HIGH GRADE OIL PALM-BASED SODIUM CARBOXYMETHYL CELLULOSE (CMC) FOR FOOD ADDITIVES

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MPOB INFORMATION SERIES • ISSN 1511-7871 • JULY 2019 MPOB TT No. 660

Carboxymethyl cellulose (CMC) is a versatile polymer derived from cellulose, most common natural polymer found in wood, cotton and agricultural waste. Cellulose extracted from oil palm empty fruit bunch (OPEFB) was converted into CMC of different grades for various applications.

The preparation of different quality and the grade of CMC is highly influenced by the concentration of sodium hydroxide (NaOH) used during the mercerization process. With the addition of a known quantity of a NaOH, will cellulose tended to be more reactive to monochloroacetic acid (MCAA). The synthesis of sodium carboxymethyl cellulose (Na-CMC) from cellulose involved two stage process. The cellulose fibres were swollen in a dilute NaOH first and followed by the reaction of hydroxyl group in cellulose with the monochloroacetic acid (MCAA). This palm-based CMC has great potential in food industry, pharmaceutical, detergent, drugs, cosmetics, textile, paper, and in oil drilling operation.

FIELDS OF APPLICATION

CMC are widely used in foods, pharmaceuticals, cosmetics, textiles, papers and paper boards, detergents, paints, oil well drillings, welding electrodes, pesticides, ceramics, tobacco, mosquito repellent incense, explosives, batteries, pencils, leathers and other industries (Trabelsi *et al.*, 2007; Yang and Zhu, 2007; Rosnah *et al.*, 2012). CMC has the following functions and properties:

- Acts as a thickener, binder, stabiliser, suspending agent and flow controlling agent.
- Forms fine films that are resistant to oils, greases, and organic solvents.
- Dissolves rapidly in cold water.
- As a protective colloid reducing water losses.
- Suitable for use in food systems.
- Physiologically inert.
- An anionic polyelectrolyte.

DESCRIPTION OF THE PROCESS

The CMC can be synthesised via its reaction with alkali and chloroacetic acid (Bao *et al.*, 2011; Joshi *et al.*, 2015; Siqueira *et al.*, 2015). The steps involved in the CMC production of different grades is shown in *Figure 1*. The product is white to yellowish in colour and it is odourless (*Figure 2*). *Table 1* lists the properties of CMC.

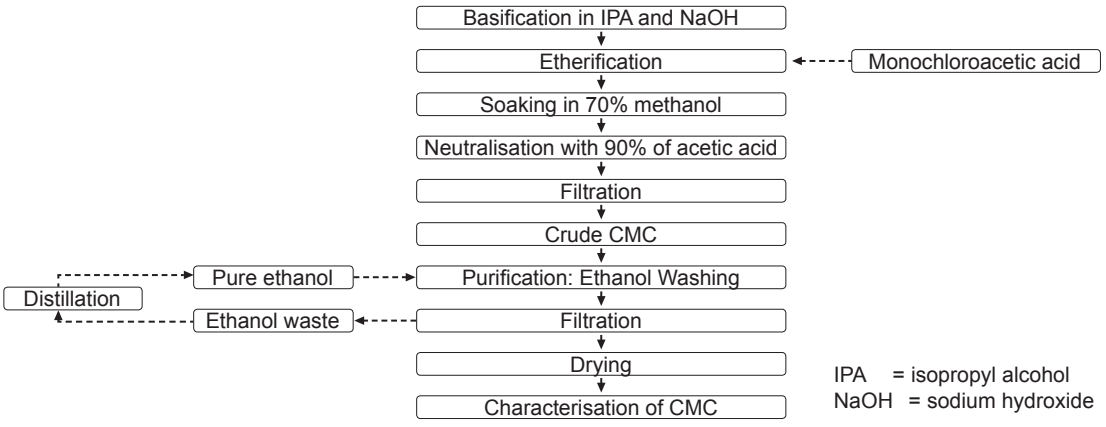

Figure 1. Process flow of CMC synthesised from cellulose.

ISSN 1511-7871

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TABLE 1. PROPERTIES OF OIL PALM BASED CARBOXYMETHYL CELLULOSE

Properties	Unit	CMC# 112	CMC# 116	CMC# 202
Purity	%	≥99.5%	≥99.5%	≥99.5%
Degree of substitution (DS)	-	1.3	0.7	0.68
Viscosity (at 25°C)				
2% dilution in distilled water	cP	555-950	1 019-1 687	156-376
1% dilution in distilled water	cP	127-225	129-234	47-68

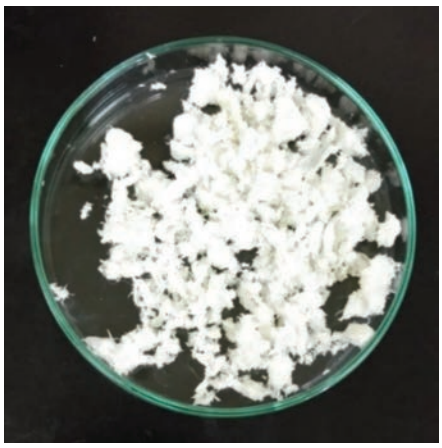

Figure 2. Sodium carboxymethyl cellulose.

ECONOMIC FEASIBILITY

The economic feasibility for the production of palm-based sodium carboxymethyl celluloses is shown in *Table 2*.

TABLE 2. ECONOMIC ANALYSIS OF CMC PRODUCTION OF FROM OPEFB

Economic analysis	Value
Net present value (NPV) @ 10%, RM	12 989 081
Internal rate of return (IRR), %	31.40
Discounted payback period (DPBP), years	4.3
Discounted benefit cost ratio	1.16:1

*Note: This value is based on new plant set up.

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