

Microfibrillated cellulose- a new structural material

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Cellulose is a naturally occurring polymer made of repeating units of glucose. Microfibrillated cellulose (MFC) is cellulose in which the outer layer of the fibres has been stripped away by mechanical shearing, exposing the fibril bundles. These fibrils are much smaller in diameter compared to the original fibres as shown in Figure 1. The structure of MFC can be seen in Figure 2. The macroscopic fibres are mechanically sheared until the fibrils are released. The fibrils can form a network or web-like structure.

The structure of MFC is intrinsic to its properties. This can be seen by comparing the properties of untreated and treated fibres. Untreated fibres form a pulp solution in the presence of water but as the fibres are not soluble the water and fibres quickly separate when left to stand. However, MFC forms a solution with water that is not easily separated. When an MFC solution is concentrated it forms a gel. The fibrils are hydrophilic and form hydrogen bonds with water, which allows the MFC to 'hold' water. This can be an advantage, for example when using MFC as a thickener, but it can also be a disadvantage, for example MFC can be used to strengthen paper but can slow down the drainage of water from the paper machine wire.

The degree of fibrillation and properties of the MFC are closely linked. Too little fibrillation and the MFC separates out from water, as with untreated fibres. However, too much processing and the MFC structure starts to break down, forming a film. This film can be used, for example, as a coating or packaging for food products [1]. The cellulose films stay in solution with water in the same way as MFC.

There are several methods of production currently in use [2]: electro-spinning [3], bacterial [4], non wood [5], high shear [6], grinding [7] and a combination of enzyme hydrolysis, shear and homogenisation [8]. Homogenisation is also widely used as a single method of production [9, 10].

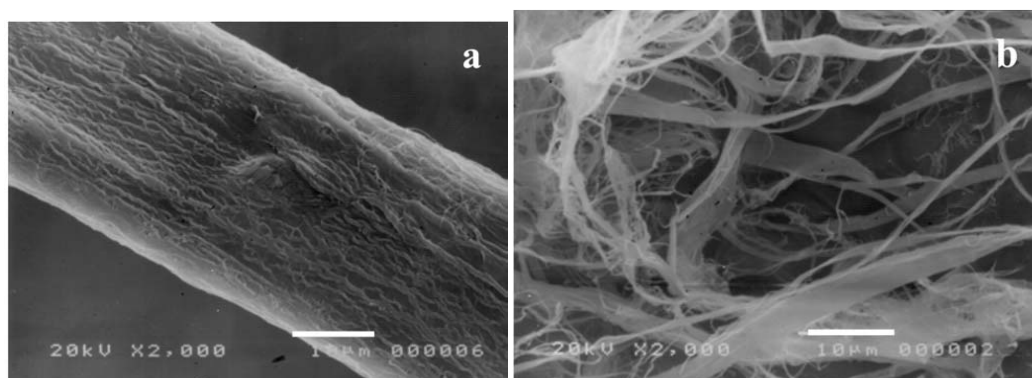


Figure 1: SEM images of: a) Kraft pulp single elementary fibre; b) MFC. Scale bar: 10 µm [9]

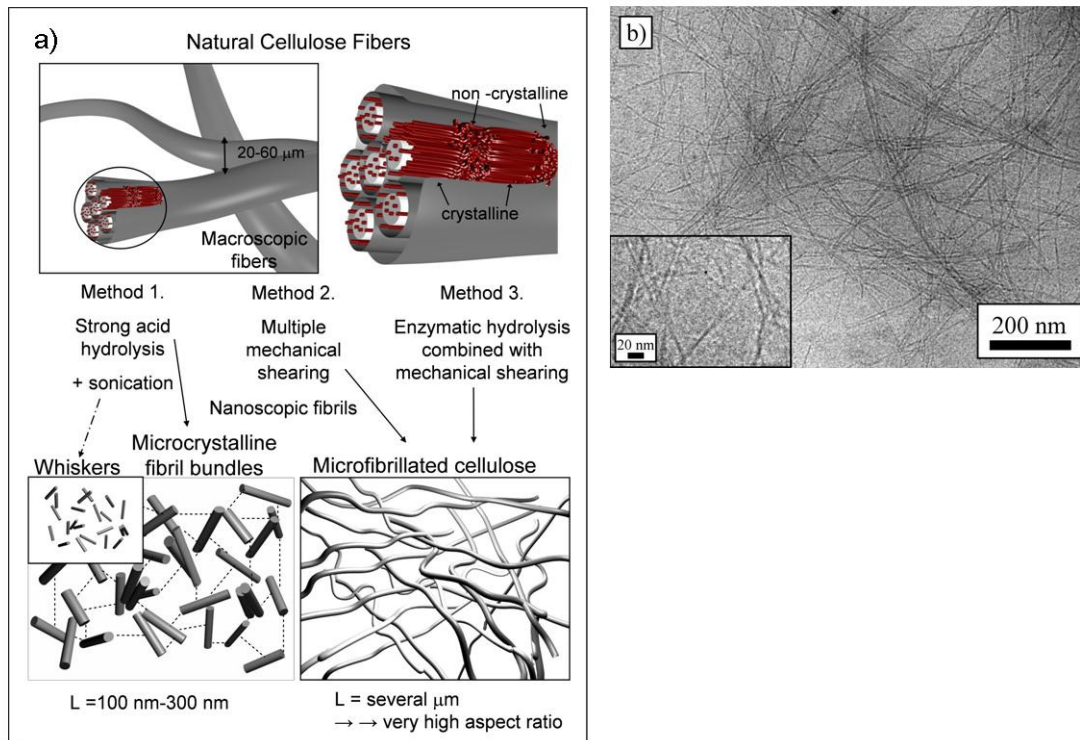


Figure 2: a) Diagram showing treatment of cellulose to give microfibrillated cellulose. Source: [8] b) SEM image of MFC. Source: IMERYS

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