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QUALITY TEST OF CMC (CARBOXYMETHYL CELLULOSE) USING SEMI-BATCH REAKTOR

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ABSTRACT

Carboxymethyl Cellulose, one of the additives commonly used in the industrial sector, is carboxymethyl cellulose. The state of the art of this research is because no research makes a reactor to manufacture carboxymethyl cellulose. This study tested the quality of making carboxymethyl cellulose using a semi-batch reactor using samples of potential organic cellulose waste materials: durian seeds, taro rods, and bagasse. This sample has been used to make carboxymethyl cellulose in previous studies using a laboratory scale. Then compared, the manufacture of carboxymethyl cellulose using a reactor laboratory scale. From the result obtained, carboxymethyl cellulose from durian seeds, taro rod, and bagasse made on a laboratory scale and using a reactor has become carboxymethyl cellulose in quality number 1 and 2, which are commonly called carboxymethyl cellulose industrial grade and food chemical codex quality which met the minimum quality requirements by SNI 8762; 2019. Carboxymethyl cellulose from durian seeds, taro rod, and bagasse obtained from research that has been tested with FTIR, the spectra of the best results of carboxymethyl cellulose from durian seeds, taro rod, and bagasse can be seen in the picture there are similar peaks that appear indicates carboxymethyl cellulose durian seeds, carboxymethyl cellulose taro rod, and carboxymethyl cellulose bagasse produced in this study have the same chemical molecule as industrial grade and food chemical codex.[1,2]

Keywords: Carboxymethyl Cellulose, durian seeds, taro rod, bagasse, waste

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INTRODUCTION

Carboxymethyl Cellulose (CMC) One of the additives commonly used in several industrial fields is carboxymethyl cellulose, also known as CMC (Carboxymethyl Cellulose). Carboxymethyl Cellulose or Carboxymethyl cellulose is an additive usually added to foodstuffs as a thickener or emulsion stabilizer in the form of linear cellulose polymer ethers and anionic compounds, which are biodegradable, colorless, odorless, non-toxic, water-soluble granules or powder.2,7 However, insoluble in organic solutions, has a pH range of 6.5 to 8.0, is stable in the pH range of 2-10, reacts with heavy metal salts to form a film insoluble in water, is transparent, and does not react with organic compounds. The need for carboxy methyl cellulose (CMC) in Indonesia is currently only being met by two factories with a capacity of 6000 tons per year and 500 tons per year.[3] The reactor used in this study is a semi-Back reactor. Semi Batch Reactor is usually in the form of a stirred tank and is semi-continuous. In a stirred tank flow reactor, one or more reactants enter into a stirred vessel, and at the same time, the same amount (product) is removed from the reactor. The stirrer is designed to mix the mixture thoroughly, and the reaction is expected to take place optimally. The operation is done by entering some reagents into the reactor while other reagents or the rest are added continuously. The reaction products can be removed continuously or remain in the reactor. A chemical reactor is a vessel in which a chemical reaction takes place. The design of this reactor depends on many variables studied, and the design of a chemical reactor must prioritize the efficiency of reactor performance so that the product results are obtained compared to significant inputs with minimum capital and operating costs. This research was conducted with the aim of To test the quality of CMC (Carboxymethyl Cellulose) using a semi-batch reactor using 3 samples used in previous CMC (carboxymethyl cellulose) research and To be an evaluation of reactor design in the CMC synthesis research stage from organic material/organic cellulose potential waste in the development of a semi-batch reactor to become an automatic semi-batch reactor.[4]

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EXPERIMENTAL

Material and Methods

This research use durian seeds, taro stalks, and bagasse whose optimum conditions have been obtained in previous studies, propanol pa., methanol pa., distilled water, 30% sodium hydroxide solution, sodium monochloroacetate pa., 0.1N sulfuric acid solution, aqueous solution pH 7 buffer, acetic acid and ethanol, stirred tank reactor (RTB) kit, 20 mesh sieve, Sartorius analytical balance, Memmert oven, desiccator, Heidolph stirrer set, RZR type 1, three- neck flask 1 L, glass funnels, beakers, measuring cups, Buchner funnels and Heraeus brand vacuum pumps and furnaces.[5]

Method is Alkalization and carboxymethylation processes, Neutralization and drying processes by gravimetry method, alkalimetry method used to Determint of Degree of Substitution (DS), Measurement of the pH of 1% CMC solution by potentiomectric, viscsity Measurement of 2% CMC solution by viscometre oswald, determination of NaCl levels using argentometry titration, determination of CMC purity using rendemen, yield determination and organoleptic Test.[5]

General Procedure

Samples (durian seeds, taro stalks, bagasse). The samples were cleaned, cut into small pieces, and crushed directly with a chopping machine to form a powder measuring 20 mesh. The enumeration results were in the form of powder with a size of ± 20 mesh. The sample slurry (durian seeds, taro rod, and bagasse) is ready for use, and the synthesis process is continued using a CMC reactor. Then the bagasse powder produced from the chopper machine weighed 5 kg directly into the reactor. In step 1, 3.5 % HNO_3 solution containing 10 mg $NaNO_2$ (every 1 L volume of HNO_3) was added. The ratio of the weight of bagasse powder to the volume of HNO_3 solution is 1: 2. The extraction process takes place with the reactor for 2 hours at a temperature of 80 ^{0}C. After 2 hours, the solution in the reactor is deleted and washed with running water until the pH is neutral. The process continues to stage 2 by adding a solution of 2% NaOH and 2% Sodium Sulfite at a temperature of 50 ^{0}C with an addition ratio of 1:1.5 (per kg of the initial weight of sample slurry (durian seeds, taro rod, and bagasse)) for 1 hour. In the third step, 1.75% sodium hypochlorite was added for an hour at 100 ^{0}C with an addition ratio of 1:2 (per kg initial weight). Furthermore, the solution used in the third stage was discarded and washed with running water until the pH was neutral. At this stage, cellulose has been obtained. The fourth stage is to add cellulose to the reactor by adding a solution of 1500 mL of 17.5% NaOH and heating it at a temperature of 80 ^{0} C., then washing and filtering until the pH is neutral. The stage was continued to the last stage by adding 1500 mL of 1.75% sodium hypochlorite for 5 minutes at a temperature of 100 ^{0} C, then washing and filtering until the pH was neutral. In each stage of the process, the stirrer reactor must continuously rotate until the process at that stage is complete. The wet weight of - cellulose obtained after the fifth stage of the extraction process in the reactor was weighed. For every kg of the wet weight of -cellulose that was put into the reactor, 1200 mL of propanol p.a, 250 mL of ethanol p.a, and 150 mL of distilled water were added and stirred for 10 minutes. Furthermore, 30 % NaOH solution was added dropwise until the color changed to dark red (brown) thoroughly. This alkalization process lasts for 1 hour at 24 ^{0} C. After completion, the carboxymethylation process was continued by adding 100 g of sodium mono-chloroacetate pa little by little. This process lasts for 3.5 hours at a temperature of 55 ^{0}C. During these two processes, the stirrer continues to rotate. Then the neutralization and drying process was carried out, determining the degree of substitution (DS), measuring the pH of the 1% CMC solution, measuring the viscosity of the 2% CMC solution, determining the NaCl content, determining the purity of CMC, determining the yield, and FTIR.[6,7,8]

RESULTS AND DISCUSSION

Based on the results of research conducted on the manufacture of CMC (Carboxymethyl Cellulose) durian seeds, taro stalks, and bagasse, data was obtained for the manufacture of CMC (Carboxymethyl Cellulose) on a laboratory scale and the manufacture of CMC (Carboxymethyl Cellulose) using a Reactor.

Carboxymethyl Cellulose (CMC) Durian Seeds

We have seen this in table 1. CMC durian seeds in laboratory scale and CMC durian seeds use a reactor when compared to SNI quality CMC, and it can be said that CMC durian seeds using a reactor have the quality as CMC quality I and CMC Quality II, which is commonly called CMC Industrial Grade.

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Table-1: Result of Carboxymethyl Cellulose (CMC) Durian Seeds

Parameter	CMC Durian Seeds Laboratory Scale	CMC Durian Seeds Using Reactor	SNI CMC Quality I	SNI CMC Quality II	Food Chemical Codex
Degree of Subtitution	0.77	0.76	0.7 – 1.2	0.4 – 1.0	0.7 – 1.2
Solution pH 1 %	8	8	6 - 8	6.0 – 8.5	6 - 8
Viscosity (cP)	6	8	< 26	-	-
Moisture Content (%)	8.7	9	-	-	-
NaCl Content (%)	2.06	2.07	0.25	-	-
Purity (%)	9.94	97.93	> 99.6	> 65.0	99.5
Rendemen CMC (%)	97.5	98	-	-	-

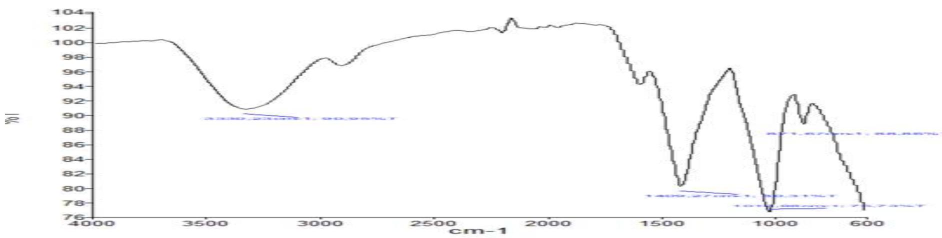

Fig.-1: FTIR Carboxymethyl Cellulose Durian Seeds Laboratory Scale

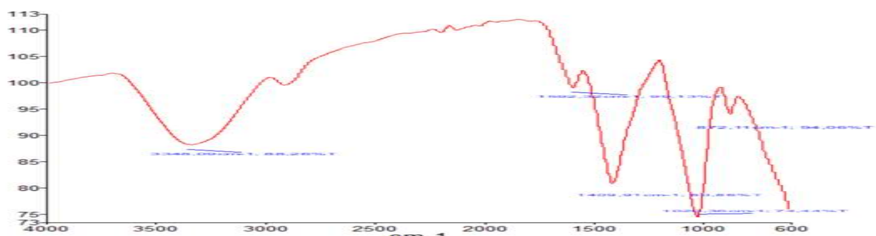

Fig.-2: FTIR Carboxymethyl Cellulose Durian seeds Using Reactor

Furthermore, it has a Food Chemical Codex quality called Food Grade because it meets the minimum quality requirements set by SNI 8762; 2019. Carboxymethyl Cellulose durian seeds are obtained from research that has been tested with FTIR in Figures 1 and 2; the spectra of the laboratory-scale Carboxymethyl Cellulose test results and Carboxymethyl Cellulose durian seeds using a reactor can be seen in the picture there are similar peaks that appear indicating Carboxy Methyl Cellulose of durian seeds in laboratory scale and Carboxymethyl Cellulose of durian seeds using a reactor device produced in this study have the same chemical molecule as SNI Quality I and SNI 2 for Industrial Grade and food chemical codex.[9,10,11]

Table-2: Result of Carboxymethyl Cellulose (CMC) Taro Rod

Parameter	CMC Taro Rod Laboratory Scale	CMC Taro Rod Using Reactor	SNI CMC Quality I	SNI CMC Quality II	Food Chemical Codex
Degree of Subtitution	0.13	0.11	0.7 – 1.2	0.4 – 1.0	0.7 – 1.2
Solution pH 1 %	8	8	6 - 8	6.0 – 8.5	6 - 8
Viscosity (cP)	2	1,88	< 26	-	-
Moisture Content (%)	5.1	6.1	-	-	-
NaCl Content (%)	4.43	3.97	0.25	-	-
Purity (%)	95.57	96.03	> 99.6	> 65.0	99.5
Rendemen CMC (%)	7.7	7.9	-	-	-

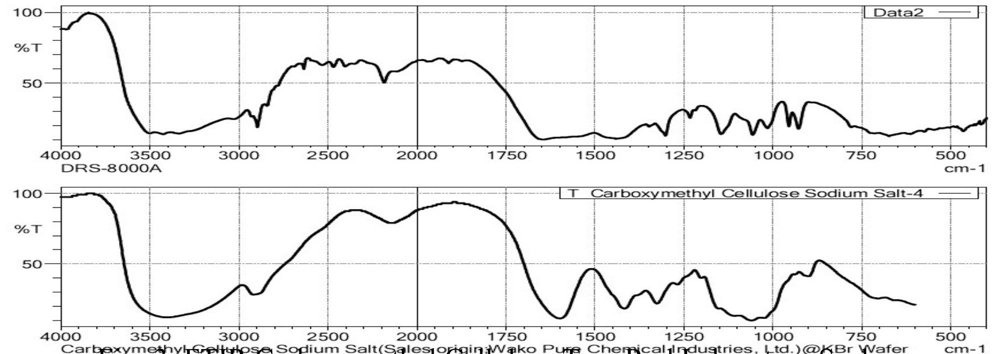

Fig.-3: FTIR Carboxymethyl Cellulose Taro Rod Laboratory Scale

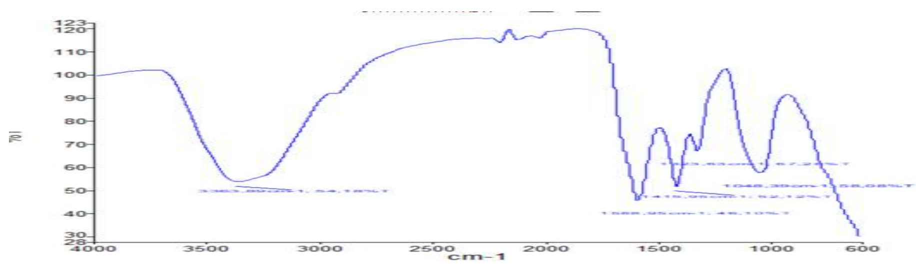

Fig.-4: FTIR Carboxymethyl Cellulose Taro Rod Using Reactor

Carboxymethyl Cellulose (CMC) Taro Rod

We have seen this in table 2. CMC of taro rod laboratory scale and CMC of taro rod using a reactor when compared with SNI quality CMC, it can be said that CMC of taro stems using a reactor has the quality as CMC quality I and CMC Quality II, which is commonly called CMC Industrial Grade and also has a Food Chemical Codex quality called Food Grade because it meets the minimum quality requirements set by SNI 8762; 2019.[1,13] Carboxymethyl Cellulose of taro rod, obtained from research that has been tested with FTIR in Figures 3 and 4, the spectra of the laboratory-scale Carboxy Methyl Cellulose of taro rod and Carboxymethyl Cellulose of taro stems using a reactor can be seen in the picture, there are similar peaks that appear indicates that the laboratory scale Carboxymethyl Cellulose of taro rod and Carboxymethyl Cellulose of taro rod using a reactor device produced in this study have the same chemical molecules as SNI Quality I and SNI 2 for Industrial Grade and food chemical codex. [9,10,11]

Table-3: Result of Carboxymethyl Cellulose (CMC) Bagasse

Parameter	CMC Bagasse Laboratory Scale	CMC Baggase Using Reactor	SNI CMC Quality I	SNI CMC Quality II	Food Chemical Codex
Degree of Subtitution	0.04	0,9	0.7 – 1.2	0.4 – 1.0	0.7 – 1.2
Solution pH 1 %	7	7	6 - 8	6.0 – 8.5	6 - 8
Viscosity (cP)	1.58	1.58	< 26	-	-
Moisture Content (%)	5.1	3,28	-	-	-
NaCl Content (%)	1.3	1.5	0.25	-	-
Purity (%)	98.7	98.9	> 99.6	> 65.0	99.5
Rendemen CMC (%)	21	25	-	-	-

Carboxymethyl Cellulose (CMC) Bagasse

They have seen from table 3. CMC of bagasse on a laboratory scale and CMC of bagasse using a reactor when compared to SNI quality CMC, it can be said that CMC of bagasse using a reactor has the quality as CMC quality I and CMC Quality II, which is commonly called CMC Industrial Grade and also has a Food Chemical Codex quality called Food Grade because it meets the minimum quality requirements set by SNI 8762; 2019.[13,14]

Carboxymethyl Cellulose, obtained from research that has been tested with FTIR in Fig.-5 and 6, the spectra of the laboratory-scale Carboxy Methyl Cellulose test results and Carboxymethyl Cellulose bagasse using a reactor can be seen in the picture there are similar peaks that appear indicates that the laboratory scale Carboxymethyl Cellulose bagasse and Carboxymethyl Cellulose bagasse using a reactor device produced in this study have the same chemical molecules as SNI Quality I and SNI 2 for Industrial Grade and food chemical codex. [9,10,11]

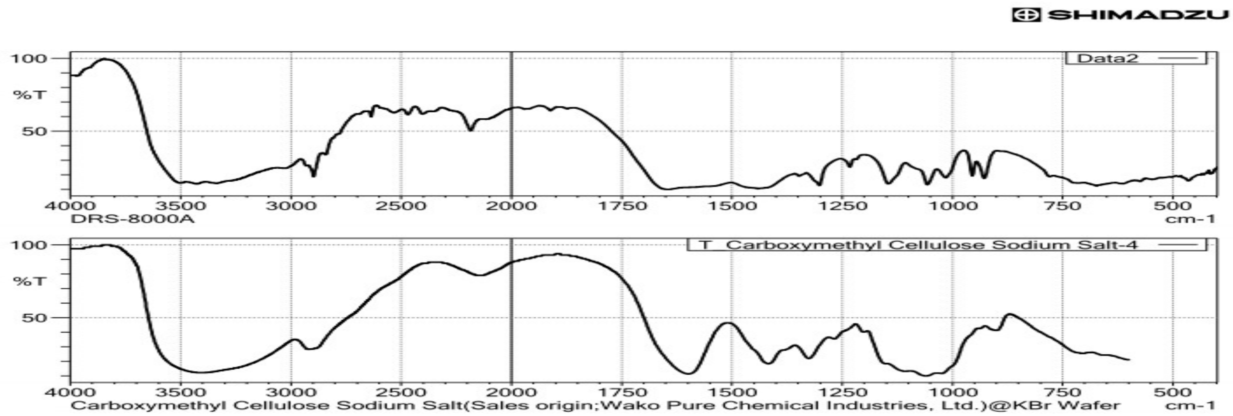

Fig.-5: FTIR Carboxymethyl Cellulose Bagasse Laboratory Scale

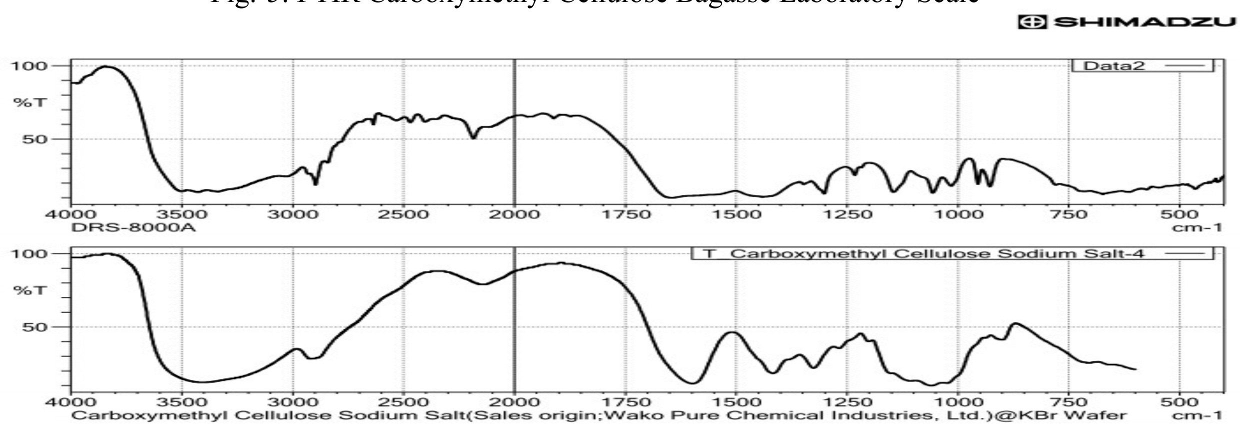

Fig.-6: FTIR, Carboxymethyl Cellulose Baggase Using Reactor

CONCLUSION

From the results and discussion of this study, it can be concluded as follows:

Research on the manufacture of carboxymethyl cellulose from durian seeds, carboxymethyl cellulose from taro rods and carboxymethyl Cellulose bagasse. From the results obtained, carboxymethyl cellulose from durian seeds, carboxymethyl cellulose from taro rods, and carboxymethyl cellulose from sugarcane bagasse made on a laboratory scale and using a reactor have the quality of carboxymethyl cellulose SNI quality I and carboxymethyl cellulose SNI Quality II which is commonly called carboxymethyl cellulose Industrial Grade and also has Food Chemical Codex quality meets the minimum quality requirements set by SNI 8762; 2019.[12,] carboxymethyl cellulose durian seeds, carboxymethyl cellulose taro stems, and Carboxymethyl Cellulose bagasse was obtained from research that has been tested with FTIR, the spectra of the test results of Carboxy Methyl Cellulose of durian seeds, carboxymethyl cellulose of taro stems and carboxymethyl cellulose of sugarcane bagasse can be seen in the picture there are similar peaks that appear indicating carboxymethyl cellulose of durian seeds, carboxymethyl cellulose of taro stems and carboxymethyl cellulose.The sugarcane ash produced in this study has the same chemical molecule as SNI Quality I and SNI Quality 2 for Industrial Grade and food chemical codex.[13]

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CONFLICT OF INTERESTS

All authors declare that there is no conflict of interest in the publication of this article.

AUTHOR CONTRIBUTIONS

All the authors contributed significantly to this manuscript, participated in reviewing/editing and approved the final draft for publication. The research profile of the authors can be verified from their ORCID ids, given below:

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