Creating a Draft Design and Quality Plan for Packing Material for PT. Apollo Aneka Persada Batam

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Abstract: PT. Apollo Aneka Persada (AAP) is a plastic injection company that focus on making pipe accessory (pipe and thread protector). thread protector, bevel protector, end cap, separator bar, a-rap, spacer, bumper ring, and varnish coating for pipe. International Maritime Organization (IMO) will implement a reduction from 3.5% to 0.5% sulphur for every ship, based on the new regulation that have been made in 2016. PT. There are only 2 options, whether changing the fuel or applying the scruber tank. PT. AAP has a new product for the scrubber tank and it is called Packing Material. PT. AAP still does not have any design for Packing Material and PT. AAP needs to make a design for the mold. The design was made by Solidworks in 3D model, and then converted into 2D to ease the mold maker on seeing the draft. This new product also needs to be controlled on the quality, so this research is focused on making the design of Packing Material and making a Quality Plan. This Quality Plan is to control the quality of Packing Material on every process production based on the acceptance criteria that QA Department have made.

Keywords: Product Design, Quality Plan.

Introduction

PT. Apollo Aneka Persada (AAP) is a plastic injection company that focused on making pipe accessory and pipe varnish coating based in Batam island. PT. AAP has a lot of products like thread protector, bevel protector, end cap, separator bar, a-rap, spacer, bumper ring, and varnish coating for pipe. Lately, PT. Apollo Aneka Persada has a new product to make. This new product called Packing Material.

There is a new regulation on 2020, that International Maritime Organisation (IMO) will implement a reduction from 3.5% to 0.5% sulphur for every ship. This regulation caused a lot of ships to either changing their fuels that will cost more, or adding a Scrubber tank. In this Scrubber tank, there are lot of components inside, such as Packing Materials, Mist Separator (Demister), Spiral Nozzle and a lot more. PT. AAP has never make any of this product so they need to make a draft of this Packing Material to make a new mold. this new product does not have any quality control system and inspection method.

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Research Methods

Product Design

Definition of Product Design

Product design is a process to create a new product to sell from a company to another company or to an individual (customer) (Ahmadi, [1]). Designers can design a product in 3D model. With this 3D modelling, designer can easily give detail information of the product to the customer or people who contribute with the product. And also, this 3D modelling, is one of the way for designers to communicate about the product by visual. Designers have responsibility on giving detail information on the product. There are a lot of softwares to draw or draft a design for a product, such as Solidworks, AutoCad, Inventor, etc.

Product Design Goals

The main goal of product design is to help a company to create a new design of a product. An injection molding company really needs a design for the product and the mold to manufacture. These are the goals of the product design (Creohouse, [2]):

- To avoid any possible mistakes from creating any products.
- To get the best and economical method from creating any products.
- To determine specification of the product.
- To determine the price and cost making of the product.
- To produce a product with high quality with high value.

Product Design Process

Designing a product is not an instant move, it needs some processes to do. From planning, doing research, brainstorming, making a prototype and presenting the design to the audiences. Here are some processes to follow which can be seen from figure 1 (Russel, [3]):

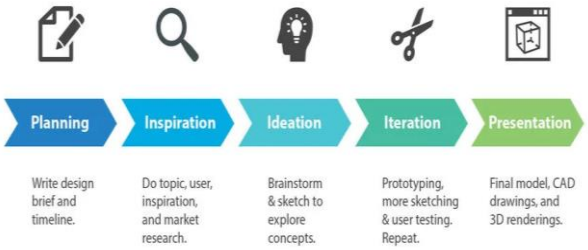

Figure 1. Process of design

a. Planning
The first process on designing a product is making a plan. Write down any plan for the project. If needed make a Gantt Chart of it to make it easier to trace what to do base on the schedule.

b. Inspiration
Do a research, from user and market. There is a lot of type research that designer can do, from interview one on one to the user or market, making a survey and spreading it directly or online, or just find some inspiration on internet.

c. Ideation
Brainstorming is the next step from research. Gather every ideas from research and do a brainstorm with the team. This brainstorm is to find the result of the research and find the best concept to design the product. There is a lot of technique for brainstorming like sketching, wireframing, and storyboarding.

d. Iteration
After the concept of the product is done, make a prototype of the product. Designers need to test the product before it will be mass produce, so sample or prototype is needed. The prototype is to make sure that the final product is good enough to make.

e. Presentation
After the prototype is good, then the final step is making a presentation. This presentation is the final model of the product. Final model of the product are presented in 3D, because it will be more flexible to show to the audience.

Quality Control

Definition of Quality

In every manufacturing company, quality is a very important thing to maintained. According to Jain, [4] the meaning of quality is every product that has been manufactured should met the company or customer requirements or specifications. There must be an agreement between company and customer on the requirements and specifications, so both company and customer give the best treatment to each other. Quality of a product as customer valuation on the excellence of the product itself. If customer judgement on the customer is not good enough, then the product is considered as bad quality.

Definition of Quality Control

Quality control is a system that maintain quality by collecting feedbacks on the product characteristics so the product not deviate from the standard (Mitra, [5]). A company has their own (internal) standards or customer (external) standards and these standards can be improved by time. Quality Control Department on every company needs to maintain and make sure that the quality of every product is good and have the same requirements and specifications as standards. There is a difference between Quality Assurance and Quality Control. Generally Quality Assurance has a job to make sure that the product has a good quality and Quality Control has a job to control the quality of the product. There are some tools to control the quality of a product. These tools are commonly known as Seven QC Tools. These tools are used to found any defects on the product. These are the explanation of Seven QC Tool:

- Check Sheet
- Pareto Diagram
- Cause and Effect Diagram
- Histogram
- Control Chart
- Scatter Diagram
- Flow Chart

Cause and Effect Diagram or commonly known as Fishbone Diagram, is the only tool that has been used in this research. This diagram is founded by Dr. Kaoru Ishikawa, then this diagram is known as Ishikawa Diagram. This diagram is used to identified the root cause of a problem. On the head of the fishbone is the main problem and the other bones is the causes that contribute to the problem.

Quality Plan

Quality Plan is a document or set documents that consists of quality standards of the products or services (Rasumessen, [6]). Planning is one of the management strategies to make the objectives of the company can be clearly informed to all the staffs. This is an example template for the Quality Plan Document as can be seen on figure 2:

					QUALITY PLAN					
					Prepared by:		Approved by:		Page:	
									Date:	
									Document No.:	
									Revision No.:	
No.	Process	Machine Name	Checking Point	Acceptance Criteria	Inspection Tool	Frequency	Checking Method	Checked by	Data Check	Action

Figure 2. Quality plan template

Quality Plan is so important for a product. Quality Plan here is to show the information of how the company manage for the quality of the product. These are explanations on the informations of the Quality Plan:

- Process, the steps of the making the product.
- Machine name, machine name(s) that have been used in the process.
- Checking point, checking the important part of the product.
- Acceptance criteria, the criteria of the product that can be accepted.
- Inspection tool, tool(s) that have been used to inspect the product.
- Frequency, how many times is the inspection
- Checking method, how the product is checked.
- Checked by, who do the inspection.
- Data check, the data report of the inspection.
- Action, what is the next step if the product is rejected or can be reworked.

Result and Discussion

Random Packing Material

The dimension of this Packing Material is only 85 x 85 x 95 mm and for 1 m^3 there will be 1162 pcs. There is a lot of variation of diameter of the scrubber, here is an example for diameter of scrubber tank is 6 m and 2.5 m height. It means that the volume of the tank is 70.65 m^3. So, for 1 tank there will be 82,095 pcs of Packing Materials. These whole Packing Materials are poured down to the Scrubber tank and not arranged well.

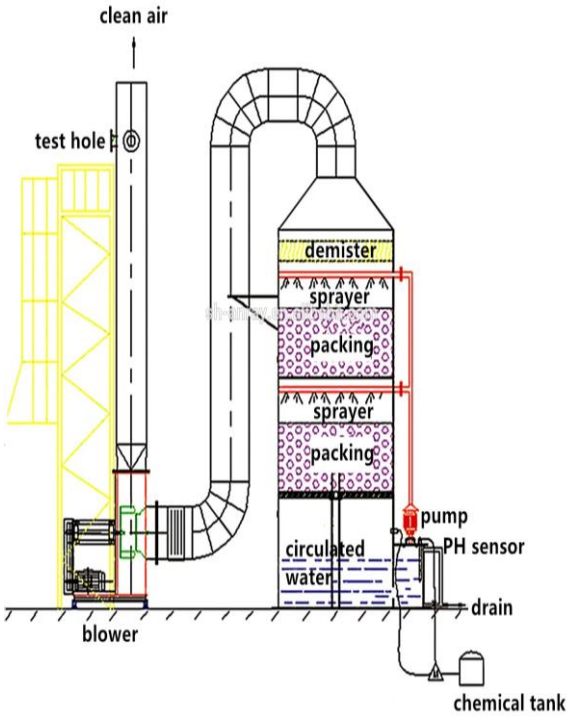

Figure 3. Scrubber tank

Based on figure 3, the way this Scrubber tank work is, after the Scrubber tank is full of the Packing Materials, then liquid are sprayed to the Packing Materials. Because of the drip points of the Packing Material, then the liquid will be spread into droplets. Then, these droplets will collect the chemical from the gas that contain sulphur. So, the gas that go through the tank is clean air and the chemical is collected in a chemical tank.

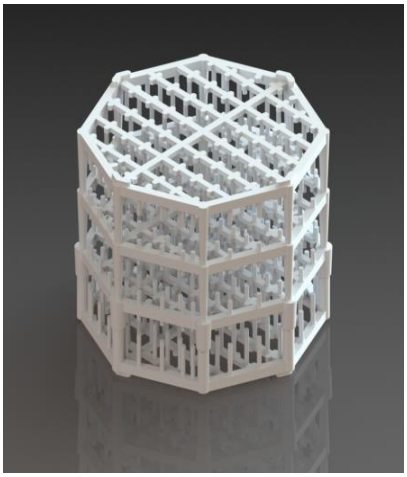

Figure 4. Packing Material (AAP NH-168)

This Random Packing Material was designed by Solidworks as can be seen from figure 5. It has 4 different parts and each part is attached to the other. The most important thing of this Packing Material is the drip points. For the Part 1 and Part 4 there are only 100 drip points, and for the Part 2 and Part 3 there are 200 drip points for each part, so the total of the drip points on 1 set is 600 drip points.

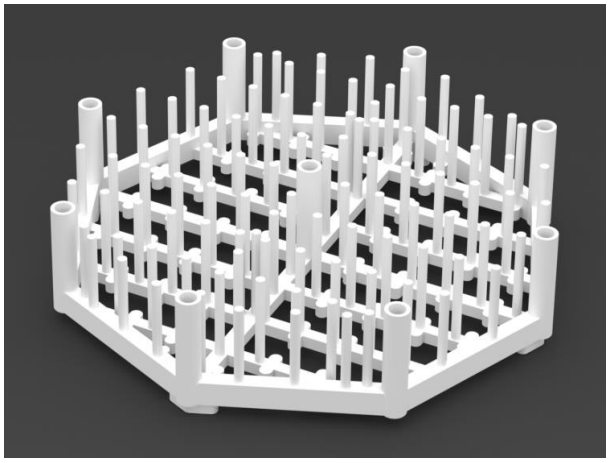

Figure 5. Part 1 of Packing Material

Moreover, the difference between the 4 parts is on the pillar. This pillar is the foundation of the parts and the connection between each part. For the frame of each part is the same and every part has an octagonal shape. The other parts can be seen on the appendix. After making the 3D model of the Packing Material, then convert to 2D for the mold maker to make the mold. 2D drawing can be seen on figure 6.

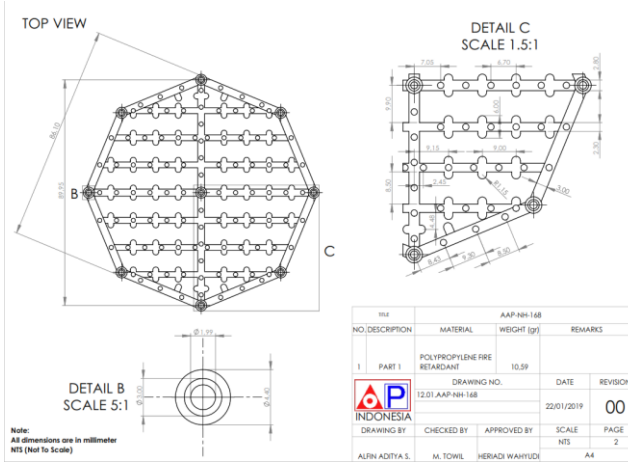

Figure 6. 2D drawing of Packing Material part 1

This 2D drawing is giving more details on the dimensions of Packing Material. Because of there is a lot of tiny parts on this Packing material, then the Top View, Side View and Bottom View are separated into 3 drawings. In this drawing also there is information on the material, weight, drawing number and other elses.

Production Process

The production process of injection molding is quite simple. From making a design of a product that want to be made, then sending the design to the mold maker, after the mold is done then the main process is the injection process. There is 4 parts in a product so there is an assembly process. After all the parts are assembled well, the Packing Material are packaged into a jumbo bag. The detail of the production process:

1. Incoming Goods

The raw material is plastic seeds and there is some more materials needed to be mixed, but the main material is plastic seeds. All of the raw material that coming into the store are inspected by QC Inspector. The inspection is only to make sure that the raw material that came is according to the order. There are a lot of types of plastic seeds, and the one that been used for this Packing Material is Polypropylene Fire Retardant. This material is fire resistant because of in the scrubber tank the temperature is very hot, so the material needed to be fireproof.

2. Raw Material Mixing

The process of mixing material is only Quality Assurance Department that has responsibility to make and release the formula. Quality Assurance making the formula based on the datasheet of the material. After the mixing formula is released, then Material Department will start to mix the material. This mixing process is to make sure that the result of injection process is according to customer requirement or specification.

3. Injection Process

The injection process is the main process of making the Packing Material. First, the raw material are poured to the container (Hopper) of the machine. Then, the plastic seeds are go down to the barrel where the material will be melted and pushed to the nozzle. From the nozzle, the melted plastic seeds will be injected to the mold. After the injection is done and with several times of cooling, the mold will open and eject the product. This product is almost a finished goods because there still a cutting process of the material leftover from the injection process.

4. Weight Product Inspection
After the injection process there is an inspection of the weight of the product. This inspection is by weigh the product by scales. If the weight of the product not according to the acceptance criteria then the product will be rejected.

5. Drip Point Lost Inspection
QC Inspector checking the drip point by visual check. The acceptance or rejection of the product is based on the drip point lost. This inspection is only using visual check, and Inspector does not need to count it one by one.

6. Drop Off Test
After all the parts are attached, then QC Inspector do the drop off test. This test is to make sure that the product is strong enough. QC Inspector drop the product from 2 meters, if each part detached from other parts, then the product counted as reject.

7. Assembly
After the injection process and cutting the leftover material is done, then the 4 parts are carried to the assembly area. In the assembly area, the assembling part is differentiated into 3 process, assembling part 1 and 2, part 3 and 4, and all part.

8. Packaging
This Packing Material is do not need to be packaged neatly, then the packaging of the Packing Material is only in a jumbo bag and not in a box. The volume of jumbo bag is 1 m^3, so there is approximately 1162 pieces of Packing Material in 1 jumbo bag. After all the package is done, then QC Inspector stick the QC Pass sticker on the jumbo bag.

Quality Plan

Quality plan is made to maintain the quality of the product and to satisfy customer by giving the product according to the requirement. Quality plan are provide in table so it will easy to understand. Quality plan was made according to production process and giving more detail information on the machine name, checking point, the product acceptance criteria, inspection tool, frequency on inspecting the product, checking method, checked by, data check, and action. Quality plan can be seen on table 1.

Analysis

Quality plan was made to show the steps to design a quality control system for every process of a production. To maintain the quality of product, operator need more awareness to recheck the product that have been done. This high production

Table 1. Quality plan

					QUALITY PLAN					
					Prepared by:		Approved by:		Page:	
									Date:	
									Document No.:	
No.	Process	Machine Name	Checking Point	Acceptance Criteria	Inspection Tool	Frequency	Checking Method	Checked by	Data Check	Action
1	Incoming Goods	-	Raw material	- According to order - No contamination on material	Visual check	Once every raw material arrive	Sampling inspection	QC Inspector	PF-QC-02.08 Incoming Material Inspection Report	If material is different from the order, return the material
2	Mixing Process	Mixing machine	Mixed material	According to the formula	Visual check	Once every mixing process	Sampling inspection	QC Inspector	Mixing Material Report	If the mixing is different to the formula, quarantine the mixed material
3	Injection Process	HXW	Semi-finished goods	- Good display on the product (full injection) - No crack - Product color is clear white	Visual check	First, forth, and seventh hour of production on every shift	Sampling inspection	QC Inspector	AAP NH-168 PP Report (PF-QC-03.01/REV00)	If there is any defect on result of injection (not according to acceptance criteria), then recycle to plastic seeds or rework is possible
4	Weight Product Inspection	-	Product weight	Weight tolerance of each part is ± 5% from standard weight	Scales	First, forth, and seventh hour of production on every shift	Sampling inspection	QC Inspector	AAP NH-168 PP Report (PF-QC-03.01/REV00)	If the weight not according to acceptance criteria, then recycle to plastic seeds
5	Drip Point Lost Inspection	-	Drip point of the product	Less than 2 drip points lost on each part	Visual check	First, forth, and seventh hour of production on every shift	Sampling inspection	QC Inspector	FINAL INSPECTION REPORT PF-QC-03.02/REV01)	If the drip point lost not according to acceptance criteria, then recycle to plastic seeds
6	Drop Off Test	-	Product strength	Product is not broken after drop off test and no deformation	Visual check	First, forth, and seventh hour of production on every shift	Sampling inspection	QC Inspector	AAP NH-168 PP Report (PF-QC-03.01/REV00)	If the product broke after the drop off test, then recycle to plastic seeds
7	Assembly	-	1 set of the product	Every part is attached to the other and not easily detached	Visual check	4 times on first hour then once every next hour	Sampling inspection	QC Inspector	FINAL INSPECTION REPORT PF-QC-	If the every part is not attached, then recycle to plastic seeds
8	Packing	-	Packaging	- Product is according to customer's demand - Packed in jumbo bag with QC Pass sticker	Visual check	Once on every packaging	100% Inspection	QC Inspector	AAP NH-168 PP Report (PF-QC-03.01/REV00)	If there is no QC Pass sticker, then add the QC Pass sticker

capacity per day, is almost impossible for QC inspector to inspect all of the product (100% inspection). The operator who mix the raw material and machine operator who put the material to the hopper both need to make sure that there is no contamination on the material to reduce the rejection of the product because of material contamination. Then, machine operator who has a job to cut the leftover material, also needs to make sure that the product has no flash and reject products need to set aside (recycle). Assembly operator needs to be careful on assembling the parts so there no drip points lost beside the machine error (short shot).

Conclusion

PT. Apollo Aneka Persada (AAP) is a plastic injection company that focused on making pipe accessory and pipe varnish coating based in Batam island. Based on International Maritime Organisation (IMO) new regulation, every ship needs to change the fuels or using a scrubber tank. In the scrubber tank, there is a lot of Packing Materials needed. With this new regulation, PT. AAP produce Packing Material to fulfill customer demand for the scrubber tank. This Packing Material is a new project for PT. AAP and there still no design and Quality

Plan for the Packing Material. PT. AAP needs to make a design for the Packing Material, therefore the purpose of this research is to make a design for the Packing Material. The design of Packing Material is drafted in Solidworks.

There are 4 parts of Packing Material, and each part is different to others. The designs are given in 2D and 3D view so it will easily understand.

This Packing Material also doesn't have any Quality Plan, so this research is to make a Quality Plan for the Packing Material. This Quality Plan is to show the quality control of every process production, so QC Department can maintain the quality of the product. Quality Plan is given in table so it will easily understood for everyone who seen it.

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