

PRODUCTION OF CARBOXYMETHYLCELLULOSE (CMC) FROM OIL PALM EMPTY FRUIT BUNCH (EFB)

by: ROSNAH MAT SOOM; AB GAPOR MD TOP and
WAN HASAMUDIN WAN HASSAN

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Oil palm empty fruit bunches (EFB) are a by-product produced in huge quantities by the palm oil mills. About 65% of EFB is either incinerated for bunch ash or recycled back to the plantation as mulching or used as solid fuel in the boilers to generate steam and electricity for the mills. According to Zin Zawawi *et al.* (1995), EFB constitutes about 20% to 22% of the weight of fresh fruit bunches and contains 30.5% dry matter, 2.5% oil and 67% water. Full exploitation of this biomass is necessary and this can be done by maximizing the utilization of bunches to form products of high value which not only comply to the zero waste strategy but also generate additional profit to the palm oil industry.

An approach towards adding value to EFB is by chemical modification. EFB, like other woody products is made up of cellulose, lignin and hemicellulose. Cellulose, which is the basic material for the production of cellulose derivatives, can be chemically modified to carboxymethylcellulose (CMC). This product has various uses in the food and non-food industries. The production of CMC from EFB is advantageous as the raw material is a by-product which can be processed to higher value.

DESCRIPTION

CMC is an anionic, biodegradable and linear polymer cellulose ether (Figure 1). It is one of the most versatile of water-soluble hydrocolloids and has a number of important properties including solubility, rheology, adsorption on surfaces, *etc.* Apart from these, viscosity and the degree of substitution (DS) are the two major

properties of CMC that determine its functionality, both of which can be regulated during the processing.

HISTORY

CMC was developed in Germany during World War I as a substitute for gelatin. During the 1930s, CMC was used to eliminate redeposition of soil on fabric during washing and rinsing. There was also interest in the production of CMC after the war. Kalle and Co. in Wiesbaden-Biebrich produced it in the late 1930s. Hercules then developed a commercial process in 1943.

APPLICATION OF CMC

CMC is widely used in various industries such as food, pharmaceuticals and cosmetics. Other industries, for example, detergents, drilling fluids, glue, ceramics, dye and paint stuffs also make use of the valued properties of CMC. The applications of CMC are in dissolved and dispersed forms and can be broadly categorized into:

- water binder (ice cream, ceramics, adhesives, bakery);
- film former (textile size, paper coatings);
- wet tact (denture adhesives);
- binder (bulk laxatives);

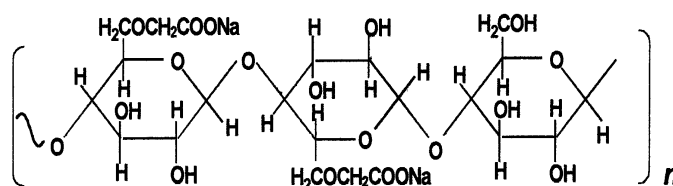


Figure 1. Molecular formula of CMC.

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Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-89259155, 89259775, Website: <http://mpob.gov.my> Telefax: 03-89259446



- suspending aid (sauces, cosmetics, beverages) and
- thickener (syrops, toothpaste).

PRODUCTION OF CMC

CMC as shown in *Figure 2* is prepared by etherification of cellulose with monochloroacetic acid or sodium monochloroacetate. Cellulose, which is embedded with lignin and hemicellulose in the fibrous EFB, is first recovered by chemical pulping prior to CMC synthesis. Typical analyses of CMC are shown in *Table 1*. A wide range of viscosity and substitution types are available from CMC of EFB for the high and less pure grades that have expanded the product uses.

CONCLUSION

- CMC produced from EFB has the potential to be a commercial specialty product.
- CMC exhibits a wide range of properties and potentially useful in many industrial applications.



Figure 2. Carboxymethylcellulose.

TABLE 1. TYPICAL ANALYSES OF EFB-BASED CMC

Properties	Range
Yield	49.7% - 59.0%
Degree of substitution (DS)	0.7 - 0.9
Purity	85.5% - 99.5%
Viscosity	200 - 2200 cps

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For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-89259155, 89259775
Website: <http://mpob.gov.my>
Telefax: 03-89259446