

PHYSICAL CHARACTER OF POLYLACTIC ACID MATERIAL

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ABSTRACT

Exploration is known as one method that can be used to get new results. With exploration, object research could have various options in its applications, Material US something elements that can produce something form Becomesreal. Could presenting something object not only in the form of imagination courses. With the presence of materialin making something objects, then by no direct can also produce scrap materials. Because in something the processesardused materials are generated because of existing advantages or the remainder of the materials used. Polylactic Acid is a material applied to the production of the nature of things diverse. The diversity that, can give influence the amountof the object produced, so in development, the problem that exists is that there is a PolyLactic material that is the remainder results of the production process. The waste material is faced with the problem of material being reused. Due to PolyLactic material, Residual acid production has the opportunity to be reused as material for an object. PolyLactic material exploration Acid is used for knowing new opportunities from the existing use of the materialas materials that can be used by maximum. With the use method study qualitative description, hope study could give results as guidelines in something method use of PolyLactic materials Acid with produce forms and characteristics that can be maximized for its application to an object. Based on the expertise of research partners, resulting in conformity with the research carried out because of the partner's experience in using PolyLactic materials Acid in producing objects can be an added value because it can help identify PolyLactic materials Acidmaximally.

Keywords: *Exploration, Material, Physical, PolyLactic Acid, Used, Wear.*

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A. INTRODUCTION

There are various kinds or types of materials that have been applied to support human activities today. The activities carried out can be individually or in groups which can be interpreted more broadly in the industrial context (Suharto, 2005: 20) . The application of materials or materials is also adjusted with the characteristics or properties of the material. And in its development, the material is one of the components that must exist in an object or can also be interpreted as the substance from which something is made. Therefore, the material element is one of the important elements because each object must also be considered material.

Material is known as anything that has mass and occupies space. And in its application, the material is an object that is used to compose an object that is applied and used for an engineering and design process in the field of engineering. (Supriyanto, 2020: 25) . Material is present as one of the elements in science that must be owned and studied. Because with material science, the material can directly influence various decisions and processes to the realization of the production of an object. Because with knowledge about materials, one can understand the characteristics of a material which can be taken into consideration when making objects and even producing.

PolyLactic Acid or simplified as PolyLactic Acid is known as a thermoPolyLactic Acid polymer material used in the production process using a 3D Printer. It is known that PolyLactic Acid has its characteristics to be applied to commodity materials and products in everyday life, such as packaging materials, coating materials, fibers, and others. And along with the development of the use of *PolyLactic Acid*, the production of PolyLactic Acid can be fully produced by biological activity from renewable resources. Because it is not uncommon for 3D printer users to use this material as a material that is easy to find and apply.

B. METHODS

The method used in this research will refer to the qualitative descriptive method. Qualitative method because it is a particular tradition in social science which fundamentally depends on observing humans on their terms and relating to these people in their language and their events. (Mohr, 1999) . The qualitative method is used to examine the condition of natural objects, (as opposed to experimentation) where the researcher is the key instrument, the sampling of data sources is carried out purposively, and *snowballing*, (Yusuf et al., 2020) technique of collection by triangulation (combined), data analysis is inductive or qualitative and the results of qualitative research emphasize meaning rather than generalizations . . Qualitative is a method that uses an investigation that explains the condition of an object in a social influence by taking data. While descriptive is explained as a way of collecting data in the form of words, pictures, and not numbers, it is a type of descriptive qualitative data collection. All the data collected is the key to what has been researched. And in the research conducted, qualitative descriptive methods are used to determine the value of independent variables in the form of physical exploration of used materials from PolyLactic Acid so that their characteristics can be known without making comparisons or combining other materials.

The data processing method used is the triangulation method. Triangulation is the most commonly used method of checking the validity of data. This method is done by utilizing something other than the data for checking or as a comparison against the data. If the researcher collects data by triangulation, then the researcher collects data while testing the credibility of the data, namely

checking the credibility of the data with various data collection techniques and various data sources.

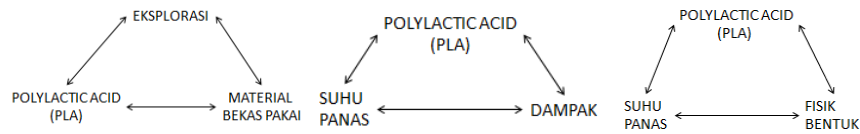


Figure 1. Method of processing triangulation of used PolyLactic Acid physical exploration

The triangulation applied to this research will focus on the main part of the research, namely the physical exploration of used PolyLactic Acid materials. And in the exploration carried out, certain heat temperatures will be used to determine the impact resulting from its application. Not much different from the previous process, the impact of the hot temperature carried out in the physical exploration will refer to the physical/form that will be produced.

C. RESULTS AND DISCUSSION

Polylactic Acid is a "biodegradable polymer" or polymer that can be decomposed by the action of living organisms, such as microbes, into the water, carbon dioxide, and biomass. . Currently Polylactic Acid has been used as a polymer material in environmentally friendly packaging applications and developed into biodegradable Polylactic Acids. What can be described as a Polylactic Acidstic material that can be biodegraded (by the activity of microorganisms) in the environment.

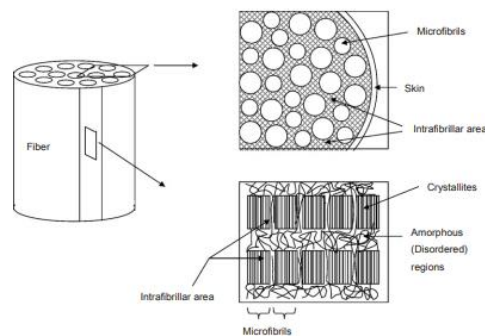


Figure 2. Structure of Polylactic Acid

Poly lactide is known as one of the biodegradable polymers because of its mechanical properties profile, thermoPolyLactic Acids process capability, and biological properties, such as a material that can get the right biological response when applied to the human body (biocompatibility) and can be broken down by enzymes produced by living organisms. (biodegradability).

The biocompatibility of Polylactic Acid can be extended to its ability to be applied to the human body such as prosthetic devices, polylactic Acid, vascular grafts, catheters, sutures, and ligament repair materials. In addition, the presence of biodegradability allows Polylactic Acid to combine

with other materials to make other composite properties in terms of developing what substances are engineered to interact with biological systems (biomaterials).

As a polymer material, PolyLactic Acid is different from other thermo polylactic acid polymer materials such as Polyethylene (PE) or Polyvinyl chloride (PVC). This is because PolyLactic Acid comes from renewable resources such as corn starch or sugar cane. In addition, it is not uncommon for PolyLactic Acids to come from the distillation and polymerization of non-renewable petroleum reserves. So that PolyLactic acid can be included in the category of "a type of environmentally friendly PolyLactic Acids, that can be decomposed by microorganisms (bioPolyLactic Acids).

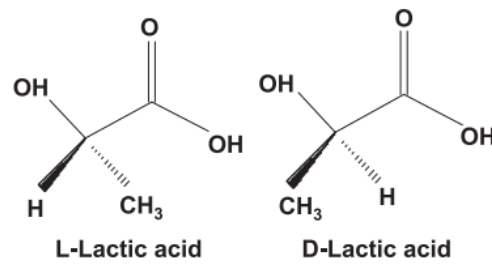


Figure 3. Types of PolyLactic Acid

Currently, there are several types of PolyLactic Acid which are broadly divided into 2 types, namely PLLA (Poly-L-lactic Acid) and PDLA (Poly-D-lactic Acid) and each type has slightly different but similar characteristics because it is produced from natural sources. renewable power as opposed to traditional PolyLactic Acids derived from non-renewable petroleum. It is described that PLLA is a “semi-crystalline” polymer or described as A PolyLactic Acid in the mixed crystalline state. And the content of the crystal determines the physical or part properties, while PDLA is a polymer without a melting point. In addition, the rate of degradation (degradation) of PLLA is slower than that of PDLA, due to the presence of crystalline regions.

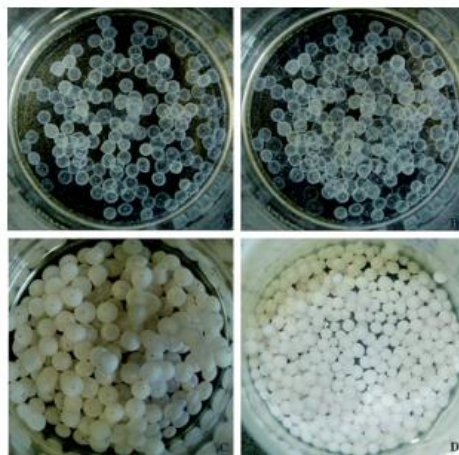


Figure 4. PolyLactic Acid is PolyLactic Acid with crystal elements

PolyLactic Acid as bioPolyLactic Acid is explained by the fact that it is explained that it degrades naturally when exposed to the environment. This is exemplified in a case where an object made of PolyLactic Acid will be damaged within six to 24 months. This will be inversely proportional to conventional PolyLactic Acids which in the same environment take longer to decompose. And as a plus, although the ability of PolyLactic Acid decreases when exposed to natural elements for a long time, PolyLactic Acid Material has the strength to be applied under normal conditions.

- Characteristics of PolyLactic Acid

PolyLactic Acid is known to be biodegradable and has characteristics that can be produced from existing manufacturing equipment such as industrial PolyLactic Acids. This makes the production cost not much different from the production of PolyLactic Acids such as Poly-ethylene (PE) and Polyvinyl chloride (PVC). With this development at this time, PolyLactic Acid has the second-largest production volume in the category of bioPolyLactic Acids

There are many applications of PolyLactic Acid. Currently, there are several uses for this material and the most common include PolyLactic Acidtic films, bottles, and even biodegradable medical devices such as pins, rods, and plates which are expected to biodegrade in 6-12 months but in mixed conditions. other forming materials.

Table 1. General properties of PolyLactic Acid

| No | Property | Score |
|----|------------------------------------|--|
| 1 | Technical Name | PolyLactic Acid(POLYLACTIC ACID) |
| 2 | Chemical Formula | (C ₃ H ₄ O ₂) _n |
| 3 | Melting Temperature | PLLA: 157 - 170°C (315 - 338°F) ** |
| 4 | Typical Injection Mold Temperature | PLLA: 178 - 240°C (353 - 464°F) ** |
| 5 | Heat Deflection Temperature (HDT) | 49 - 52 °C (121 - 126 °F) at 0.46 MPa (66 PSI) |
| 6 | Tensile strength | PLLA: 61-66 MPa (8840-9500 PSI) *** |
| 7 | Flexural Strength | PLLA: 48 - 110 MPa (6,950 - 16,000 PSI) *** |

From its characteristics, PolyLactic Acid is often used as a packaging material. This is because there is an ease with which PolyLactic Acid can be melted. In addition, for some applications, it is used as the main material of 3D printing (3D Printer). But on the one hand. Because it is easy to melt or change shape due to hot temperatures, PolyLactic Acid is very rarely used for activities that use

hot liquids. Like glass products.

As an applied material, it is known that PolyLactic Acid has a relatively low transition temperature (typically between 111 and 145°F). This makes the material unsuitable for high-temperature applications. Even in certain cases, such as applying to a hot room during the summer, it can cause the components to soften and deform. In addition, in the application as a prototype of a product, PolyLactic Acid is more fragile in terms of strength when applied to products that focus on the weight content of objects that have a weight value.

In addition, PolyLactic Acid as a renewable material has other values from PolyLactic Acid as a material as well as environmental issues through reducing carbon dioxide emissions compared to conventional petroleum-based commodity PolyLactic Acids because it helps with the fixation of significant amounts of carbon dioxide. In addition, from its characteristics, the material can adjust its physical properties by modifying the material. As can be developed to be harder or softer. The final result is that the melting point will adjust to the mixed material

- Use of PolyLactic Acid

As a material, PolyLactic Acid was developed to be used, in this case directly or through processing. Currently, polylactic acid is one of two plastics commonly used in Fused Deposition Modeling or 3D Printing machines and is available as a 3D printed filament. PolyLactic Acid in its application to 3D printers as a filament for 3D printing is used under certain conditions according to its capacity as the main material for product prototypes. Because according to its condition as the lowest plastic material from other plastic filaments, polylactic acid is used only for the application of lightweight products. And it will be used for low temperatures. So it is not uncommon to use it to make production molds. Because in terms of stiffness, the material can represent the manufacture of product molds. One of the interesting things that can be done with PolyLactic Acid in 3D printers is called a process where PolyLactic Acid is printed in the form of a cavity so that it can be filled often with a liquid material.

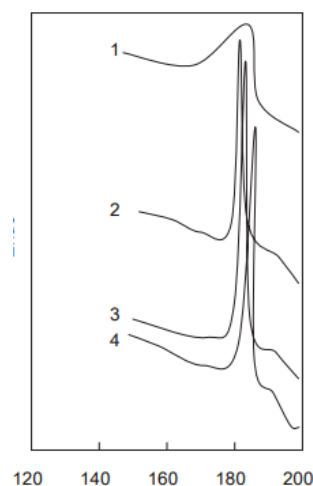


Figure 5. The melting point of Polylactic Acid

Polylactic Acid is made through two different processes, namely the change of state of matter to a denser state (condensation) and the process by which monomers chemically combine to form large molecular structures (polymerization). These process techniques are combined into processes and temperature differences to produce a new look. Through its response to heat. Through its melting point and cooled in a certain time so that the potential for the material to burn will turn into a melt.

In addition to this, polylactic acid is easily biodegradable which is safe for the human body but will be dangerous if it is in a liquid state. This is because, in these conditions, the liquid material is due to the high temperature which is not safe for human skin.

D. CONCLUSION

Polylactic Acid has value in the environment for being an environmentally friendly plastic. In addition, Polylactic Acid can also provide an opportunity to be developed into other materials so that it becomes a combination. In its application, PolyLactic Acid has been developed to be one of the materials in the 3-dimensional printing process. And the material becomes a material that is not infrequently a material that must be applied to the process.

From its characteristics, polylactic acid material has a lower melting value because with a temperature of 90 degrees for a certain time it can change the main shape into another form. So the material is susceptible to heat. And besides, with the ease of decomposing, the resistance of the material will be different in its application as a product object.

When viewed from its use, polylactic acid material will be able to provide value as the main material of an object if it has certain considerations, this is because adjustments to the characteristics of the material will be maximized to be conditioned as a forming material. Because if polylactic acid is used as the main material, it will be vulnerable to air temperature and usage time, so there needs to be developed so that its application is more optimal.

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