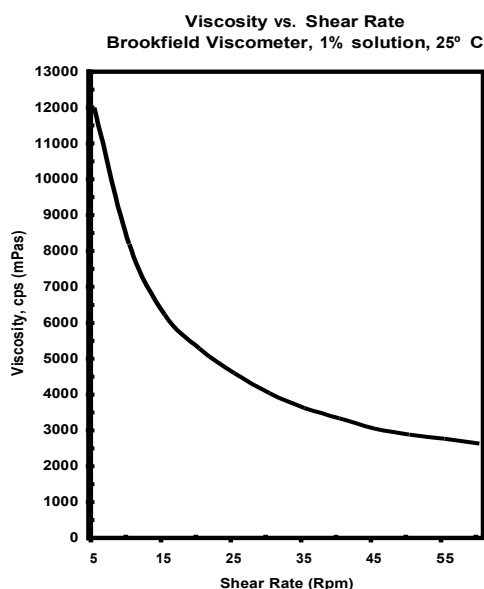


Techcol® is one of the most cost effective and efficient water-soluble polymers known. It forms highly viscous solutions at low concentrations. It exhibits non-Newtonian rheological properties and yields acid reversible gels with Borax. Due to the unique properties of this gum, it finds wide application in several industrial applications.



Techcol® is a plant seed hydrocolloid - a cold and hot water-soluble galactomannan polysaccharide derived from the seeds of the Guar plant 'Cyamopsis Tetragonalobus'. Chemically, it is composed of a beta 1-4 linked linear mannose backbone chain with single galactose side unit on approximately every other mannose unit, in a 1-6 alpha linkage. The molecular structure reveals that it is a rigid rod-like polymer due to the beta linkage between the monomer units. The mannose to galactose ratio has been estimated at 1.8:1 to 2:1. Recent studies indicate that the galactose side units may not follow a regular spacing pattern, but in fact, may appear in "clusters" and on either side of the mannose backbone and the molecular weight of Guar Gum has been estimated as high as 1.8 - 2.5 million. Depolymerised **Techcol®** products have significantly lower molecular weights. Usually, viscosities can be directly related to the molecular weight.

Several grades and type of **Techcol®** are available and can be customised – straight Guar Gums, modified Guar Gums such as hydrolysed, depolymerised, delayed hydration, anti-dusted, free-flowing etc., Guar Derivatives such as Hydroxypropyl Guar (HPG), Carboxymethyl Guar (CMG), Hydroxypropyl Carboxymethyl Guar (CMHPG, anionic Guar), Guar Hydroxypropyl trimethyl ammonium chloride (GHPT, cationic Guar).

In general, it is the high galactose (to mannose) molar ratio that accounts for the excellent cold-water solubility of **Techcol®**. An important feature of **Techcol®** structure to be noted is the cis-position of the adjacent hydroxyl groups on the C2 and C3 in the mannose and C3 and C4 in the case of galactose. This is an important factor since these adjacent hydroxyl groups reinforce each other in hydrogen bonding reactions.

Techcol® is soluble in hot and cold water, but insoluble in most organic solvents. It is commercially used in several industrial applications for its excellent ability to control rheology by economic water phase management.



Techcol® forms highly viscous colloidal dispersions when hydrated in cold water. These solutions exhibit non-Newtonian, pseudo-plastic rheological properties. Aqueous solution viscosities decrease with increasing rates of shear.

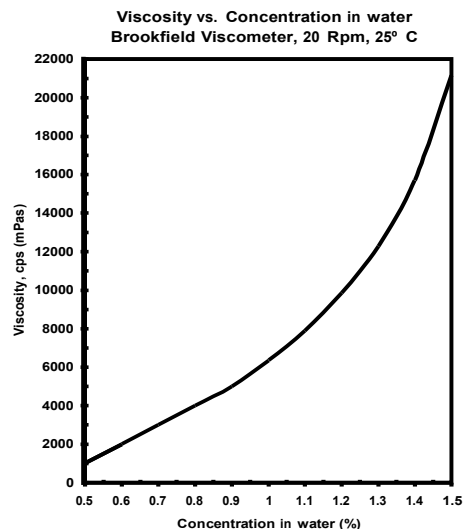
Techcol® aqueous dispersions, like most hydrocolloids, obey the power law:

$$\tau = \kappa \dot{\gamma}^n$$

Where τ = stress, $\dot{\gamma}$ = shear rate, κ = consistency modulus, n = flow behaviour index.

The lower the value of n , the greater the shear thinning effect (loss of viscosity on increasing shear). For an ideal Newtonian fluid, the viscosity is independent of shear and therefore $n = 1$.

Techcol® solution viscosities increase exponentially with increasing concentration of **Techcol®** in water. In addition to shear rates and polymer concentration, **Techcol®** solution viscosities are also influenced by previous shear history, temperature, pH and the presence of salts and other solids. The time required for **Techcol®** to completely hydrate in water, and reach peak viscosities depends upon the grade of **Techcol®**, the dispersion and stirring equipment used, the pH and temperature. **Techcol®** viscosities will tend to irreversibly reduce if the dispersion is sheared at very high speeds for extended periods. Such a reduction is more pronounced at elevated temperatures and extremes of pH.



The viscosities of aqueous **Techcol®** dispersions are not significantly affected by temperature. Hydration rates (rate of viscosity development) are influenced by short term heating. **Techcol®** will reach peak viscosities faster if the dispersion is heated to about 40°C for short while. Beyond 40°C and up to 80°C, viscosities will decrease, but will recover on cooling, though this depends upon the holding time at the high temperature and the pH. For example, typical **Techcol®** solutions having a pH of 4-9 exhibit good thermal stability when heated to 80°C and held for two hours and cooled but will thin irreversibly if the pH is held during this period at 3.

Techcol® solutions will tolerate only small amounts of organic solvents, but it is dependent on the grade of **Techcol®** used. Typically, the polymer will precipitate out of solution and viscosities will reduce sharply when the weight % organic solvent in solution exceeds a certain level of 5%-10%.

Techcol® is compatible with most other gums, starches and hydrocolloids both natural and synthetic. Excellent viscosity synergism is achieved, without gel formation, with Xanthan gum in ratios of 50:50 to 90:10 (**Techcol®**: Xanthan)

Like most natural galactomannans, **Techcol®** solutions are subject to degradation by microbial attack and hydrolysis. Preservatives may be added to **Techcol®** solutions to extend solution shelf life. **Techcol®** has a long shelf- life in its dry form.

Techcol® Guar Gums are available in a variety of viscosities, particle size distributions and hydration rates to suit every need. Detailed specification sheets are available on request. Specialised "tailor-made" products are possible.



Techcol® are Guar Gums manufactured under strict quality conditions. The manufacturing process from raw material to finished goods is fully automatic, incorporating complex pneumatic conveying and material handling system. Various safety features during manufacturing and packaging ensure that **Techcol™** is free of foreign matter and impurities.

Average standardised / blended batch sizes range from 5,000 to 8,000 kilos (11,000 to 17,5000 lbs), thus ensuring consistency and reproducibility from batch-to-batch. Every batch shipped to customers carries a certificate of analysis. Our well-equipped labs are capable of carrying out various tests and analytical procedures.

Techcol® must be stored in a cool, dry place, away from heat and out of the sun. It is recommended to use all the contents from a **Techcol®** bag/ container, within a reasonable time, once opened. Due to the hygroscopic nature of the product, excessive humidity may lead to absorption of moisture and consequent degradation if bags/ containers are left in an open state for long periods.

Techcol® is available in 25 kgs or 50 lbs net, multi-wall paper (open mouth or valve filled) bags with a suitable liner or coated paper as a moisture barrier. Other packing available on request (Plastic bags, Fibre drums, Jumbo sacks etc.). Pallets also available on request.

For Safety, Health, Environment and Handling, see Material Safety Data Sheet.

In order to obtain lump-free, homogeneous solutions and aid dispersion; **Techcol®** should be dry blended with other ingredients used, such as sugar, starches etc. Such a pre-blend should be added to the vortex created by an agitator.

Techcol® may also be slurried in certain miscible non-aqueous liquids (alcohol's, glycol's etc.) and poured into agitated water.

Eductor systems may be used to make stock solutions, but care must be taken to pre-blend relatively free-flowing materials with **Techcol®** to aid in having a controlled and even rate of discharge from hoppers etc. On its own, **Techcol®** may have a tendency to bridge or form "rat-holes" in hoppers and bins. Special grades are available for specific applications.

A high-speed mixing device is recommended to make **Techcol®** solutions. This ensures no formation of lumps, faster hydration and more homogeneous solutions. A holding period of up to 24 hours ensures that **Techcol®** solutions have completely hydrated and reached their peak viscosities. Heat up to 40°C may be employed through a jacketed vessel to speed up the rate of **Techcol®** hydration in water.