Characteristics Of Disabled Porosity Development Engine Hot Press For Recycle Plastic HDPE

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Abstract: The use of plastic is now inseparable from human life, ranging from the use of plastic bags, furniture, tableware, toys, electronic products are even used in building construction. Plastic consumption per capita in Indonesia has reached 17 kilograms every year with consumption growth reached 6-7 percent every year. Problem plastic waste is not only happening in the world or national scale but also occur in the area. As was the case in one of the districts in Madura Island, which is in Bangkalan. Plastic recycling is required to utilize plastic waste that is thrown away and pollute the environment to be a product of value and worth sales.Dalam wears this study, the machines used are machine Hot Press for recycled HDPE plastic. Design of the machine hot press is required to create a machine that can recycle plastic waste HDPE and has the advantages of portable and light. So in this study, will be produced little knowledge about the characteristics of the machine hot press is based on factors - factors and response - a response that is used. Based on advanced test Tukey, of all combinations, the best combination to produce the smallest porosity defects or products are Using temperature heating to 200 ^{0}C, the heating time of 5 minutes and a temperature of 80 ^{0}C. While opening the best combination to produce the best energy consumption is heating temperature 180 ^{0}C, the heating time of 1 minute and a temperature of 500^{0}C opening.

Keywords: HDPE Plastic, Recycle Machine, Hot Press Disability.

1. Introduction

The development of technology, information, and also led to the need for the plastic industry is increasing. The use of plastic is now inseparable from human life, ranging from the use of plastic bags, furniture, tableware, toys, electronic products are even used in the construction of buildings (Rokdey, Naktode and Nikhar, 2015).

Plastic is now the most important segment and very much in production and consumption compared to other technical material. Since the advent of very large plastic use in all aspects of the industry. A plastic material is now becoming an important ingredient that is required and a unique place in the world market to use this material(Dulebová and Greškovič, 2011).

Plastic recycling is required to utilize plastic waste that is thrown away and pollute the environment to be a product that is worth disposable and marketable. For the success of the recycling program of waste plastics, needed a tool that would work well, affordable and easy to move place, besides the quality of the recycling process should also be considered so that

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the product can be marketable and valuable use in accordance with the wishes of consumers(Cole *et al.*, 2011; Surono, 2013).

In this study, the machines used are machine Hot Press for recycled HDPE plastic. Design of the machine hot press is required to create a machine that can recycle plastic waste HDPE and has the advantage that is portable and lightweight. After going through the stages of design and manufacture, the next stage is the stage of testing. It is intended to determine the characteristics of the new engine that has been made.

Tests to determine characteristic this machine uses a completely randomized experimental design 23 by a factor of heating temperature, holding time and temperature of the mold opening and porosity defect response.

Senthil Kumar (2014), Researching on"AStudy on the Influence of Hot Press Forming Process Parameters on Flexural Property of Glass / PP Based Thermoplastic Composites Using Box-Behnken ExperimentalDesign"(Kumar and Balachandar, 2014).The study was conducted using a design of an experiment. The object of research is a kind of plastic polypropylene (PP) combined with glass fibers so as to produce the claimed composite environmentally friendly because of its use-of-life return after completion of the initial material.

Kumar study was based on the results obtained from the manufacture of composites. Although the claim is environmentally friendly, it has poor mechanical properties when compared with thermoset matrix composites(Kumar and Balachandar, 2014). Therefore, attempts were made to improve the mechanical properties such as flexural properties of woven composites glass / PP with. Experiments to optimize some influential factor duringmolding,the hot presssuch as pressure molding, mold temperature, and time of printing using the Box-Behnken experimental design.

Gadekar (2015), Doing the research"EffectOf Temperature Molding On The Properties Of Polypropylene / High Density Polyethylene / Clay / Glass FiberComposites"(Smith, 2009; Rajkolhe and Khan, 2014; Gadekar, Khan and Dalu, 2015).Gadekar research on comparative polymer nanocomposite synthesized under different printing temperature and printing temperature effect on the manufacture of polymer nanocomposite with different characterization techniques. Another focus of this research is the increase in the physical and mechanical properties of the polymer nanocomposite with different nanofillers. Poly-hybrid nanocomposite such as polypropylene (PP) (80% mixture) and a mixture of high densitypolyethylene (HDPE) (20% mixture) were selected for this study. While nanofiller used is nano kaolin clay (2%) and / or glass fiber (GF) (20%) are incorporated in the polymer matrix. The treatment applied is a print temperature.

HDPE or high density polyethylene normally is rigid, thin and not transparent or opaque(Mok, Kwong and Lau, 1999; Sarker, Rashid and Molla, 2011; Susilawati, Mustafa and Maulina, 2011). HDPE (Ethylene polymer with densities ranging from 0.941 to 0.965 grams per cubic centimeter) are typically used in grocery stores or used as a plastic bag (Gogte, 2009).

Disability can be defined as the failure of one unit or more in order to meet the specifications for the quality certain. While defects also means that each unit has one or more disabilities, the possibility of involving a number of features or parts that can not be functioning. Defects that have been established as a hindrance or obstacle in a manufactured product(Rosato, Rosato and Di Mattia, 2004).

According to Smith, 2017 Rajkolhe, 2014. Porosity in printing caused by the gas can be of any trapped air, hydrogen dissolved in the aluminum alloy, causing moisture vapor from the line so that the cooling cracks(Lewins, 2004; Ruiz Espejo, 2006; Al-Helou, 2012). Air in the

cavity can be easily caught up and began to fill the cavity. The air is then compressed as more and more metal stream into the cavity and the pressure rises. When the cavity is full of it being dispersed as small spheres of high air pressure. Swirling flow can cause them to become elongated.

2. Methods

The research process begins with the design tool first. The design of the tool begins the process of planning, purchasing equipment, and materials as well as the implementation of the work of making tools(Walpole, 1993; Ruiz Espejo, 2006; Rosato and Rosato, 2012; Bruder, 2015). Here is a hot press machine design process as shown on figure 1.

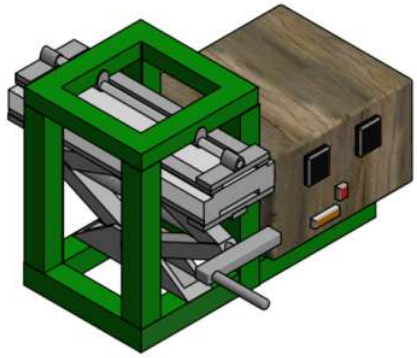

Fig. 1. 3D designmachine hot press.

Here are the tools and materials used in the hot press tool design as shown on table 1.

Table 1. List of tools and material shot press machine.

No	Materials and tools	Quantity
1	Catride heater	4
2	Bottom mold	1
3	Top mold	1
4	Frame	4
5	Catride Frame	4
6	Jack	1
7	Hollow MS 2x4	1
8	Cable	3 m
9	Controller	2
10	Thermocouple	2
11	Switch NCB	1
12	Switch	1
13	Plug-in	1
14	Paints	3
15	Putty	1
16	Bolts	40
17	Frame Lock	4

How the hot press machine to recycle this plastic is to heat the HDPE plastic in the mold by pressure. Heating is carried out above the melting point of HDPE plastic. After heating and pressing are completed, plastic prints and checked lifted porosity defects.

There are 3 factors and 2 levels to be used in research. That factor is the heating temperature, heating time and temperature opening. Heating temperature has a level of 180^{o} C and 200^{o} C. The heating time of 1 minute and 5 minutes, opening temperature of 50^{o} C and 80^{o} C. Completion method used in this research is using a 2factorial3design, with the base model as formulation.

$Yijkl = \mu + \alpha i\ \beta + j + Ck + (\alpha\beta)ij + (\alpha C)ik + (\beta C)jk + (\alpha\beta C)ijk + \varepsilon ijkl$..... . ...(1)

$i=1,2, ..., a;$ .....(2)

$j=1,2,...,b;$.....(3)

$k=1,2,...,c;$ .....(4)

Description:

Yijkl	Observations on the experimental unit to - l obtaining treatment combinations extent to - i and factor A and the extent to - j of factor B and the extent to - k of factor C.
μ	Mean population.
αi	Influence level to - i of factor A.
βj	Influence extent to - j of factor B.
Ck	Influence extent to - k of factor C.
αβij	Influence level to - i of factor A and the extent to - j of factor B.
αcik	Influence level to - i of factor A and the extent to - k of factor C.
βcjk	Influence extent to - j of factors B and the extent to - j of factor C.
(αβc) ijk	Influence level to - i of factor A and the extent to - j of factors B and the extent to - k of factor C.
εijkl	random Influence of experimental unit to-lobtaining ijk treatment combination. εijkl - N (0, σ2).

Hypothesis:

H_0	There is the influence of the heating temperature for defects porosity.
H_0	There is no influence of heating time against defects defects porosity.
H_0	There is the influence of the opening time of the defects of porosity.
H_0	There is the influence of A (temperature heating), B (heating time) against defects defects porosity.
H_0	There is no influence of A (temperature heating), C (temperature opening) against defects porosity.
H_0	There is an influence factor B (heating time), C (temperature opening) against defects porosity.
H_0	There is no effect of A (temperature heating), B (heating time), C (temperature opening) against defects porosity.

3. Result And Discussion

In printing, the time required to raise temperature maximum temperature faster towards compared time required during cooling, as shown on figure 2.

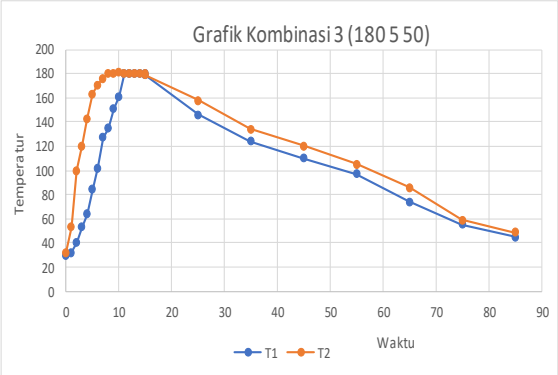

Fig. 2. Temperature machinery on a combination of 3 (180 5 50).

Figure 2 is a record increase and decrease in temperature on the combination of three namely heating 180 ^{0}C, the heating time 5 minutes and the temperature of the opening 50 ^{0}C. Based on the graph it can be seen that the rise in temperature during machine hot press started printing is running quickly, meaning not take long. Visible only takes about 13 minute mold has reached the set temperature of 180 ^{0}C.

Test Normal Half

Half Normal Plot Tests to determine the significant factors, which are a significant factor on the right side (positive influence) and the furthest point is a significant factor as shown on figure 3.

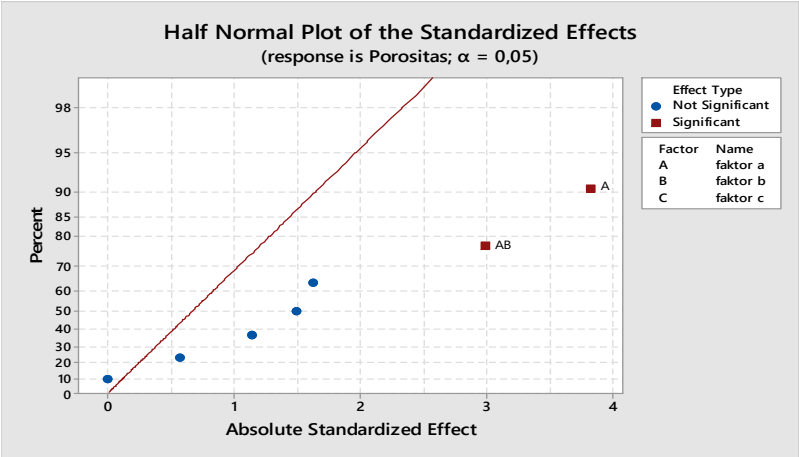

Fig. 3. Test half normal plot.

Test Normal Plot

Test normal plot is used to determine a significant factor in which a significant factor on the left side (influence negatively) and on the right side (influence positively).

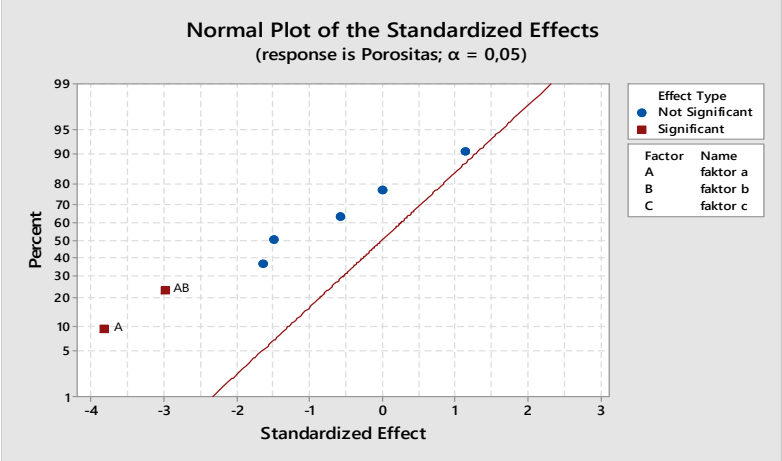

Fig. 4. Test normalplot.

Under normal test plot, factor A (temperature heating) and interaction of factors A and B (the interaction of the heating temperature and the duration of heating) significantly against defects porosity

Analysis of R2

Below is an analysis of the R2 of the study Yag been donetable analysis R2 as shown on table 2.

Table 2. Analysis R2

Model Summary			
S	R - sq	R – sq(adj)	R – sq(pred)
4,64691	65,24%	50,03%	21,79%

Based on the tables R2 can be seen the value of R square was 65.24% indicating that factors a, b, and c as well as the interaction between the three may explain the variable Y (disabled porosity) of 65.24% while the remaining 34.76 or variable explained by factors other than research.

Table Anova

Here is a table ANOVA from the calculation of the test defects porosity were made as shown on table 3:

Table 3. ANOVA testing defect porosity.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor a	1	315,375	315,375	14,60	0,002
Factor b	1	48,167	48,167	2,23	0,155
Factor c	1	57,042	57,042	2,64	0,124
Factor a*b	1	192,667	192,667	8,92	0,009
Factor a*c	1	7,042	7,042	0,33	0,576
Factor b*c	1	28,167	28,167	1,30	0,270
Factor a*b*c	1	0	0	0	1

Error	16	345	21,594

Based on Table ANOVA, then the conclusion is as follows. Factor a (Temperature Change), Value P-value of 0.002 < 0.05 So that reject H0. There is a significant effect of heating temperature on porosity defect. Factor b (Time Heating), Value P - Value 0.155> 005 so thank H_0. No significant effect of heating time on porosity defect. Factor c (Temperature opening), P Value - Value 0.124> 0.05 so thank H_0. No significant effect of temperature against defects porosity openinga combination of factors and factor b. Values P-value 0.009 <0.05 so reject H0. There is a significant effect of heating temperature and heating time for defects porosity

combination of factors a and c. Rated P-value = 0.576> 0.05 so thank H_0. There was no significant effect of heating time and temperature for defects porosity opening. Combination of factors b and c

Rated P-value = 0.27> 0.05 so thank H_0. There was no significant effect of heating time and temperature for a defects porosity opening. Combination of a, b and c. Rated P-value = 1> 0.05 so thank H_0. There is no significant influence of temperature heating, the heating time and temperature opening against defects porosity.

4. Conclusions

Testing for defects porosity, factors that significantly influence the defect porosity is a factor a (temperature heating) and the interaction between the factors a and b are (temperature of heating and the heating time).

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