

Defect In The Process Of Injection Moulding: Plastic Manufacturing Factory Issue And Solutions

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ABSTRACT: Major problems faced by plastic manufacturing factory were high defective percentage in produced product. This study is carried out at a plastic manufacturing factory which carried out injection mould process located in Penang. Injection mould process is one process to generate various products based on plastic. In this study researchers would study those products called Finder Base as study material by obtaining defect data from the specific factory to study the process capacity of the creation by using capability process index (C_{pk}) and also predicting any defect in the month of November and December 2009. From analysis made, it has been discovered that Finder Base product's manufacturing process is not capable in the manufacturing process because during 34th months of the product take out just nine month only index's value $C_{pk} \geq 1$. While defect forecast in the month of November and December 2009 method used moving average (MA) found defect number increasingly rise against previous months with 2850 defect unit forecasted in the month of November and 2815 defect unit in December 2009.

Keywords: Defective, Plastic, Capability, Forecast, Product

INTRODUCTION

Goods usage based on plastic in Malaysia continue to increase where increasingly widespread plastic material use his use together with residential population development growing from time to time by rapid economic development see much industry based on plastic manufacturing grew rapidly in our country. Plastic product we always see and use daily such as food wrapper, electronic equipment, vehicle accessories, home appliance, toy, automotive equipment, furniture etc. Material utilization increase base on plastic are because plastic having own advantage such as flexible, having high absorbency on shock loading (impact load) and vibration, resilient and malleable rust . Plastic goods use widespread now because of several factor such as light and cheap by own unique color and tidiness design (Amelia. 2008). The increasing demand on products based on plastic had caused plastic manufacturing industrial development in Malaysia.

Malaysian Plastic Manufacturer Association President (MPMA) Lim Kok Boon said, plastic manufacturing industry is one economic contributor to our country. News from Bernama said that, plastic industry in Malaysia remain stay when grow 8.3 percent and sales recorded RM7.96 billion in first half of the year 2008 from the RM7.35 billion in the year 2007. Exports recorded strong growth 18 percent with RM4.6 sales billion compare RM3.9 billion in that same period year 2007. To remain competitive in global market, companies need to take advantage from the increased of material to expand respective business profile and by the attracted of large overseas market. All companies should continue improve product, process and business, whether in manufacturing excellence, production speed, in production quality or in product design, he's said.(Source: Bernama.Com 13.Oct 2008)

Research Background

Study-conducted researcher is about plastic product defect based on injection mould process. In this study researcher will studies defect on the type of plastic product. This study is made at a factory which carried out injection mould operation. Researcher has chosen plastic manufacturing factory in Penang as study location.

In plastic manufacturing industry not all those products produced according to the standards their wish for, those products do not follow standards in categorized as disabled product. Disabled definition as any failure to one unit is in order to meet specification to one particular quality feature, when assessment involves use. While defect also any unit have one or more disabled, probable involving a number disabled features. It used when one product unit or service in assess in consumption pattern (Dr Zalinda Othman, 2005).

Problem Statement

Main problem faced by plastic manufacturing factory was high defect level in either their production products namely Finder Base (EC 213) a plastic components in Canon lens's camera. This component is one of the parts in camera components lens. This product selection is predicated most frequent component or products always have problem in manufacturing process compared to another product. From the interview with quality control unit in plastic manufacturing factory, most frequent defect occurring on this product was flashing. Among frequent other defects occurring on this product are such as Warpage/ Bend, Sink Mark and Short Mould. Table 1 shows characteristics for Finder Base 's products

Table 1. Product Features

Product Name	Finder Base
Component No.	EC 213
Types Of Material	ABS Techno Nc401 Pc138
Colour	Black
Defect	Flashing, Warpage/ Bend, Sink Mark, Short Mould

Objective Of The Study

Among objective of the study is:

Identify whether Finder Base products is in capable or poor in their manufacturing process by using capacity process index (C_{pk}).

Use prediction method to predict defect number in coming months.

Scope of Study

To attainment of the objectives, this research is done by using method case study which will doing in plastic factory based on process operation mould injection. Data's obtain by two sources which are last data and interview from quality control technique factories. Data's achieved based on two source namely from last data and also from interview quality unit control in that factory. This research committed against a most problematic product type generated by plastic manufacturing factory.

Importance of Research

Importance between of this research is:

This study is made so that can identify capacity something inside production products in manufacturing process, beside follow-up action can be taken based on capacity level to something production products. Hereby raw material waste rate can be avoid and minimize operating cost. This study also aims to reveal on prediction method would be vital to predict defect in future based on current performance. Apart from that also, purpose of this study would be to expose immensely useful quality control practice to production industry which functions as improve the quality manufacturing.

Literature Study

Defect Definition

Disabled can be defined as any failure to one unit in order to meet specification to one particular quality feature, when assessment involves use. While defect also mean any unit have one or more disabled, probable involving a number disabled features. It used when one product unit or service valued in consumption pattern (Dr Zalinda Othman,2005). Predefined defect any obstacle obstructive in process or service in products manufacture

for customer requirements. Failure in order to meet those needs was being proposed is either failure character quality or particular type that does not fulfill specification of necessity. A product or service is not meets the requirements or criteria by consumer is called defect, such as security features (Bill Motley. 2006).

In books 'polymers, the environment and sustainable development' said this substance has applied since world war second, especially at making military needs equipment. However uses not so widespread and only used to be added inside element materials composite to get necessity nature. Plastic is polymer but polymer does not necessarily plastic. Polymer constitutes wood, rubber, glass and ceramic other than plastic. Plastic material was polymer material behave rigid or semi rigidity (semi rigid). All plastic materials will be tender when heated. Materials formation processes plastic done when it's in liquid,

Plastic Qualities Thermoplastic

This type plastic may be tempered and turn hard repeatedly with imposed suitable heat and pressure. It can be decomposed if too high heat temperature imposed.

This is linear polymer formed of tied long carbon chain by covalent bond. Thermoplastic can be obtained in piece form, tube, thin sheet and rod.

Formation could be made in temperature above water boiling point temperature and need some force to change the form.

Between of this uses are toys, equipment holder, insulator, packer and clothes.

Plastic Qualities Thermosetting

Molten material during first time heating and then curing to hard and rigid form and will not changes if in second heating.

After first formation, no changes happened even heating and applied pressure.

Usually harder, stronger and more fragile compared thermoplastic.

The uses of Plastic Thermosetting are such as electrical insulator, fiberglass, utensil and heat insulator layer.

(Source: Wright R, 1991)

Injection Moulding

This is injection plastic material process that had in liquidizes and injected into mould to seek form or products according to mould form and followed by cold process. This process suitable for complicated plastic production shaped. It is the fastest process and extensive used.

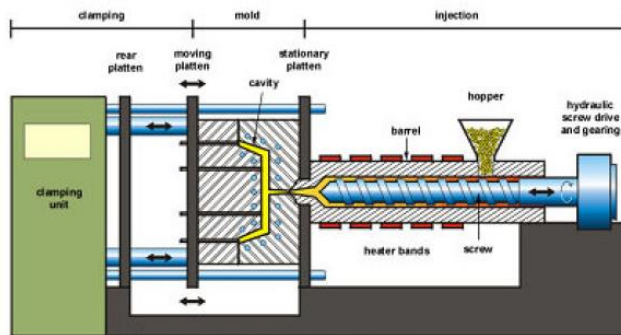


Figure 1. Injection mould machine components

Capacity Process Index (C_{pk})

Capacity Process Index (C_{pk}) used to measure capacity of products manufacturing process to comply specification that is fixed.

By consider process normality (C_{pk} > 1). This means we want C_{pk} value ≥ 1.

When C_{pk} = 1, this show equivalent process dispersion with dispersion between specification. When this happened, this process can be called potential rate.

If C_{pk} < 1 it shows the process in no capacity position in producing process.

Literature Review

From studies which is done by Azman and Jafri, (2001) formulate that quality control basic technique was one method to increase quality and output productivity and ensure need or customer specification filled. In this study, some methods from sevens quality control basic technique was practiced to resolve two inside major flaw type

products manufacture process billet in steel industry. Two that major flaw type based on Pareto Chart was pin hole and distortion. By apply a few quality control basic technique such as Pareto chart, Control Chart, cause and effect diagram, scatter diagram, flow chart and check sheet a few solution measure plan repair had used to increase product quality billet. Research results showed percentages rate of reduction two that major flaw type, namely pin hole as much as 11% and distortion as much as 2%.

Myer Ezrin et al, (1999) had studied why occurrence of defect in plastic manufacturing in his study entitled "Plastic Product Failure Due To Design, Material or Processing Problem". In his study, he divided into two causes main class damage namely second first class and class. Most plastic product handicap case happened is due to failure at first level as in injection mould process and also in second class of class operation such as material or used raw material during unsuitable process. Based on Bordonaro et.al, (2004) perusal, states that temperature mould is highest influence on quality of a product. Temperature influence influenced by type material plastic used, because every type of basic material plastic own temperature level different processes. Jani and Rosilinawati, (2002) formulate in his study in carried out at a plastics industry that one factory method used trial and error in machine coordination and had no specific studies on those products conducted will experience sufficiently large defect floor. As such, one factory could not find real factors power in minimize product defects. Defect is products that cannot fulfill the normal character in specification. It fall into two principal divisions namely primary features and secondary features. Primary features is defect which occur after products manufacture process made such as short mould, sink mark, void and secondary features is defect which occur after the products are used like broke 'crack'. (Gaspersz, 2003) .

METHODOLOGY

Methodology Study provide as guideline to studies which operate whether from aspect to obtained data or analysis of data. Organized and effective study methodology would facilitate study process implemented by ensure study-conducted is parallel to his objective. Study methodology efficient would ensure related and useful data only grouped and included in analysis so that could produce result more accurate.

STUDY FINDINGS ANALYSIS

Capacity Index Process (C_{pk})

Overall, index value minimum process capacity is $C_{pk} = 1$. Increasingly invaluable mean capacity process capacity process is better. If index value $C_{pk} \geq 1$, its mean process fulfill of specification and more capable in process. If $C_{pk} < 1$, it shows capacity is weak process. (Neil Polhemus, 2002) Data's in analysis index form process capacity, C_{pk} (Capability Process Index) namely either quality control tool to assess inside products manufacture process industry whether capable in operation or no capable by using QI MACROS 2009 Excel liquidware.

Study Analysis Of Data Based on Capacity Process Index (C_{pk})

Based on Table 3 Appendix A, shows defect data products for Finder Base's component. From analysis of data schedule found in year 2006 this products is first year take out in December show production process is not capable or weak because $C_{pk} < 1$ value. During 34 months of this products taken out, just nine month, this process fulfill of specification and potential in process by referring $C_{pk} \geq 1$ value. In year 2007, only four month of process in the potential position those are on February, June, August and December. C_{pk} index in year 2008 showing that only four month of this products manufacture process be in process capable namely in May, July, August and November. While in year 2009 only one month only C_{pk} index ≥ 1 namely in August.

Defect Forecasting Finder Base Products for November and December 2009

For this purpose researcher use ForecastX Excell liquidware which accounts one of the liquidware occur in Six Sigma liquidware. Figure 2 show schedule example produced by using ForecastX Excell liquidware for this analysis purposes.

Date	Flashing Forecast		
	Monthly	Quarterly	Annual
Nov-2009	1,530.26		
Dec-2009	1,509.68	3,039.95	3,039.95
Jan-2010	1,479.09		
Feb-2010	1,496.56		
Mar-2010	1,457.90	4,433.55	
Apr-2010	1,406.10		
May-2010	1,358.75		
Jun-2010	1,370.66	4,135.51	
Jul-2010	1,328.85		
Aug-2010	1,312.88		
Sep-2010	1,284.52	3,926.25	
Oct-2010	1,277.51		
Avg	1,401.06	3,889.82	3,039.95
Max	1,530.26	4,433.55	3,039.95
Min	1,277.51	3,039.95	3,039.95

Figure 2. Monthly forecast schedule

Forecast Schedule Defect for Month November and December 2009

Table 2. Defect forecast of November and December 2009

Year	Month	Product Defect				Total Defect
		Flashing	Warpage/ Bend	Sink Mark	Short Mould	
2009	Nov	1530	365	235	719	2850
	Dec	1510	357	236	712	2815

Table 2 above showed defect forecast for Finder Base’s products of November and December 2009 method used moving average (MA). In the month of November found defect type flashing is highest defect forecast compared to other defect types with defect number 1530 defect unit and number total 2850 unit. In December found defect flashing is highest defect forecast to four that defect type namely 1510 defect unit and number total was 2815 unit.

Conclusion Objective Of The Study

In analysis has been done in previous chapter, researcher wish to summarize that this study has answer all objective of the study issue. researcher have conducted study in plastic factory producing by taking those products called Finder Base in produce through moulding method mould as study material. Product selection this is predicated to products most problematic in his manufacturing process in this factory. This products experience defect floor highest as compared with other products. In study analysis in make, researcher found most capacity index C_{pk} process in Finder Base products’s defect for period 34 his production month is $C_{pk} < 1$. These show process capacity Finder Base products manufactures was weak and not follow real specification. Just nine month only of 34 Finder Base production’s month is in capacity in manufacturing process where $C_{pk} \geq 1$. At the same time also, in find out forecast for number defect of November and December are soaring if in compare with previous month respectively 2850 unit and 2815 unit.

Overall Conclusion

For the overall, we can conclude that defect occur on Finder Base products is because no specific specialization to prevent this disorder from continue to repeat. Method used by plastic manufacturing factory is inside prediction method overcomes the defect problem. Based on index value process capacity (C_{pk}) in schedule 4.1 found more than half C_{pk} index’s value monthly defect products is less than 1. This show weakness in products manufacturing process Finder Base.

Study Proposal

Improve should be done so that products manufacture operating cost does not increase and also do not waste the time, energy, source and productivity. There are researcher bring up some suggestions that their thinks suitable to overcoming this such as apply a few basic technique in Statistical Process Control (SPC) like cause and effect diagram and control chart and also shorten inspection time upper products or sample. Cause and effect diagram is referring to explain reasons occurrence of problem and due to. Control Chart is evaluates and maintains stability something process. Shorten inspection time upper products from two once hour to an hour once to minimize defect because able defect in earlier effect.

Table 3. Capacity process index (Cpk) of Finder Base defect

Year	Month	Product Defect				C _{pk}
		Flashing	Warping/Bend	Spot Mark	Short Mould	
2006	Dec	2230	617	212	965	0.8898
2007	Jan	2550	514	230	1237	0.9191
	Feb	555	593	641	919	1.0503
	Mac	2811	603	330	1411	0.9243
	April	3219	574	177	1951	0.8987
	Mei	3016	545	424	1078	0.954
	Jun	954	397	327	910	1.0864
	July	2792	398	274	1218	0.948
	Aug	1872	346	213	1861	1.1398
	Sept	2277	273	216	478	0.9828
	Oct	1923	326	237	613	0.9411
	Nov	2842	558	225	354	0.9749
	Dec	2249	231	189	252	1.0123
2008	Jan	1991	239	113	351	0.9448
	Feb	1281	491	118	438	0.8751
	Mac	1260	366	150	663	0.8938
	April	448	279	286	591	0.9819
	Mei	1227	236	77	1286	1.088
	Jun	1208	243	202	604	0.953
	July	1066	169	217	813	1.0183
	Aug	658	100	250	704	1.0195
	Sept	1165	144	198	547	0.9471
	Oct	1006	178	143	264	0.975
	Nov	1105	426	144	1031	1.0016
	Dec	1120	303	200	657	0.9302
2009	Jan	1180	434	255	544	0.896
	Feb	1257	530	327	265	0.946
	Mac	1207	290	191	283	0.9693
	April	895	310	149	513	0.8888
	Mei	1177	277	138	457	0.9156
	Jun	1168	283	260	437	0.9704
	July	1240	356	252	338	0.9681
	Aug	1080	237	215	188	1.0013
	Sept	670	240	422	231	0.9658

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