METHYL CELLULOSE
Sigma Prod. Nos. **M0262, M0387,**
M0512, M6385 and M7140

CAS NUMBER: 9004-67-5
SYNONYMS: Methocel A®, Methylcellulose A, Methyl cellulose ether

PHYSICAL DESCRIPTION:

Appearance: Powder
Molecular weight: Correlated approximately with viscosity[1]

Product Number	Approximate Viscosity at 2%, 20 °C	Approximate Molecular Weight
M 7140	15 cPs	14,000
M 6385	25 cPs	17,000
M 0262	400 cPs	41,000
M 0387	1500 cPs	63,000
M 0512	4000 cPs	88,000

Structure: Cellulose, with methoxy substitution between 27.5-31.5% (weight). Degree of substitution (D.S., average number of substituent groups attached to the ring hydroxyls) is 1.5-1.9. (This range gives maximum water solubility.)[1]

STORAGE / STABILITY AS SUPPLIED:

These products are very stable at room temperature.

SOLUBILITY / SOLUTION STABILITY:

Although up to 10% solution in water can be prepared for low viscosity methyl cellulose, the high-viscosity products are normally limited to 2-3% (w/w). The concentration to prepare will depend on the intended usage and desired viscosity. Dissolving methyl cellulose into water requires some care.

Method 1:[1]

1. Heat about 1/3 of the required volume of water to at least 80 °C.
2. Add the methyl cellulose powder to the hot water with agitation.
3. Agitate the mixture until the particles are thoroughly wetted and evenly dispersed.

SOLUBILITY / SOLUTION STABILITY: (continued)

Method 1:[1] (continued)

4. For complete solubilization, the remainder of the water is then added as cold water or ice to lower the temperature of the dispersion. Once the dispersion reaches the temperature at which that particular methyl cellulose product becomes water soluble, the powder begins to hydrate and the viscosity increases. Solution should be cooled to 0-5 °C for 20-40 min.
5. Continue agitation for at least 30 min. after the proper temperature is reached.

Method 2:[4]

Add 10 g methylcellulose to 1 liter of distilled water, and using a heating magnetic stirrer, slowly "bring to a boil for 5-10 minutes until small amorphous aggregates" of methylcellulose are formed. Immediately sterilize the solution for 16 minutes at 121 °C and 15 psi steam pressure. Allow solution to stand overnight at room temperature for complete dispersion. The solution will be cloudy, but uniform. The solution stored at room temperature can be used for one year.

Note: If a lumpy solution forms because of the methyl cellulose was not dispersed properly in cold water, then a high shear force is necessary to break the lumps, using a tissue homogenizer or blender.

A 0.5-1% solution of these products in water can be autoclaved under the usual conditions. However, higher concentrations may lead to chunks of methyl cellulose coming out of solution, so autoclaving these higher concentrations is not recommended. Heating a solution to the gel point results in thermogelation (see below). Upon cooling, the material rehydrates to the initial viscosity. If higher concentrations are autoclaved to thermogelation, then the rehydration may not take place sufficiently and big chunks will form. An alternative method to obtain a sterile solution of higher concentration would be to sterilize the water first, then add the material to the solvent.

GENERAL REMARKS:

Methylcelluloses have a wide range of uses in general industrial settings, depending on viscosity (related to molecular weight). They can be used for adhesives or thickening agents, viscosity control agents, or protection in paint formulations. Pharmaceutical grades have been used as thickeners, binders, emulsifiers, and stabilizers in a variety of cosmetic and food products. Biochemical applications are similar, as noted below.

GENERAL REMARKS: (continued)

Methylcelluose solutions when heated will reversibly form gels- at a temperature characteristic of the type and percentage. For these products, a 2% solution (w/w) has a gelation temperature of approximately 48 °C. The gelatin temperature drops linearly with increasing concentrations to about 30 °C for a 10% solution. Agitation affects the strength and apparent temperature of gelation; continued rapid agitation during gelation may break down gel structure. Additives (such as ordinary buffer salts or ethanol) can affect the gelation temperature, in either positive or negative direction. For maximum development of gel strength under quiescent conditions, the solution should be above the gelation temperature for about three hours.[1]

M 7140 (or cell culture tested M7027) is used at approximately 50 g/L in media to enhance viscosity characteristics.[2] Stewart et al. used methylcellulose (low viscosity, 0.2% solution) to restore the ability of human umbilical cord vein cells to adhere to fibronectin after they were removed from substrata. Methylcellulose also prevented human skin fibroblasts, human melanoma cells and mouse lung fibroblasts from losing adhesive properties. The authors concluded that the product can be a useful reagent for the preservation of cell function in suspension. They described methylcellulose as being non-toxic, enzyme-resistant, and not cell-permeable.[3]

M 0512 is recommended over glycerol for use in a cryopreservation medium; a higher percentage of viability was noted for each organism tested in a 1% methylcellulose solution compared to a 15% glycerol solution. The Sensitivity and resistance of the preserved organisms to various antibiotics did not change.[4] Methylcellulose of 4000 cps (M0512) was used in a semi-solid culture medium; plating cells in 1.2% methylcellulose with 10% fetal calf serum were plated over a layer of 0.9% agar.[5,6] Similar applications involved plating cells in an 0.8% solution.[7,8] Human neuroblastoma cells were cloned and cultured successfully in a 1% methylcellulose medium.[9] A standard protocol for plating in Methocel (M0512) using 1.6% final concentration in medium has been published.[10]

The graph that follows gives the correlation between concentration and viscosity for methyl cellulose of different molecular weights.

REFERENCES:

1. Supplier information.
2. Sigma Cell Culture Technical Service.
3. Stewart, G.J. et al., *Biotechniques*, 19, 598 (1995).
4. Reamer, R. et al, *Journal of AOAC International*, 78, 997-1001 (1995).
5. Freedman, V.H. and Shin, S., *Cell*, 3, 355-359 (1974).

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8. Rennick, D., Yang, G., Muller-Sieburg, C. et al., *Proc. Natl. Acad. Sci.* USA, 84, 6889-6983 (1987).
9. Ito, T. et al., *Cancer Research*, 47, 4146-4149 (1987).
10. *Gene Transfer and Expression: A Laboratory Manual*, M. Kriegler (Stockton Press, NY, 1990), pp 94-95.

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