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Process Bulletin

Cellulose Gum Dispersion

Description

These are dispersions of water-soluble or dispersible cellulose compounds such as CMC (sodium carboxymethylcellulose), methylcellulose or microcrystalline cellulose. They are used in a wide range of food, pharmaceutical and chemical products as thickening or dispersing agents. For example, their thickening ability may retard oil globules from rising to the surface of an oil-in-water emulsion, or they may retard the settling of solids in a dispersion. Any product which would benefit from a viscosity increase could be an application for these materials. For example, CMC is used as a thickener, stabilizer and suspending agent. It affects rheological properties, inhibits growth of crystals, and stabilizes foams. CMC is physiologically inert and is used in ice cream mix, bakery products, sauces, drinks and salad dressings. CMC and methylcellulose are water-soluble but require strong agitation for 30 minutes or more to complete the dissolution. Low shear agitation is not recommended for dispersing CMC. Microcrystalline cellulose is not soluble and requires a high level of mechanical energy to complete the dispersion and obtain the viscosity increase.

Objective

To achieve complete solubility and freedom from gels, it is essential to minimize the quantity of cellulose compound required to obtain a desired viscosity. These compounds are usually expensive, or the permissible quantity may be limited by the FDA regulations; therefore, it is essential that maximum utilization be made. In addition to providing immediate, complete dissolution or dispersion, homogenization produces improved clarity and freedom from gels.

Equipment and Process

Premixing prior to homogenization is usually required. This may be carried out in a kettle equipped with a propeller agitator, a paddle mixer or a high shear disperser. The selection of premix equipment will depend upon the viscosity of the premix, and this viscosity will depend upon the solids level. In some cases, high solids level solutions are prepared and later cut back as required.

The premix of the desired cellulose derivative is pump-fed to a single-stage homogenizer and is processed at a pressure appropriate for the application. The most common pressure range is 3000-5000 psi. The efficiency of the homogenizer is not improved by processing at elevated temperatures. Below is a table showing the effect of homogenizing 7.5% solution of medium-viscosity CMC. The data was taken at 72°F, both immediately after homogenizing and after aging for 24 hours.

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Homogenizing Pressure (psi)	Same Day Viscosity (cP)	24-Hour Viscosity (cP)
0	8,000	17,000
1,000	20,000	20,000
3,000	31,000	31,000
5,000	39,000	39,000
8,000	46,000	47,000

(The sample with no homogenizing pressure was the premix made by vigorous mixing for 30 minutes.) There was a definite increase in viscosity with increasing pressure, indicating that all of the CMC was not completely in solution without homogenizing, even after 24 hours at room temperature. Note, also, the stability with time of the viscosity generated by homogenization, as opposed to the unhomogenized instability over a 24-hour period.

Testing

Testing usually consists of two parts; a visual examination for clarity and freedom from gels, and viscosity determination, both initially and after 24 hours to determine stability.

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