased fold strength, increased tensile strength, increased pick, increased flat crush of corrugating medium, increased machine speed, increased retention of fines, improved finish, decreased porosity.

The hydrogen-bonding effect is one of the major factors affecting fiber to fiber bonding. The rigid molecular structure of Guar with its primary and its cis secondary hydroxyl groups contributes to its interaction with the cellulose fibers in counteracting the fibers' natural tendency to lie in a machine-oriented pattern.

Mining Industry

This same hydrogen-bonding action is utilized with the hydrated mineral surfaces of the clay, talc, or shale. Guar acts in froth flotation and potash as an auxiliary reagent, depressing the gangue material.

Guar is used as a settling agent to speed the settling of suspended solids in slimes and tailings from ore beneficiation. The separated water is then recycled. Use level: 1 kg. per 4100 - 20, 500 kg. of dry solids. Guar (at twice the level as above) added to slime or clay pulp causes coagulation and allows faster filtration since the filter screen is no longer blinded by small particles.

Water Treatment

Guar has U.S. Public Health Service approval in potable water treatment as a coagulant aid together with alum, ferric sulfate, and lime. Guar increases the size of the floc initially formed by the coagulant, thereby increasing the rate of settling of solid impurities, reducing solids carry over to the filters, and increasing periods between backwashes. In industrial water, Guar flocculates clays, carbonates, hydroxides, and silica when used alone or in conjunction with inorganic coagulants.

Tobacco Industry

Guar is used as a binder for fragmented tobacco fines to produce reconstituted tobacco sheets. These flexible sheets with tensile strength and thickness of leaf tobacco, are blended with leaf tobacco, and retain the taste, flavor, and aroma of an all-leaf product. Sheets are formed by passing a moist mixture of Guar, humectant, and tobacco fines between closely spaced steel rollers revolving at different peripheral speeds.

Pharmaceutical and Cosmetics

Guar has been used as an appetite depressant. Its thickening ability is utilized in various lotions and creams. Coarse Guar gum is often used as a binding and disintegrating ingredient in compressed tablets.

Petroleum Drilling

Guar has been used to control water flow and as a protective colloid in oil well drilling muds. It is also used in acid fracturing to increase oil flow.

Textile Industry

Guar gum derivatives are used as print-paste thickeners. These derivatives are also used in roller and screen printing, as well as finishing agents. They are more economical than Locust Bean gum derivatives.

Derivatives

Recently hydroxyalkylguar has been used in oil well fracturing and aqueous slurry explosives since it is not affected by saturated calcium salt solutions.

PROPERTIES

Physical

Guar gum is practically odorless and has a bland taste. Its color is off white to very light yellow tan. Mesh sizes are readily available from 100 to 250.

Solubility

Guar gum will disperse and swell almost completely in cold or hot water. It is insoluble in organic solvents.

Viscosity

The most important characteristic of Guar is its ability to be dispersed in water and hydrate or swell rapidly and almost completely in cold water to form viscous colloidal dispersions or sols. The viscosity attained is dependent on time, temperature, concentration, pH, rate of agitation, and particle size of the powdered gum used. The lower the temperature, the lower the rate at which viscosity increases, and the lower the final viscosity. Above 80° Celsius the final viscosity is slightly reduced. The finer Guar powders swell more rapidly than coarse powdered gum.

Chemical Characteristics

Guar gum, like Locust Bean gum, is a polysaccharide consisting of a straight chain of D-mannopyranose units joined by β - (1 \rightarrow 4) linkages with a side-branching unit of a single D-galactopyranose unit joined to every other mannose unit by α - (1 \rightarrow 6) linkages. Locust Bean gum has a single galactose side-branch every fourth mannose unit. The molecular weight of Guar is 220,000 \pm 10%. The greater side-branching of Guar accounts for its cold water hydration as well as its greater hydrogen-bonding activity. An average quality Guar gum contains about 80% galactomannan, 12% water, 5% protein, 2% acid insoluble residue or crude fiber, 0.7% fat, a trace of heavy metals, zero arsenic, and zero lead.

pH

A 1% Guar sol has a pH between 5 and 7. The optimum hydration rate occurs between pH 7.5 and 9. It has a very slight buffering action and is very stable from pH 4 to 10.5. The preferred method to prepare a sol having a very low or very high pH is to prepare a sol at the gum's normal pH and then adjust to as low as pH 1 or slightly above pH 10.5 to give stable sols.

Compatibility

Guar gum, being a nonionic polymer, is compatible with most other hydrocolloids. It is compatible with most chemically modified starches, modified celluloses, synthetic polymers, and water-soluble proteins. Guar is compatible with many salts over a wide range of electrolyte concentration. Some multivalent salts affect hydration and viscosity, and even produce gels. Borate ion present in alkaline water inhibits the hydration. If Guar gum is hydrated, a cohesive structural gel may be formed by the borate ion at pH 7.5 to 10.5. This gel is reversible by reducing pH below 7 or by heating the gel. Polysaccharides, having numerous cis hydroxyl groups, can form these three dimensional gels with pentavalent boron. The guar borate gel may also be liquefied by addition of glycerol or mannitol, both low-molecular weight polyols.

Preservatives

Bacterial attack, common to all plant hydrocolloids, may be controlled by a mixture of 0.15% methyl and 0.02% propyl parahydroxy benzoate.

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