2019 3rd INTERNATIONAL CONFERENCE

FIRST

FORUM IN RESEARCH, SCIENCE, AND TECHNOLOGY (FIRST)

CONFERENCE PROGRAMS AND ABSTRACT

The 3rd FIRST 2019 INTERNATIONAL CONFERENCE
FORUM IN RESEARCH, SCIENCE, AND TECHNOLOGY
OCTOBER 09-10, 2019

Palembang, Province of South Sumatera
Indonesia

Organized by :

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PREFACE

The 3rd FIRST 2019 (Forum in Research, Science, and Technology) International Conference was initiated and organized by State Polytechnic of Sriwijaya in collaboration with Management and Science, University (MSU), Malaysia and National Chin-Yi University of Technology, Taiwan. The theme of the conference was "Integration of Advanced Technology to Enhance Social Welfare". The 3rd FIRST 2019 International Conference facilitated the participants from all over the world to meet face to face to open chances in establishing connection and collaboration among them. It was not only for the researchers in academics, but also in industries and governments. This conference became an effective media to link the researchers from many parts of the world conference, for exchanging, sharing, following up and discussing the results of the latest research, industry's needs, and government regulatory policies. The 3rd FIRST 2019 International Conference became worthwhile platform for researchers to present their finding in the areas on multidisciplinary of Engineering and Science (Track 1), Computer Science and ICT (Track 2), and Social Science (Track 3). It has also provided an opportunity for the professionals and researchers to learn and share about the latest development and research in those 3 tracks.

The 3rd FIRST 2019 International Conference attracted so many authors not only from Indonesia but also from other countries, such as Japan, Taiwan, and Malaysia. There were 180 papers were accepted in the 3rd FIRST 2019 International Conference, including 89 papers for Track 1 (Engineering and Science), 46 papers for Track 2 (Computer Science and ICT), and 45 papers for Track 3 (Social Science). In The 3rd FIRST 2019 International Conference, there were 4 keynote speakers and 2 invited speakers. As the keynote speakers, there were Prof. Yasushi Kiyoki, Ph. D from KEIO University, Japan, Prof. Nurul Taufiqu Rochman, M. Eng, Ph. D, From LIPI, Indonesia, Prof. Tjiptohadi Sawarjuwono, M. Ec., Ph. D., Ak, from Universitas Airlangga, Indonesia, and Prof. Win-Jet Luo, from National Chin-Yi University of Technology, Taiwan. As the invited speakers, there were Dr. R. Wisnu Nurcahyo, DVM from Universitas Gadjah Mada, Indonesia, and Assoc. Prof. Dr. Intan Zaurah binti Mat Darus from Universiti Teknologi, Malaysia. The 3rd FIRST 2019 International Conference committee would like to say thank you very much for all the participants and their respected institutions that have supported for the success of the 3rd FIRST 2019 International Conference, and also forall of the guess and sponsors of the 3rd FIRST 2019 International Conference.

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Modification of Starch from Taro Tubers with Hydrolysis Acid As the Adhesive

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Abstract. The use of Starch from Taro tubers as an adhesive raw material is done by hydrolyzing talc of Taro Tuber into dextrin using Chloride Acid (HCl) as the catalyst. The variables involved in this research are temperature and hydrolysis time whence the variations of temperature are 80ºC, 100ºC, 120ºC, and 140ºC also for the duration of hydrolysis time are 10, 20 and 30 minutes. The variations of temperature and time can affect the nature of dextrin produced. The analysis parameters include swelling power, solubility, dextrose equivalent (DE) and water content. The hydrolysis of taro tuber starch is then added with sodium bicarbonate ($NaHCO_3$) and formaldehyde solution (CH_2O). The mixture is added with some water and heated to a temperature of 60ºC to form a homogeneous mixture. After the Dextrin Glue is formed, the process is continued by analyzing the adhesive power of the synthesized gluten. From the research's outcome, knowing that the optimum condition of adhesive was at 80ºC and 30 min of hydrolysis time also the analysis number of swelling power is 2.27, along with 1.7% solubility, dextrose equivalent 3,523%, moisture content 14% and the adhesion 283,84 N/cm^2.

1. Introduction

Taro is one of the plants that contain high levels of starch in the tuber. Level of starch in 100 grams taro tuber equal to 67,42%. The others consist of amylose equal to 2,25% and amylopectin is 65,17% [1]. The high content of amylopectin in taro starch is one of the reasons why taro starch is used as raw material for making the adhesive. Compared to the other starches, taro starch has the advantages such as abundant availability and the price is cheaper than the other starches which they have high content of amylopectins like glutinous rice with its 0,56% amylose and amylopectin 62,75% or tapioca starch that is having amylose content about 5,26% and amylopectin 60% [2]. Also, taro talc has a small granular size, which is about 0.5-5 μm while the sticky starch 5 μm and tapioca talc is 20 μm. [3]. The small size of the granules can help the effectiveness of the adhesive homogenization process. This research is going to discuss the process of the modification of taro tuber starch by hydrolysis process using Chloride acid (HCl) hence the product will be used as the adhesive dextrin, thereby increasing the use-value for taro tuber.

Hydrolysis of starch occurs between a starch reactant and a water reactant. The reaction of starch hydrolysis aims to cut a saccharide polymer bond of starch with the aid of a particular compound as a catalyst, in this study using HCl as a catalyst. The difference in hydrolysis duration will cause the amount of modified starch to become different. The longer the hydrolysis time, the greater the percentage of starch that turns into reducing sugar. This can be seen from the increasingly higher values of DE [4].

Talc-based adhesives mostly come from plants such as corn, potatoes, cassava, sago, wheat, rice, soybeans. Chemically, the processing of talc has the same element that is cellulose (C6H10O5) n. When the talc is processed in hydrolysis, the amylase changes its properties to colloidal and then forms a paste. This property is called gelatinization, which is formed due to the rising temperature that can provide a sticky property on the surface of the material. Dextrin from starch can be used as the wood adhesive, the adhesive is made from taro talc hydrolysis with HCl, then added NaHCO3 and the addition of formalin as the hardener [5]. Increasing the temperature will cause the reaction to occur quicker, but to some extent, it can impact a reduction of the adhesive's strength. According to [6], the reasonable limit for most adhesives is about 70ºC.

In Indonesia, it still uses synthetic adhesives or resin such as urea-formaldehyde, phenol-formaldehyde and melamine-formaldehyde in which obtained from petroleum. Therefore, the adhesive of natural raw material is expected to reduce the dependence of adhesive on the production of petroleum that the number is decreasing.

Moreover, there are several reasons why natural adhesives or adhesive-based dextrin is better than synthetic adhesives or commercial adhesives: abundant raw materials, cheap price, and stable quality, Adhesion toward the cellulose and other substrates are splendid, insoluble in fats and oils, non-toxic and biodegradable, as well as heat resistant. Inward this study aims to optimize the utilization of taro tubers.

2. Experimental Procedure

The materials used are taro tuber, Chloride Acid (HCl), Sodium bicarbonate ($NaHCO_3$), Formaldehyde (CHO), Fehling A and Fehling B solutions, standard glucose and Methylene blue

The equipment used are beaker glass, Erlenmeyer flask, Burette, water bath, spatula, stirrer rod, three-neck flask, measuring flask, measuring glass, measuring pipette, rubber ball, watch glass, test tubes, analytical balance, oven, desiccator, Shear stress testing machine, 200 mesh screen and centrifuge tubes.The equipment

Preparation of Taro Starch as Raw Materials [5]

The taro tuber is peeled off and washed thoroughly. Soak tuber taro with salt water for 24 hours to relieve itching on taro tuber. The taro tubers that have been soaked are cut into small chunky pieces and then drained. The taro tuber is then shredded so that the fine slurry is formed and the distilled water is added 1/3 of its weight and then filtered with a flannel cloth and squeezed until its water is discharged, repeat until it is obtained clearly. The mixture is precipitated for 24 hours, after precipitating, the residual liquid is removed to obtain the deposition of starch. Then the deposit is dried in the oven at 40ºC for 24 hours. The dried starch is mashed and sieved with 80 mesh size.

Modification Process of Starch with Acid Hydrolysis [5]

A total of 40 grams of taro starch in hydrolysis is put into the porcelain plate then adding 20 ml and 0.6 N of chloride acid catalyst, the talc was heated to some varying temperature (80ºC, 100ºC, 120ºC, and 140ºC) while the reaction time was varied for 0, 10, 20, and 30 minutes. When the hydrolysis process is done, the talc changes color to gray or brown, its result is rinsed with water after it is dried at room temperature and being granulated. Next, sodium bicarbonate as much as 0.025 grams and 2 ml of formaldehyde solution are added to 20 grams of hydrolysis dextrin, and cold water, then stir to form a paste. The mixture is re-added with water and heated at 60ºC and then stir until the mixture is homogeneous. Analysis parameters consist of moisture content, solubility test, swelling power a total dextrin content, while for the adhesive is the shear strength test.

Swelling Power Analysis [7]

A total of 0.1 g of hydrolysis starch is dissolved in 10 ml of non-mineral water. The solution was heated to 60°C in a water batch for 30 minutes with continuous stirring. Centrifuge the solution at 2500 rpm for 15 minutes. Pasta is separated from its supernatant and weighed its weight. Calculation :

$$Swelling\ Power = \frac{\text{Weight of pasta}}{\text{Weight of dry sample}} \quad (1)$$

Solubility Analysis [8]

As much as 1 gr of hydrolysis starch is dissolved in 20 ml non-mineral. The solution is immersed in a 60°C water bath for 30 minutes with continuous stirring. Centrifuge solution at 3000 rpm for 20 minutes. The supernatant is taken as much as 10 ml then it's dried at 105°C in the oven. Its dry supernatant is weighed. The calculation :

$$\%\ \text{Solubility} = \frac{\text{Weight of dry sample}}{\text{Supernatant volume}} \times 100\% \quad (2)$$

Analysis of Glucose Level

Samples of hydrolyzed yields of 2.5 grams are dissolved in 25 ml non-mineral water. The solution after being stirred is then filtered, the filtrate is added with as much as 5 ml each of Fehling A and Fehling B then titrated with standard glucose in boiling state. Add the indicator of methylene blue as much as 2-4 drops. Titration is stopped when there has been a change of color from blue to red.

$$\%\ \text{Dextrin} = \frac{\text{Total glucose - Free glucose}}{\text{Dry Sample}} \text{ x } 100\ \% \quad (3)$$

Moisture Content Analysis

The empty plate and lid are dried in the oven for 15 minutes and chilled in the desiccator for 10 minutes then weigh 5 grams of starch samples that have been hydrolyzed. Put the sample into the plate and heated in the oven for 15 minutes, avoid the contact between the plate and the oven wall. Chill the saucer and sample into the desiccator, next weigh the sample with the plate after the heating process. Repeat the procedure until it reaches a constant weight, the difference between sample weight before and after heating is the amount of moisture content vaporized.

$$\%\ \text{Water} = \frac{\text{Weight of sample before heating - Weight of sample after heating}}{\text{Weight of sample before heating}} \text{ x } 100\% \quad (4)$$

Determination of Adhesive Glue

Apply dextrin glue to the bar of the wood with 2.5 x 2.5 cm^2width. Put the wood's ends off of the shear stress testing machine. Note the shear upon the test of dextrin glue's adhesiveness. *The calculation:*

$$\text{The adhesive shear stress} = \frac{\text{Friction (kg)}}{\text{Adhesive bond area } (cm^2)} \quad (5)$$

3. Results and Discussion

Swelling Power is defined as the enhancement volume and maximum weight of starch inner water, when the cold water is poured into the starch, its granules will absorb water and swell [9] Swelling power is the power of talc to expand. Factors that influence include a comparison of amylose and amylopectin, length of chain and molecular weight distribution [10]. The higher the swelling power, the starch ability to absorb water will be higher. The rising temperature and duration of heating time will affect the value of the swelling power of starch produced. Based on the analysis of some variations of temperature and hydrolysis time can be seen the effect on the value of swelling power in figure 1.

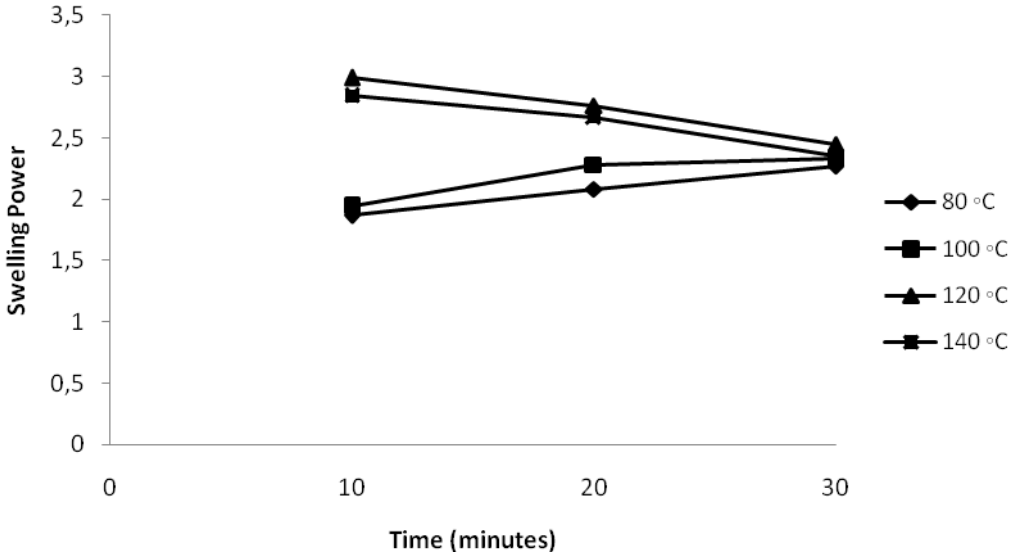

Figure 1. Effect of Temperature and Time on Swelling Power

Figure 1 shows that and the control starch having a swelling power value of 1.23 will increase the swelling power value after modification. Figure 1 gives information that when the temperature raises from 80ºC to 100ºC, the swelling power will increase, as the temperature is raised from 100ºC to 120ºC. But, this does not happen when the temperature is raised from 120ºC to 140ºC, because there will be a decrease in swelling power.

This also occurs at the time of hydrolysis of 20 and 30 minutes. This is caused by the influence of temperature, [11] states that the higher temperature causes the value of swelling power increases. Increasing the temperature from 80ºC to 100ºC will increase the reactivity of HCl as the catalyst, the increase of starch heating temperature causes amylopectin content to extend where the amylopectin is in the amorphous region of starch granules. [12] states that the amorphous region is a tenuous area so it is easy to absorb the water. The more amylopectin contained in the starch, the sprawling area will be wider so that the water absorption will get bigger. Likewise the temperature raises from 100ºC to 120ºC, when the temperature raises from 120ºC to 140ºC, the starch will relax. This because, when the heating process is accomplished at temperatures above 120ºC, HCl as catalyst will evaporate, where the boiling point of HCl is 120ºC, [13]. Consequently, the ability of starch to produce amylopectin will decrease, the decreasing amylopectin level impacts to swelling power value that will decrease too. However, in the evaporation of the catalyst, the maximum temperature will destruct the structure of the starch itself. According to the Arrhenius equation, the high temperature will cause the process to react faster, which means the higher the speed of the product can be formed. The hydrolysis reaction starch:

$$(C_6H_{10}O_5)\ n \rightarrow nH_2O + nC_6H_{12}O_6$$

According to Mastuti (2010), if hydrolysis takes place at maximum temperature, the conversion will decrease. This is due to the presence of amylopectin which can be broken into charcoal (the color of the resulting solution gets darker). Figure 1 gives information that in addition to temperature and time can affect the value of swelling power. It can be seen that the value of swelling power at a temperature of 80^0C to 100^0C and temperature 100^0C to 120^0C will increase, while at 120^0C and 140^0C will decrease as hydrolysis time increases. According to [13] the longer the hydrolysis time, the greater the conversion is. Till the limit of a certain time, it will obtain a relatively high conversion and if the time is extended, the conversion's increment is low. From the influence of temperature and time is figured out that the optimum condition for the highest swelling power value is at 120^0C and 10

minutes which result number is 2.99. Based on the research's outcome, the swelling power value for dextrin is 3,629 - 5,966. This study shows that the value of swelling power produced is lower than previous research. Due to the hydrolysis process in research [14] using heat moist (Heat Moisture Treatment) is making the temperature rose higher, whereas this research process of hydrolysis only uses hotplate.

Solubility is the ability of a particular substance (solute) to dissolve in a solvent. The solubility of a substance is the maximum amount of solute that dissolves in a solvent. In this case, the solute of starch will be dissolved in a certain volume of water. The substances may dissolve in any ratio to a solvent, for example, ethanol in water. The more the amount of solid that can be dissolved by water then the value of its solubility will be higher. The increase of temperature and time during the hydrolysis process will affect the modified starch product. Figure 2 below can be seen as the influence of temperature and the duration of hydrolysis time to the solubility value of dextrin product. Dextrin is the result of hydrolysis starch into sugar by heat, acid or enzyme. Hydrolysis aims to reduce the length of the chain structure on starch, the reduction of the chain's length will lead to a change in properties where the water-insoluble starch is converted to easily soluble dextrin. Dextrin is eminently soluble in hot or cold water, with relatively low viscosity [15].

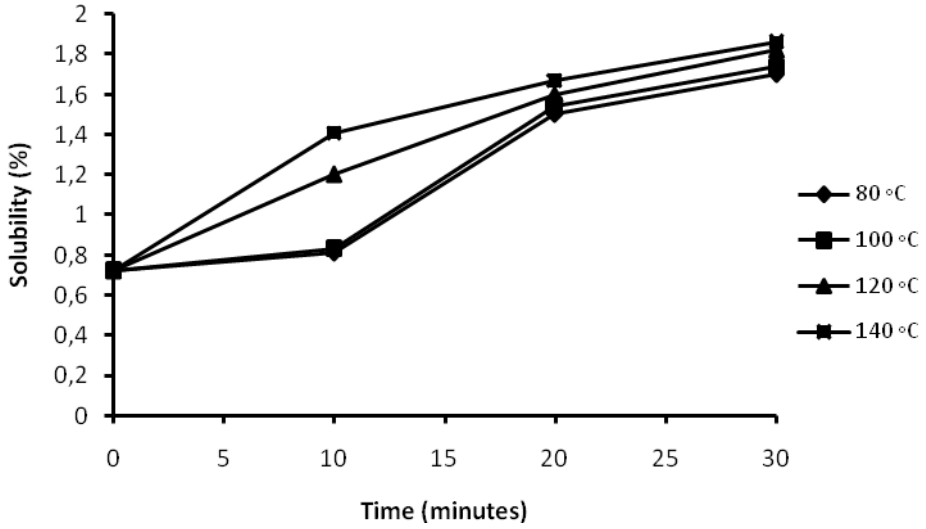

Figure 2. Effect of Temperature and Time on Solubility

Figure 2 shows that the control starch is having 0.72% solubility that will increase the solubility value when the initial starch has 0.72% of solubility. Figure 2 gives information that the starch solubility is directly proportional to temperature, the higher the temperature the solubility value will increase. According to the Le Chatelier principle, if the dissolution process is endothermic, then the solubility will be increasing at higher temperatures. So as a result of the hydrolysis process that requires heat coupled with the enhancement of temperature, the starch solubility will increase. By following with the statement of [16] that compared with the original starch, modified starch has different properties that one of which is the increased solubility in hot water. According to [17], that is because the hydrolysis process degrades the granules and cracks the chain of starch's compound to be shorter. So there is a decrease in the type of weight that causes the dissolving process will be faster and the solubility value gets higher. In this case, that is the effect of the temperature on the solubility value.

Figure 2 also shows the effect of time on the solubility value, the longer the hydrolysis time the higher the solubility value is. This is in by following with the statement by [18] Utumphorn et al

(2010) that Hydrolysis of starch causes the sizes of the molecular particles are decreased, unlike the solubility which increases, so that the longer the hydrolysis, the smaller the molecular size is, the lower the solubility increases. Based on research conducted by Haryani (2015) that the modified starch with the aid of acid has a solubility between 0.5-4%, it indicates that the solubility value in this study is lower than the research conducted by Haryani (2015). From this research, the highest solubility value is 1,86% at 140^0C along the time of 30 minutes. Based on SNI 01-2593-1992, the solubility of dextrin is at least 97%. This study shows that the solubility of dextrin is far below standard. This is due to the less maximum heating temperature, so the heat generated is not able to destruct the structure of the starch granules more and increase its solubility.

Dextrose Equivalent (DE) is a quantity stating the total value of starch reduction or starch modification product in percent units. The greater the DE means the greater the percentage of starch that turns into reducing sugar. Dextrose Equivalent (DE) is inversely proportional to the average molecular weight. The amount of dextrin produced increases the Dextrose Equivalent (DE). Dextrin is a product of the imperfect hydrolysis of starches using acids or enzymes. According to [19], Dextrose Equivalent can be expressed in percentages of 1-100%, in which the dextrin has a DE value of 1 - 13% by using acid or enzyme α - amylase. Factors affecting the Dextrose Equivalent (DE) values are the duration of hydrolysis time, varied temperatures, type and concentration of acids used. To determine the value of DE, the dextrin is produced in the analysis by the volumetrical method. Figure 3 below shows the effect of temperature and hydrolysis time on the value of Dextrose Equivalent produced.

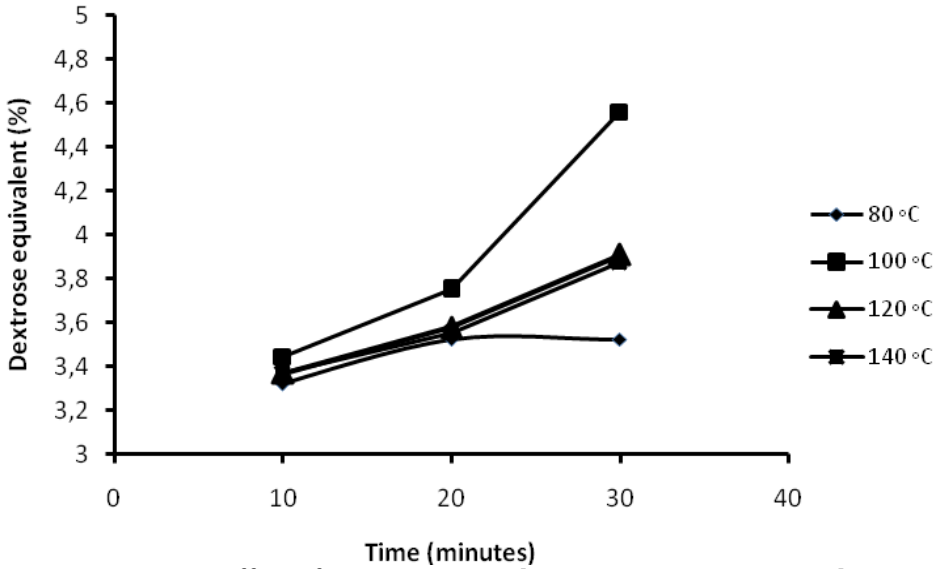

Figure 3. Effect of Temperature and Time on Dextrose Equivalent

In the figure 3 is obtained that at hydrolysis time of 10 minutes when the temperature is increased from 80^0C to 100^0C, there will be an increase in the value of DE, but when the temperature raises from 100^0C to 120^0C, there will be a decrease in the value of DE similar to the temperature that raises from 120^0C to 140^0C withal hydrolysis time of each 20 minutes and 30 minutes. This confirms the nature of dextrin, each 10^0C raising temperature, the reaction has enhancement inactivity of 50-100%. The high temperature affects to the enhancement reaction so that the speed of dextrin formation is higher also the Dextrose Equivalent (DE) increases. But when the hydrolysis process over the maximum conditions, then the resulting dextrin formed will decompose into glucose, consequently its DE value decreases. This is consistent with [20], that to obtain dextrin from starch by using an acid catalyst at atmospheric pressure, the heating temperature is between 70-130 °C.

At the hydrolysis time of 20 minutes, the percentage of DE at each temperature such as at 80^0C gives the outcome 3.523%, at 100^0C equal to 3.750%, at 120^0C equal to 3.577%, and 140^0C equal to 3.550%. At the time of 30 minutes hydrolysis is figured out that the value of solubility at the temperature of 80^0C equal to 3.523%, at 100^0C equal to 4.599%, at 120^0C equal to 3.908% and at the temperature of 140^0C, the number of DE is 3.875%. From figure 3, besides the effect of temperature on Dextrose Equivalent, there is the hydrolysis time influencing the value of DE. Figure 3 shows that the increase of hydrolysis time causes the value of DE will get higher, this is due to the longer hydrolysis time in converting the starch into Dextrin. In accordance with the statement of [21] that in addition to the rising temperature, the duration of hydrolysis time will also increase its DE value. According to [20] that the optimal time for the process of starch hydrolysis by using acid catalyst at atmospheric pressure 1 atm equal to the heating temperature ranges between 70-130^{o}C and heating time between 3-30 minutes. Based on research conducted by [22] dextrin produced from the hydrolysis process has Dextrose Equivalent value ranges between 4-10%. From research, the highest DE value obtained is 4.599% a temperature condition of 100^0C and 30 minutes hydrolysis time.

Based on [23], DE values for dextrin ranged from 4.69 to 10.23%. This research indicates that the value of DE is lower than that of Chafid (2010), this is because [23] used enzyme as a catalyst in the hydrolysis process while in this study only use an acid catalyst. According to SNI 01-2593-1992, the maximum DE value for dextrin is 5%, it indicates that the results of this study approximately reach the standard of maximum dextrin product because the resulting dextrin product has a value of DE between 3.321 to 4.559%.

Water is a significant component of dextrin because water can affect the nature of dextrin. In this research, water content analysis based the dry method is using an oven. The principle of a dry method using the oven is to dry the sample in an oven at 10^0 - 105^0C to a constant weight also the difference between initial and final weight is the amount of the moisture content contained in the material. Its maximum temperature and the duration of the hydrolysis process will affect the water content contained in the dextrin product. Below we can see the effect of temperature and time on the water content contained in dextrin shown in Figure 4.

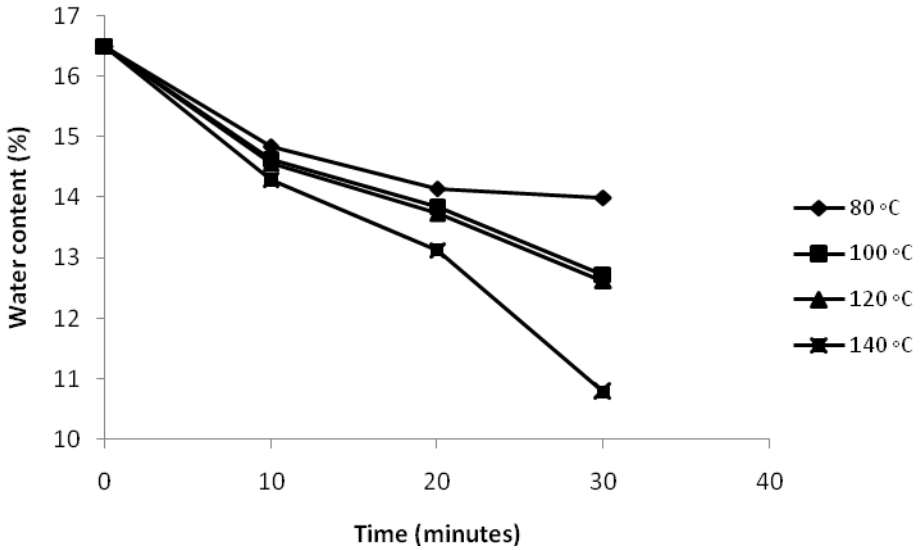

Figure 4. Temperature and Time on Water Content

Figure 4 provides information that there is a decrease in water content due to the temperature effect, the starch has a water content of 16.5%. Within 10 minutes, when the starch is modified at 80^0C, the water content is 14.85%, while at 100^0C, its water content equal to 14.64%. At 120^0C, the

moisture content equal to 14.64% and at 140^0C is 14.29%. Figure 4 gives information that the higher the hydrolysis temperature, the water content will decrease. This is by following previous research by [5], the analysis of water content concludes that water percentage decreases as hydrolysis temperature increases. This can happen, among others, because the water is more volatile if the temperature is raised. Within 20 minutes and 30 minutes when the temperature is increased, the water content also decreases. Based on SNI 01-2593-1992, the quality requirements of dextrin moisture content contained within the maximum of 11% dextrin. This study shows that the water content contained in dextrin is between 10.78% -14.85%, it does not reach the standards because it exceeds 11%, this can be due to the draining process of dextrin that is less long so that the water content contained in dextrin will extend.

Figure 4 shows that the effect of time on water content, it concludes that the longer the heating time is, the water will be more evaporated so that the water contained becomes less [5]. Water content is one of the indicators in choosing the quality adhesive. Compare to a thermoplastic adhesive, when it's too dry, it can be wet, by using a solvent, or heating to the melting point. Adhesive specimens may be disconnected if there is mechanical stress in the presence of water or other wetting agents, therefore moisture content should be taken into account in the use of adhesives. The strength of the adhesive will decrease when the water content is maximum or minimum. From this research figured out that the lowest water content value at 140^0C along the time 30 minutes.

The tensile strength is the maximum voltage that a material can stretch at or be stretched, before it is broken, in this case, the adhesive's ability to resist the force given to the adhesive surface area applied to the wood surface where both kinds of wood glued between their surfaces of 25 cm^2 until both surfaces are released. The tensile strength can generally be searched by conducting tensile tests and recording strain and stress changes. The dimension of tensile strength is the force per unit area. In this study, the adhesive is made by using the raw material of dextrin, the product resulting from the modification of starch. The starch is modified with temperature and time variations so that the dextrin product's properties differ from each other. The different properties of dextrin raw materials give the adhesion of the dextrin glue also differs, which means that temperature and time can affect the adhesiveness of the glue produced.

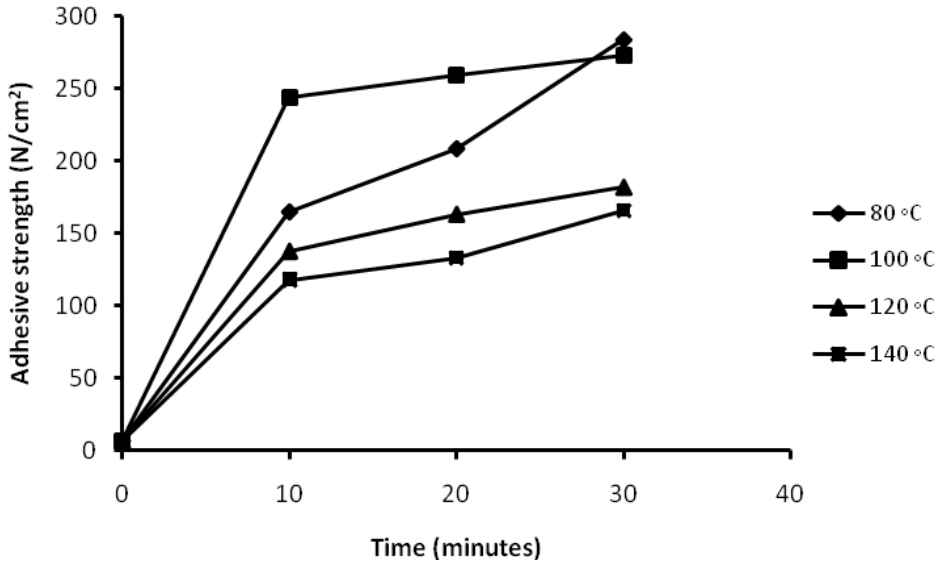

Figure 5. Effect of Temperature and Time on Sticking Power

Figure 5 shows the effect of temperature and time on the adhesive strength of the dextrin. Compared with the original starch, the modified starch has better adhesion. Figure 5 shows that hydrolysis time has a role in the synthesis of adhesive in causing the increase of adhesive power. This can be due to the higher temperature, the greater the kinetic energy of adhesive molecules is. The reacting molecules become more active in collisions. Raising the temperature will cause the reaction to occur faster, but to some extent can cause the adhesive can be reduced strength.

According to [6]. The higher the temperature and the longer the time, the yield of dextrin product will get higher to a certain extent, yet after that there is a decrease in the value of dextrin because, at too high temperature and time, the dextrin product may decompose into glucose which has sticky properties that are not good compared to dextrin. From this research, the highest adhesive power is 283,84 N/cm^2 (28,94 kg /cm^2) which is at temperature condition 80^{0}C with time 30 minutes. As the synthetic glue is used to be a comparison, to determine the quality of the adhesives produced from the research. Based on research accomplished, the synthetic glue has adhesive value of 275,44 N/cm^2 (28,09 kg/cm^2) while adhesive with optimum adhesion from result of research equal to 283,84 N/ cm2 (28,94 kg/cm^2) which means the adhesive at the optimum condition of the research's outcome has better adhesion than the synthetic glue. Based on research conducted by [5] adhesive produced from dextrin has adhesion of 7-14 kg / cm^2. This study shows that the adhesive of dextrin produced by following with SNI 06-4567-1998 which states that quality adhesive for wood should have the adhesion of more than 10 kg/cm^2 so that this dextrin adhesive has finer adhesion than previous research by [5].

This study shows the effect of Swelling power, solubility, Dextrose Equivalent and water content on of dextrin glue. The adhesive is at an optimum temperature of 800C with a hydrolysis time of 30 minutes. From the research, DE value at optimum condition is 3,523 which is including the highest DE value. The higher DE Value, hence the amount of dextrin produced will get more enormous. The ascending value of DE causes enhancement of adhesive power, this is according to [23] that the conversion of starch turns to dextrin is directly proportional to the adhesive power of the glue paste resulted, since dextrin has higher adhesion than the original starch.

Besides the value of swelling power and solubility in this condition including the highest, it means the higher the swelling power value hence the adhesive power will increase. This is because the greater the ability of dextrin to be expanded, the greater the surface counter area between adhesive dextrin and wood surface, while solubility indicates that the adhesive force is directly proportional to the solubility value. This is due to the increasing of dextrin content by following the statement of [16] that compared with the original starch, the modified has different properties one of which is the ease of solubility to increase. As for the influence of moisture content on the adhesive power indicates that the moisture content for optimum adhesion is water content of moderate amount, it is by following with the statement of [5] that the adhesive specimen may be interrupted if mechanical stress is applied when there is water or other wetting agents. As the optimum condition is having water content 14% with adhesive power 283,84 hence the Swelling power, solubility, and DE value will be proportional to adhesive power with resultant glue of dextrin.

4. Conclusion

The effect of hydrolysis temperature on the properties of the resulting product is: the higher the temperature then the value of swelling power, solubility and dextrose equivalent will be higher, while the water content will decrease. The effect of hydrolysis time on the product produced is: the longer time then the swelling power, solubility, and dextrose equivalent will be higher, while the water content will decrease. The higher the swelling power, solubility, and dextrose equivalent the higher the adhesive glue of dextrin. The optimum condition for adhesive glue of dextrin glue was in condition 80^{0}C with time 30 minutes, and the result of analysis have swelling power value 2,27, solubility 1,7%, dextrose equivalent 3,523%, water content 14% and adhesion 283,84 N/cm^2.

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