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Addition Of Synthetic Fiber On Materials Plastic Injection To Minimize Product Defects

Firmansyah Azharul1 , Rahmawati1 , Harno1 , Wilarso1 and Mujiarto2*

1Department of Mechanical Engineering, Sekolah Tinggi Teknologi Muhammadiyah Cileungsi, Cileungsi, Bogor, Indonesia 16820
2Department of Mechanical Engineering, UniversitasMuhammadiyahTasikmalaya, Tasikmalaya, Indonesia

Abstract

The plastic injection molding process in the manufacture of air rifle components, namely butt stock guns and pump handles, product defects are still often found, several causes include: burning (burning), lack of material (short shot), and products cracking (cracking), this results in not achieving the production targets and sales targets. To overcome this problem, plastic injection materials need to be added in synthetic fibers to get the visual appearance, tensile strength, modulus of elasticity and hardness as desired, by utilizing recycled material products. The results showed visually the addition of recycled materials and synthetic fibers did not affect the appearance, in terms of economics the more recycled material added the cheaper the cost of procuring the material. The addition of recycled material weighing 50% of the original material and 2.5% synthetic fiber from the total amount of material to be processed, is expected to be able to increase the tensile strength, modulus of elasticity and hardness as desired. Therefore, from the addition of these fibers obtained a more accurate comparison of quality and quantity of products with a lower level of product defects, as well as being able to reduce production costs. **(Approx. 193 words)**

Keywords: Plastic Injection, synthetic fibers, recycled material, tensile strength, modulus of elasticity and hardness.

Topic: Engineering and Technology

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Letter of Acceptance for Abstract

Dear Authors: Firmansyah Azharul1 , Rahmawati1 , Harno1 , Wilarso1* and Mujiarto2

We are pleased to inform you that your abstract (ABS-290, Oral Presentation), entitled:

"Addition Of Synthetic Fiber On Materials Plastic Injection To Minimize Product Defects"

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[2]Department of Mechanical Engineering, Universitas Muhammadiyah Tasikmalaya, Tasikmalaya, Indonesia

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1. Introduction.

Manufacturing is an industrial branch that applies equipment and a process medium to transform raw materials into finished goods [1]. This effort involves all the intermediate processes needed for the production and integration of the components of a product.

This is one of the factors to encourage companies to compete in improving product quality and providing the best products and services for their customers. The higher the product's ability to meet customer needs means the quality of the product. Quality control is a way and activity to maintain, maintain, and improve product quality [2]. Therefore it is very important for companies to know the factors that influence product quality so that the improvement is more optimal. In the plastic injection molding process, especially in the manufacture of air rifle components, namely butt stock rifle (butt stock) and pump handle (pump handle), product defects are still often found, the causes include: burning (burning), lack of material (short shot), and cracking products. Product defects due to cracking often occur, both before and after assembly.

This resulted in not achieving the production targets and sales targets. If this problem is not resolved immediately it will certainly reduce the level of customer satisfaction and trust which will affect the company's survival. Therefore this research was conducted in order to improve quality (product quality), and quantity (product quantity) to be more optimal and be able to meet customer needs and satisfaction.

2. Literatur Review.

Plastic is a polymer that has unique and extraordinary properties [3], because it consists of molecular units called monomers. If the same monomer is called homopolymer, and if the monomer is different

it will produce copolymers. Natural polymers that we have known include: cellulose, proteins, natural rubber and the like [4].

At first humans used natural polymers only to make tools and weapons, but this situation only lasted until the late 19th century and then humans began to modify polymers into plastics, which developed rapidly in electronics, agriculture, machinery, transportation, furniture, construction, cosmetic packaging, children's toys and other industrial products.

Broadly speaking, plastics can be grouped into two groups, namely: Thermoplast plastic and thermoset plastic. Thermoplast plastic is plastic that can be printed repeatedly in the presence of heat, among others: PE (polyetyliene), PP (polypropyliene), PS (polysteryene), ABS (acrylonitrile butadiene strirena), nylon, PET, Polyacetal (POM), PC etc. Thermoset plastic is plastic which if it has certain conditions cannot be reprinted because the polymer is in the form of three-dimensional tissue, including: PU (Poly Urethene), UF (Urea Formaldehyde), MF (Melamine Formaldehyde), polyester, epoxy [5].

Plastics in order to have the properties as desired, in addition to the main ingredients are also needed additional ingredients or additives whose use varies depending on the raw material used and the quality of the product produced, among the additives are softeners (plasticizers), stabilizers (stabilizers), lubricants (lubricants), fillers (fillers), and coloring agents (colorant) [6].

Table 1. Comparison of specific gravity of various plastic materials

Resin	Specific grafity
PP	0.85-0.90
LDPE	0,91 – 0,93
HDPE	0,93 – 0,96
Polystyrene	1,05 – 1,08
ABS	0,99 – 1,10
PVC	1,15 – 1,65
Acetyl Cellulose	1,23 – 1,34
Nylon	1,09 – 1,14
Poly Carbonate	1,20
Acetate Poly	1,38

Table 2. Temperature melt thermoplastic process

Material	C ^{o}	F ^{o}
ABS	180 - 240	356 - 464
Acetal	185 - 225	365 -437
Acrylic	180 - 250	356 - 482
Nylon	260 - 290	500 - 554
Poly Carbonat	280 -310	536 - 590
LDPE	160 - 240	320 - 464
HDPE	200 - 280	392 - 536
PP	200 - 300	392 - 572
PS	180 - 260	356 - 500
PVC	160 - 180	320 - 365

3. Methode

This research focuses on the effect of the percentage of recycled plastic mixture [5] on product quality. The products that will be tested are rifle butts and the butt of the rifle pump. The material

used in this study is the original ABS (acrylonitrile butadiene styrene) plastic product [7], composed with recycled ABS (acrylonitrile butadiene styrene) material weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be used. In this research, the object of observation and this research is to analyze the level of product quality before and after material engineering, involving the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic recycled 50% of the weight of the original material, and 2.5% synthetic fiber of the entire material which will be processed.

As a preparation for the injection molding process, the daily production capacity injection machine is used with a molding clamping unit of 350 tons. From the trial activity, 6 specimens were made, molds made of steel ASTM ST 19. The method used in data collection is observation Method. Is a method of collecting data by holding observations and recording directly on the object of research to obtain data and information needed in research. Is a method of collecting data obtained by using documents or data that have been sourced from an agency or company in order to obtain relevant data in research.

4. Result.

Product defect analysis and analysis of ABS (Acrylonitrile Butadiene Styrene) recycling material use. In the production process there are often imperfect or defective products. This failed product certainly cannot pass the product test. This will certainly be rejected and unused goods so that the impact of losses on the company. Losses can be in the form of waste of material, high volume of return of shipping goods, not achieving production targets and sales targets while also adding production and storage costs.

In the plastic injection molding process, especially in the manufacture of air rifle components, namely butt stock guns and pump handle handles, product defects are still often found. Some of the causes include: burning (burning), lack of material (short shot), and cracking products (cracking). For product defects due to cracking (cracking) often occurs, both before and after assembly.

This is always ongoing without any follow-up, and even worse, each of the above incidents recurs, which is blamed for the main material. So that the main material is immediately replaced with a higher grade and of course the price is more expensive than the previous material.

Another impact is that by changing the material to a higher grade, the used material from recycling is no longer used and piled up in warehouses. This certainly raises new problems, namely the cost of placement and maintenance of these goods. If this problem is not resolved immediately it will certainly reduce the level of customer satisfaction and trust which will affect the company's survival. To overcome the above problems, it can be done by using reject products to become raw materials again. This is very possible because ABS plastic is one of the recyclable polymer materials, which is recycled material, which is a product of ABS material (acrylonitrile butadiene styrene) that does not pass the test, then is processed again into pieces. small similar in size to plastic pellets.

The problem with this utilization is whether ABS (acrylonitrile butadiene styrene) plastic products that use a mixture of recycled raw materials have the same quality as the original raw materials. Besides the quality of recycled plastic is not as good as the main material. The more often the recycled, the greater the decrease in its nature.

Changing properties include tensile strength, yield strength, elongation percentage, hardness and physical properties. To uncover this, it is certainly necessary to conduct research concerning the use of recycled raw materials as mixtures in the manufacture of products from ABS (acrylonitrile butadiene styrene) plastic materials [8].

In using recycled ABS plastic as a mixture in the manufacture of products, it can be seen from several aspects, including:

1. The first problem seen in terms of processing reject plastic into raw material, this concerns how to process reject material into pellet material that will be processed into a product, what machine is used to process, what size ABS plastic granules (acrylonitrile butadiene styrene)

recycling according to needs, whether or not to add synthetic fibers to support product quality.

2. Judging from the production process regarding how much the heating temperature is so that the plastic raw material is suitable enough to be injected into the mold, what percentage of recycled plastic mixture can be applied to making a quality product, how much force is given to compressing the liquid plastic into the mold, how the shape of the mold cavity can make the perfect product, how the size of the gate and raser needed in making molds.
3. Viewed from the aspect of the quality of the product made, the problems that arise how the tensile strength, how the strength of the melt, how the pull modulus, how the flexure modulus, how the impact strength, how hardness and so on.

In the process of making plastic products, there are many things that need to be studied. However, in this study due to time constraints and the importance of the study, this study is limited to two main problems namely the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic mixes 50% of the weight of the original material, 2.5% synthetic fiber of the entire material used. will be processed and product quality. Product quality can be seen from the appearance (visual) of the product, tensile strength, modulus of elasticity and hardness.

Experiments carried out 6 times the injection process that is heavy on the composition of the material, with the first rhythm is ABS plastic material 100% original, the second rhythm is ABS plastic material with the addition of recycled material 10% by weight of the original original material and without synthetic fibers. The third rhythm is ABS plastic material with the addition of recycled material 50% of the weight of the original material and 2.5% synthetic fiber of the total weight of the material to be processed.

Tests carried out include visual appearance, tensile and hardness tests. Tensile testing using a universal testing machine and hardness testing using the Shore scleroscope. Based on the research results obtained data as follows:

- Judging from the physical and visual properties of plastic texture changes can be seen in the image below.

4.1 Original 100% ABS (acrylonitrile butadiene styrene) material without the addition of synthetic fibers.

Figure 1. The original 100% ABS trial material without additional of synthetic fiber.

4.2 Original ABS material plus 10% recycled material.

Original ABS (acrylonitrile butadiene styrene) material plus 10% recycled material from the weight of the original material without the addition of synthetic fibers.

Figure 2. Product original trial material ABS plus 10% recycled material from original material weight without additional of synthetic fiber.

4.3 Material ABS (acrylonitrile butadiene styrene) with recycled material 50%.
Original ABS material plus 50% recycled material from the weight of the original material plus 2.5% synthetic fiber from the total amount of material to be processed.

Figure 3. Original ABS trial material plus 50% recycled material and 2.5% synthetic fiber.

Table 3. Original material testing results without using synthetic fiber

Original ABS (without synthetic fibers)		Maximum tensile stress (MPa)	Maximum strain (%)
100%	Inject	(40 - 50)	(150)
	1	32,13	147,5
	2	31	147,1
	3	31,08	147,3
100%	4	31,16	147,4
	5	32,68	146,7
	6	32,48	146,5

Tabel 4. Material testing results using 10% recycling material without using synthetic fiber.

Percentage of recycled ABS (without synthetic fibers)		Maximum tensile stress (MPa)	Maximum strain (%)
	Inject	(40 - 50)	(150)
10%	1	30,19	148
	2	30	148,2
	3	30,11	147,39
10%	4	29,23	148,2
	5	30,05	147,22
	6	30,25	148,1

Table 5. Material testing results using 50% recycling material using 2.5% synthetic fiber.

Percentage of recycled ABS and 2.5% synthetic fiber		Maximum tensile stress (MPa)	Maximum strain (%)
	Inject	(40 - 50)	(150)
50%	1	42,55	133
	2	43	134,28
	3	43,33	134,17
50%	4	43,12	134,20
	5	43,25	134,12
	6	43,42	134,16

Looking at the table above, it turns out there is a change in the tensile strength of ABS material which is added with 50% recycled ABS and 2.5% synthetic fiber. There is an increase in the strength level of the material by increasing the percentage of recycled ABS (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber. When looking at the tendency of the effect of the addition of recycled ABS (acrylonitrile butadiene styrene) 50% and synthetic fiber 2.5%, we can see in the following figure 3.

4.4. Effect of Recycled ABS (Acrylonitrile Butadiene Styrene) Percentage and 2.5% Synthetic Fiber on Modulus of Elasticity.

Modulus of elasticity is a measure of the stiffness of the material. Material that has a high elastic modulus can be said that the material is rigid. Modulus of elasticity is obtained from the ratio of tensile strength to strain in the elastic region. ABS test material shows the following tensile modulus:

Tabel 6. Modulus of elasticity of original ABS material without synthetic fiber

Inject	Original ABS without synthetic fibers	Modulus Elastisitas (70-90) MPa
1	100%	67
2	100%	66,1
3	100%	66
4	100%	66,2
5	100%	66,4
6	100%	66,5

Tabel 7. Modulus of elasticity of original ABS (acrylonitrile butadiene styrene) material with 10% recycling material without synthetic fiber

Inject	Percentage of ABS recycled without synthetic fibers	Modulus Elastisitas (70-90) MPa
1	10%	60
2	10%	60,1
3	10%	60,3
4	10%	60,6
5	10%	60,8
6	10%	60,9

Tabel 8. Modulus of product elasticity ABS (acrylonitrile butadiene styrene) recycled 50% and 2.5% synthetic fiber.

Inject	Percentage of recycled ABS and 2.5% synthetic fiber	Modulus Elastisitas (70-90) MPa
1	50%	93,7
2	50%	93,8
3	50%	94
4	50%	93,9
5	50%	93,6
6	50%	93,8

Test results based on the above table show that the addition of recycled ABS (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber affect the elastic modulus of ABS (acrylonitrile butadiene styrene). The effect shows a tendency to increase the modulus of material elasticity. The addition of recycled ABS weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be processed shows maximum effect.

4.5. Effect of recycled ABS (acrylonitrile butadiene styrene) percentage and 2.5% synthetic fiber on hardness

Hardness shows material resistance to constant change. This test can be done by way of emphasis, reflections and scratches. In this study the concept of rain is done with emphasis. The method used is the shore scleroscope system with the standard JIS 2240. Data from the hardness test results can be seen in the following table:

Table 9. Hardness of original ABS material without synthetic fiber, 10% recycled material without synthetic fiber and 50% recycled material with synthetic fiber.

Inject	Percentage of original ABS 100%, without synthetic fibers	Hardness Scleroscop kJ/m2	Recycling percentage of 10% without synthetic fibers	Hardness selerescop kJ/m2	Percentage of ABS recycled 50% with 2.5% synthetic fiber	Hardness selerescop kJ/m2
1	100 %	10,1	10 %	8,2	50%	31,4
2	100%	10	10%	8,3	50%	32
3	100%	9,8	10%	8,1	50%	31,3

4	100%	9,5	10%	8,3	50%	31,5
5	100%	9,5	10%	8,3	50%	31,7
6	100%	9,6	10%	8,3	50%	32

5. Conclusion.

In accordance with comparative data the quality and number of products produced has increased by 13.12%. With a lower product defect rate which is down 15.2%. The existence of material engineering when viewed from the economic side of the addition of 50% of recycled materials, the cost of material procurement is much cheaper when compared to using 100% original material. With the reduced price of the multiplier material for the handle and side pump gun handle, up to Rp 2,758,000.00 per 300 pcs of production. Visually shows the addition of recycled material weighing 50% of the original material and 2.5% synthetic fiber of the material to be processed does not affect the appearance. This is certainly far different from the trial of adding 70% recycled material. The trial results are not attached because they are stated far, the visual display is far from the specified standard criteria. Addition of recycled materials up to 50% such as mechanical properties does not diminish from the original properties. So that in terms of reliability the mechanical properties are still good and are above the original nature. From this data also obtained an increase in tensile strength, modulus of elasticity, and product hardness as expected. From the above data it can be concluded that the composition of this material is suitable for the use of rifle butts and rifle pump handles.

6. Reference.

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Broadly speaking, plastics can be grouped into two groups, namely: Thermoplast plastic and thermoset plastic. Thermoplast plastic is plastic that can be printed repeatedly in the presence of heat, among others: PE (polyetyliene), PP (polypropyliene), PS (polysteryene), ABS (acrylonitrile butadiene strirena), nylon, PET, Polyacetal (POM), PC etc. Thermoset plastic is plastic which if it has certain conditions cannot be reprinted because the polymer is in the form of three-dimensional tissue, including: PU (Poly Urethene), UF (Urea Formaldehyde), MF (Melamine Formaldehyde), polyester, epoxy.

Plastics in order to have the properties as desired, in addition to the main ingredients are also needed additional ingredients or additives whose use varies depending on the raw material used and the quality of the product produced, among the additives are softeners (plasticizers), stabilizers (stabilizers), lubricants (lubricants), fillers (fillers), and coloring agents (colorant).

3. Method

This research focuses on the effect of the percentage of recycled plastic mixture on product quality. The products that will be tested are rifle butts and the butt of the rifle pump. The material used in this study is the original ABS [6] (acrylonitrile butadiene styrene) plastic product, composed with recycled ABS (acrylonitrile butadiene styrene) material weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be used. In this research, the object of observation and this research is to analyze the level of product quality before and after material engineering, involving the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic recycled 50% of the weight of the original material, and 2.5% synthetic fiber of the entire material which will be processed.

As a preparation for the injection molding process [7], the daily production capacity injection machine is used with a molding clamping unit of 350 tons. From the trial activity, 6 specimens were made, molds made of steel ASTM ST 19. The method used in data collection is observation Method. Is a method of collecting data by holding observations and recording directly on the object of research to obtain data and information needed in research. Is a method of collecting data obtained by using documents or data that have been sourced from an agency or company in order to obtain relevant data in research.

4. Result.

Product defect analysis and analysis of ABS (Acrylonitrile Butadiene Styrene) recycling material use. In the production process there are often imperfect or defective products. This failed product certainly cannot pass the product test. This will certainly be rejected and unused goods so that the impact of losses on the company. Losses can be in the form of waste of material, high volume of return of shipping goods, not achieving production targets and sales targets while also adding production and storage costs.

In the plastic injection molding process, especially in the manufacture of air rifle components, namely butt stock guns and pump handle handles, product defects are still often found. Some of the causes include: burning (burning), lack of material (short shot), and cracking products

(cracking). For product defects due to cracking (cracking) often occurs, both before and after assembly.

This is always ongoing without any follow-up, and even worse, each of the above incidents recurs, which is blamed for the main material. So that the main material is immediately replaced with a higher grade and of course the price is more expensive than the previous material.

Another impact is that by changing the material to a higher grade, the used material from recycling is no longer used and piled up in warehouses. This certainly raises new problems, namely the cost of placement and maintenance of these goods. If this problem is not resolved immediately it will certainly reduce the level of customer satisfaction and trust which will affect the company's survival. To overcome the above problems, it can be done by using reject products to become raw materials again. This is very possible because ABS plastic is one of the recyclable polymer materials, which is recycled material, which is a product of ABS material (acrylonitrile butadiene styrene) that does not pass the test, then is processed again into pieces. small similar in size to plastic pellets.

The problem with this utilization is whether ABS (acrylonitrile butadiene styrene) plastic products that use a mixture of recycled raw materials have the same quality as the original raw materials. Besides the quality of recycled plastic is not as good as the main material. The more often the recycled, the greater the decrease in its nature.

Changing properties include tensile strength [8], yield strength, elongation percentage, hardness and physical properties. To uncover this, it is certainly necessary to conduct research concerning the use of recycled raw materials as mixtures in the manufacture of products from ABS (acrylonitrile butadiene styrene) plastic materials. In using recycled ABS plastic as a mixture in the manufacture of products, it can be seen from several aspects.

1. The first problem seen in terms of processing reject plastic into raw material, this concerns how to process reject material into pellet material that will be processed into a product, what machine is used to process, what size ABS plastic granules (acrylonitrile butadiene styrene) recycling according to needs, whether or not to add synthetic fibers to support product quality.
2. Judging from the production process regarding how much the heating temperature is so that the plastic raw material is suitable enough to be injected into the mold, what percentage of recycled plastic mixture can be applied to making a quality product, how much force is given to compressing the liquid plastic into the mold, how the shape of the mold cavity can make the perfect product, how the size of the gate and raser needed in making molds.
3. Viewed from the aspect of the quality of the product made, the problems that arise how the tensile strength, how the strength of the melt, how the pull modulus, how the flexure modulus, how the impact strength, how hardness and so on.

In the process of making plastic products, there are many things that need to be studied. However, in this study due to time constraints and the importance of the study, this study is limited to two main problems namely the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic mixes 50% of the weight of the original material, 2.5% synthetic fiber of the entire material used. will be processed and product quality. Product quality can be seen from the appearance (visual) of the product, tensile strength, modulus of elasticity and hardness.

Experiments carried out 6 times the injection process that is heavy on the composition of the material, with the first rhythm is ABS plastic material 100% original, the second rhythm is ABS plastic material with the addition of recycled material 10% by weight of the original original material and without synthetic fibers. The third rhythm is ABS plastic material with the addition of recycled material 50% of the weight of the original material and 2.5% synthetic fiber of the total weight of the material to be processed.

Tests carried out include visual appearance, tensile and hardness tests. Tensile testing using a universal testing machine and hardness testing using the shore scleroscope. Based on the research results obtained data as follows:

- Judging from the physical and visual properties of plastic texture changes can be seen in the image below.

4.1 Original 100% ABS (acrylonitrile butadiene styrene) material without the addition of synthetic fibers, yang dijelaskan pada gambar 1 and original ABS material plus 10% recycled material.

Original ABS (acrylonitrile butadiene styrene) material plus 10% recycled material from the weight of the original material without the addition of synthetic fibers, yang dijelaskan pada gambar 2.

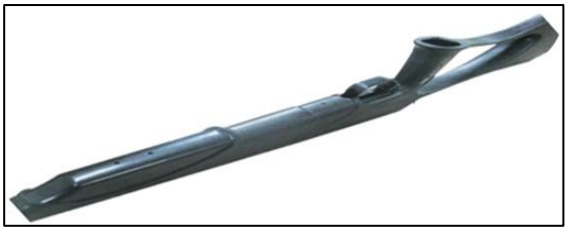

Figure 1. The original 100% ABS trial material without additional of synthetic fiber.

Figure 2. Product original trial material ABS plus 10% recycled material from original material weight without additional of synthetic fiber

4.2 Material ABS (acrylonitrile butadiene styrene) with recycled material 50%.

Original ABS material plus 50% recycled material from the weight of the original material plus 2.5% synthetic fiber from the total amount of material to be processed, yang dijelaskan pada gambar 3.

Figure 3. Original ABS trial material plus 50% recycled material and 2.5% synthetic fiber

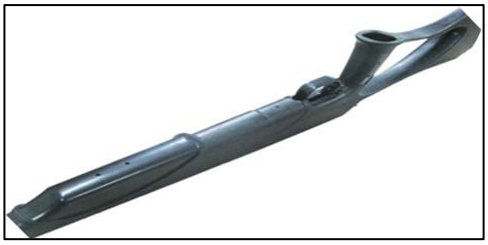

Figure 4. Original ABS trial material plus 50% recycled material and 2.5% synthetic fiber.

The original ABS test results were compared with the addition of recycled ABS and added 2.5% synthetic fiber, which is explained in table 1. Where added 2.5% synthetic fiber, the maximum tensile stress was high compared to the original ABS 100%.

Table 1. Original material testing results without using synthetic fiber

Inject	Original ABS (without synthetic fibers) 100%		Percentage of recycled ABS (without synthetic fibers) 10%		Material testing results using 50% recycling material using 2.5% synthetic fiber	
	Maximum tensile stress (MPa)	Maximum strain (%)	Maximum tensile stress (MPa)	Maximum strain (%)	Maximum tensile stress (MPa)	Maximum strain (%)
Inject 1	(40 - 50) 32,13	(150) 147,5	(40 - 50) 30,19	(150) 148	(40 - 50) 42,55	133 134,28

2	31	147,1	30	148,2	43	134,17
3	31,08	147,3	30,11	147,39	43,33	134,20
4	31,16	147,4	29,23	148,2	43,12	134,12
5	32,68	146,7	30,05	147,22	43,25	134,16
6	32,48	146,5	30,25	148,1	43,42	133

Looking at the table above, it turns out there is a change in the tensile strength of ABS material which is added with 50% recycled ABS and 2.5% synthetic fiber. There is an increase in the strength level of the material by increasing the percentage of recycled ABS (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber. When looking at the tendency of the effect of the addition of recycled ABS (acrylonitrile butadiene styrene) 50% and synthetic fiber 2.5%, we can see in the following figure 3.

4.4. Effect of Recycled ABS (Acrylonitrile Butadiene Styrene) Percentage and 2.5% Synthetic Fiber on Modulus of Elasticity.

Modulus of elasticity is a measure of the stiffness of the material. Material that has a high elastic modulus can be said that the material is rigid. Modulus of elasticity is obtained from the ratio of tensile strength to strain in the elastic region. ABS test material shows the following tensile modulus:

Table 2. Modulus of elasticity of original ABS

Inject	Material without synthetic fiber		Material with 10% recycling material without synthetic fiber		Recycled 50% and 2.5% synthetic fiber.	
	Original ABS without synthetic fibers	Modulus Elastisitas (70-90) MPa	Percentage of ABS recycled without synthetic fibers	Modulus Elastisitas (70-90) MPa	Percentage of recycled ABS and 2.5% synthetic fiber	Modulus Elastisitas (70-90) MPa
1	100%	67	10%	60	50%	93,7
2	100%	66,1	10%	60,1	50%	93,8
3	100%	66	10%	60,3	50%	94
4	100%	66,2	10%	60,6	50%	93,9
5	100%	66,4	10%	60,8	50%	93,6
6	100%	66,5	10%	60,9	50%	93,8

Test results based on the above table show that the addition of recycled ABS [9] (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber affect the elastic modulus of ABS (acrylonitrile butadiene styrene). The effect shows a tendency to increase the modulus of material elasticity. The addition of recycled ABS weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be processed shows maximum effect.

4.5. Effect of recycled ABS (acrylonitrile butadiene styrene) percentage and 2.5% synthetic fiber on hardness

Hardness shows material resistance to constant change. This test can be done by way of emphasis, reflections and scratches. In this study the concept of rain is done with emphasis. The method used is the shore scleroscope system with the standard JIS 2240. Data from the hardness test results can be seen in the following table 3.

Table 3. Hardness of original ABS material without synthetic fiber, 10% recycled material without synthetic fiber and 50% recycled material with synthetic fiber [10].

Inject	Percentage of original ABS 100%, without synthetic fibers	Hardness Scleroscop kJ/m2	Recycling percentage of 10% without synthetic fibers	Hardness selerescop kJ/m2	Percentage of ABS recycled 50% with 2.5% synthetic fiber	Hardness selerescop kJ/m2
1	100 %	10,1	10 %	8,2	50%	31,4

2	100%	10	10%	8,3	50%	32
3	100%	9,8	10%	8,1	50%	31,3
4	100%	9,5	10%	8,3	50%	31,5
5	100%	9,5	10%	8,3	50%	31,7
6	100%	9,6	10%	8,3	50%	32

5. Conclusion.

In accordance with comparative data the quality and number of products produced has increased by 13.12%. With a lower product defect rate which is down 15.2%. The existence of material engineering when viewed from the economic side of the addition of 50% of recycled materials, the cost of material procurement is much cheaper when compared to using 100% original material. With the reduced price of the multiplier material for the handle and side pump gun handle, up to Rp 2,758,000.00 per 300 pcs of production. Visually shows the addition of recycled material weighing 50% of the original material and 2.5% synthetic fiber of the material to be processed does not affect the appearance. This is certainly far different from the trial of adding 70% recycled material. The trial results are not attached because they are stated far, the visual display is far from the specified standard criteria. Addition of recycled materials up to 50% such as mechanical properties does not diminish from the original properties. So that in terms of reliability the mechanical properties are still good and are above the original nature. From this data also obtained an increase in tensile strength, modulus of elasticity, and product hardness as expected. From the above data it can be concluded that the composition of this material is suitable for the use of rifle butts and rifle pump handles.

Acknowledgment

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Additionalto Synthetic Fiber On Materials Plastic Injection To Minimize Product Defects

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Abstract. Plastic injection molding process in the manufacture of air gun components, namely butt stock gun, and pump handles, product defects are still often found, some of the causes include: burning (burning), lack of material (short shots), and cracking products (cracking), this resulting in not achieving production targets and sales targets. The purpose of this research is to find out the root cause of failure of air gun component products. The method in this problem, plastic injection materials need to be added synthetic fibers to get the visual appearance, tensile strength, modulus of elasticity, and the desired hardness, by utilizing recycled material products. The results showed visually the addition of recycled materials and synthetic fibers did not affect appearance, in economic terms the more recycled materials added the cheaper the cost of material procurement. The addition of recycled material weighing 50% of the original material and 2.5% synthetic fiber from the total amount of material to be processed, is expected to increase the tensile strength, modulus of elasticity and desired hardness. Therefore, this addition of fiber obtains a more accurate comparison of product quality and quantity with a lower product defect rate, and is able to reduce production costs.

1. Introduction.

Manufacturing is an industrial branch that applies equipment and a process medium to transform raw materials into finished goods. This effort involves all the intermediate processes needed for the production and integration of the components of a product[1].

This is one of the factors to encourage companies to compete in improving product quality and providing the best products and services for their customers[2]. The higher the product's ability to meet customer needs means the quality of the product. Quality control is a way and activity to maintain, maintain, and improve product quality[3]. Therefore it is very important for companies to know the factors that influence product quality so that the improvement is more optimal. In the plastic injection molding process[4], especially in the manufacture of air rifle components, namely butt stock rifle (butt stock) and pump handle (pump handle), product defects are still often found, the causes include: burning (burning), lack of material (short shot), and cracking products. Product defects due to cracking often occur, both before and after assembly.

This resulted in not achieving production targets and sales targets. If this problem is not resolved immediately, it will certainly reduce the level of customer satisfaction and trust which will affect the

survival of the company. Therefore this research was conducted to reduce production damage and improve production quality[2].

2. Literatur Review.

Plastic is a polymer that has unique and extraordinary properties, because it consists of molecular units called monomers. If the same monomer is called homopolymer, and if the monomer is different it will produce copolymers. Natural polymers[5]that we have known include: cellulose, proteins, natural rubber and the like.

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Plastics in order to have the properties as desired, in addition to the main ingredients are also needed additional ingredients or additives whose use varies depending on the raw material used and the quality of the product produced, among the additives are softeners (plasticizers), stabilizers (stabilizers), lubricants (lubricants), fillers (fillers), and coloring agents (colorant).

3. Method

This research focuses on the effect of the percentage of recycled plastic mixture on product quality. The products that will be tested are rifle butts and the butt of the rifle pump. The material used in this study is the original ABS[6] (acrylonitrile butadiene styrene) plastic product, composed with recycled ABS (acrylonitrile butadiene styrene) material weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be used. In this research, the object of observation and this research is to analyze the level of product quality before and after material engineering, involving the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic recycled 50% of the weight of the original material, and 2.5% synthetic fiber of the entire material which will be processed.

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4. Result

Product defect analysis and analysis of ABS (Acrylonitrile Butadiene Styrene) recycling material use. In the production process there are often imperfect or defective products. This failed product certainly cannot pass the product test. This will certainly be rejected and unused goods so that the impact of losses on the company. Losses can be in the form of waste of material, high volume of return of shipping goods, not achieving production targets and sales targets while also adding production and storage costs.

In the plastic injection molding process, especially in the manufacture of air rifle components, namely butt stock guns and pump handle handles, product defects are still often found. Some of the causes include: burning (burning), lack of material (short shot), and cracking products (cracking). For product defects due to cracking (cracking) often occurs, both before and after assembly.

This is always ongoing without any follow-up, and even worse, each of the above incidents recurs, which is blamed for the main material. So that the main material is immediately replaced with a higher grade and of course the price is more expensive than the previous material.

Another impact is that by changing the material to a higher grade, the used material from recycling is no longer used and piled up in warehouses. This certainly raises new problems, namely the cost of placement and maintenance of these goods. If this problem is not resolved immediately it will certainly reduce the level of customer satisfaction and trust which will affect the company's survival. To overcome the above problems, it can be done by using reject products to become raw materials again. This is very possible because ABS plastic is one of the recyclable polymer materials, which is recycled material, which is a product of ABS material (acrylonitrile butadiene styrene) that does not pass the test, then is processed again into pieces. small similar in size to plastic pellets.

The problem with this utilization is whether ABS (acrylonitrile butadiene styrene) plastic products that use a mixture of recycled raw materials have the same quality as the original raw materials. Besides the quality of recycled plastic is not as good as the main material. The more often the recycled, the greater the decrease in its nature.

Changing properties include tensile strength[8], yield strength, elongation percentage, hardness and physical properties. To uncover this, it is certainly necessary to conduct research concerning the use of recycled raw materials as mixtures in the manufacture of products from ABS (acrylonitrile butadiene styrene) plastic materials.In using recycled ABS plastic as a mixture in the manufacture of products, it can be seen from several aspects.

- The first problem seen in terms of processing reject plastic into raw material, this concerns how to process reject material into pellet material that will be processed into a product, what machine is used to process, what size ABS plastic granules (acrylonitrile butadiene styrene) recycling according to needs, whether or not to add synthetic fibers to support product quality.
- Judging from the production process regarding how much the heating temperature is so that the plastic raw material is suitable enough to be injected into the mold, what percentage of recycled plastic mixture can be applied to making a quality product, how much force is given to compressing the liquid plastic into the mold, how the shape of the mold cavity can make the perfect product, how the size of the gate and raser needed in making molds.
- Viewed from the aspect of the quality of the product made, the problems that arise how the tensile strength, how the strength of the melt, how the pull modulus, how the flexure modulus, how the impact strength, how hardness and so on.

In the process of making plastic products, there are many things that need to be studied. However, in this study due to time constraints and the importance of the study, this study is limited to two main problems namely the percentage of recycled ABS (acrylonitrile butadiene styrene) plastic mixes 50% of the weight of the original material, 2.5% synthetic fiber of the entire material used. will be processed and product quality. Product quality can be seen from the appearance (visual) of the product, tensile strength, modulus of elasticity and hardness.

Experiments carried out 6 times the injection process that is heavy on the composition of the material, with the first rhythm is ABS plastic material 100% original, the second rhythm is ABS plastic material with the addition of recycled material 10% by weight of the original original material and without synthetic fibers. The third rhythm is ABS plastic material with the addition of recycled material 50% of the weight of the original material and 2.5% synthetic fiber of the total weight of the material to be processed.

Tests carried out include visual appearance, tensile and hardness tests. Tensile testing using a universal testing machine and hardness testing using the shore scleroscope. Based on the research results obtained data as follows:

- Judging from the physical and visual properties of plastic texture changes can be seen in the image below.

4.1 Original 100% ABS (acrylonitrile butadiene styrene) material without the addition of synthetic fibers, yang dijelaskan pada gambar 1 and original ABS material plus 10% recycled material.

Original ABS (acrylonitrile butadiene styrene) material plus 10% recycled material from the weight of the original material without the addition of synthetic fibers, yang dijelaskan pada gambar 2.

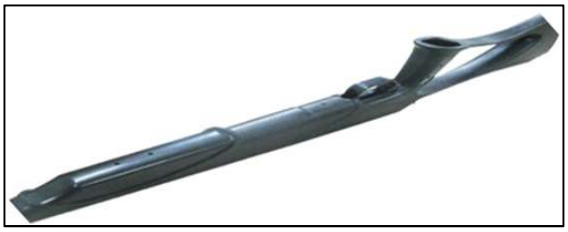

Figure 1. The original 100% ABS trial material without additional of synthetic fiber.

Figure 2. Product original trial material ABS plus 10% recycled material from original material weight without additional of synthetic fiber

4.2 Material ABS (acrylonitrile butadiene styrene) with recycled material 50%.

Original ABS material plus 50% recycled material from the weight of the original material plus 2.5% synthetic fiber from the total amount of material to be processed, yang dijelaskan pada gambar 3.

Figure 3. Original ABS trial material plus 50% recycled material and 2.5% synthetic fiber

Figure 4. Original ABS trial material plus 50% recycled material and 2.5% synthetic fiber.

The original ABS test results were compared with the addition of recycled ABS and added 2.5% synthetic fiber, which is explained in table 1. Where added 2.5% synthetic fiber, the maximum tensile stress was high compared to the original ABS 100%.

Table 1. Original material testing results without using synthetic fiber

Inject	Original ABS (without synthetic fibers)100%		Percentage of recycled ABS (without synthetic fibers) 10%		Material testing results using 50% recycling material using 2.5% synthetic fiber	
	Maximum tensile stress (MPa)	Maximum strain (%)	Maximum tensile stress (MPa)	Maximum strain (%)	Maximum tensile stress (MPa)	Maximum strain (%)
Inject	(40 - 50)	(150)	(40 - 50)	(150)	(40 - 50)	133
1	32,13	147,5	30,19	148	42,55	134,28
2	31	147,1	30	148,2	43	134,17
3	31,08	147,3	30,11	147,39	43,33	134,20
4	31,16	147,4	29,23	148,2	43,12	134,12
5	32,68	146,7	30,05	147,22	43,25	134,16
6	32,48	146,5	30,25	148,1	43,42	133

Looking at the table above, it turns out there is a change in the tensile strength of ABS material which is added with 50% recycled ABS and 2.5% synthetic fiber. There is an increase in the strength level of the material by increasing the percentage of recycled ABS (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber. When looking at the tendency of the effect of the addition of recycled ABS (acrylonitrile butadiene styrene) 50% and synthetic fiber 2.5%, we can see in the following figure 3.

4.4. Effect of Recycled ABS (Acrylonitrile Butadiene Styrene) Percentage and 2.5% Synthetic Fiber on Modulus of Elasticity.

Modulus of elasticity is a measure of the stiffness of the material. Material that has a high elastic modulus can be said that the material is rigid. Modulus of elasticity is obtained from the ratio of tensile strength to strain in the elastic region. ABS test material shows the following tensile modulus:

Table 2. Modulus of elasticity of original ABS

Inject	Material without synthetic fiber		Material with 10% recycling material without synthetic fiber		Recycled 50% and 2.5% synthetic fiber.	
	Original ABS without synthetic fibers	Modulus Elastisitas (70-90) MPa	Percentage of ABS recycled without synthetic fibers	Modulus Elastisitas (70-90) MPa	Percentage of recycled ABS and 2.5% synthetic fiber	Modulus Elastisitas (70-90) MPa
1	100%	67	10%	60	50%	93,7
2	100%	66,1	10%	60,1	50%	93,8
3	100%	66	10%	60,3	50%	94
4	100%	66,2	10%	60,6	50%	93,9
5	100%	66,4	10%	60,8	50%	93,6
6	100%	66,5	10%	60,9	50%	93,8

Test results based on the above table show that the addition of recycled ABS[9] (acrylonitrile butadiene styrene) 50% and 2.5% synthetic fiber affect the elastic modulus of ABS (acrylonitrile butadiene styrene). The effect shows a tendency to increase the modulus of material elasticity. The addition of recycled ABS weighing 50% of the original material and 2.5% synthetic fiber of the entire material to be processed shows maximum effect.

4.5. Effect of recycled ABS (acrylonitrile butadiene styrene) percentage and 2.5% synthetic fiber on hardness

Hardness shows material resistance to constant change. This test can be done by way of emphasis, reflections and scratches. In this study the concept of rain is done with emphasis. The method used is the shore scleroscope system with the standard JIS 2240. Data from the hardness test results can be seen in the following table 3.

Table 3. Hardness of original ABS material without synthetic fiber, 10% recycled material without synthetic fiber and 50% recycled material with synthetic fiber[10].

Inject	Percentage of original ABS 100%, without synthetic fibers	Hardness Scleroscop kJ/m2	Recycling percentage of 10% without synthetic fibers	Hardness selerescop kJ/m2	Percentage of ABS recycled 50% with 2.5% synthetic fiber	Hardness selerescop kJ/m2
1	100 %	10,1	10 %	8,2	50%	31,4
2	100%	10	10%	8,3	50%	32
3	100%	9,8	10%	8,1	50%	31,3
4	100%	9,5	10%	8,3	50%	31,5
5	100%	9,5	10%	8,3	50%	31,7
6	100%	9,6	10%	8,3	50%	32

5. Conclusion.

In accordance with comparative data the quality and number of products produced has increased by 13.12%. With a lower product defect rate which is down 15.2%. The existence of material engineering when viewed from the economic side of the addition of 50% of recycled materials, the cost of material procurement is much cheaper when compared to using 100% original material. With the reduced price of the multiplier material for the handle and side pump gun handle, up to Rp 2,758,000.00 per 300 pcs of production. Visually shows the addition of recycled material weighing 50% of the original material and 2.5% synthetic fiber of the material to be processed does not affect the appearance. This is certainly far different from the trial of adding 70% recycled material. The trial results are not attached because they are stated far, the visual display is far from the specified standard criteria. Addition of recycled materials up to 50% such as mechanical properties does not diminish from the original properties. So that in terms of reliability the mechanical properties are still good and are above the original nature. From this data also obtained an increase in tensile strength, modulus of elasticity, and product hardness as expected. From the above data it can be concluded that the composition of this material is suitable for the use of rifle butts and rifle pump handles.

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