Quality Control Analysis to Reduce Moist Defects of Dolomite Materials with Six Sigma Methods (Dmaic, Fmea) PT. Muliaglass Float

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***Abstract*—** The goal of this study is to examine the quality control of the dolomite used as a raw material to make glass sheets. The study was carried out at PT. Muliaglass Float is a business in the industrial sector. The population of this study is the dolomite raw material, which was delivered as 3,764,200 samples and weighed 9,767,500 kilos over three months, with a moisture content of 13.32 percent overall. Six Sigma DMAIC (Define, Measure, Analyze, Improve, Control) and FMEA are used in the analytical process (Failure Mode Effect Analysis). The increase in sigma levels before and after the process has shown that quality control using the Six Sigma approach is a successful strategy for raising the quality of dolomite raw materials. However, due to several factors, including a lack of awareness of the value of quality control and the high expense of maintaining warehouses as a location to keep raw materials, the deployment of the Six Sigma DMAIC and FMEA procedures in the organization has not been performed satisfactorily. The article discusses the ramifications of this research.

***Keywords*—** FMEA, Six Sigma, Dolomite, DMAIC, Defect, Quality Improvement.

I. INTRODUCTION

In the manufacturing industry sector where one of the important things that must be considered is the proper operational flow through the Standard operating procedure (SOP) and the method of testing the feasibility of the quality of the raw materials to be used before carrying out the production process of an item. According to Soemarso (2005:271), raw materials are objects that function in the production cycle that can be effectively and directly identified in goods or finished products. The purpose of quality control is to prevent delays in the production process of goods and to reduce production costs. One of the quality control methods that can be used is to use the Six Sigma method on the DMAIC concept (Define, Measure, Analyze, Improve, Control) and FMEA (Failure Mode and Effect Analysis). According to Gasperz (2002), six sigma is a statistical notion that refers to processes where faults at a level of six (Six) Sigma only occur in 3.4 out of a million possibilities. The essential element of the DMAIC concept is the design of the actions that must be taken to enhance each stage of the business process, and the FMEA concept is an organized method to identify and avoid failure causes (Gasperz 2010). The benefits of applying the Six Sigma approach to the DMAIC idea include problem measurement, customer focus, testing or demonstrating the problem's root cause, interrupting the cycle of ingrained behavior, and risk management.

A division of the Mulia Group that manufactures glass is called PT. Muliaglass Float Division. In comparison to other glass goods, flat glass has the biggest volume due to the greater level of consumer demand for sheet glass items. Maintaining the quality of the raw materials that will be used in the production process is thus one of the efforts made by PT. Muliaglass Float. A dolomite issue was discovered using information and data from the Quality Control (QC) department. Due to a moisture problem in dolomite that is not yet specific to the wet dolomite quality standard established by the company, this incidence occurred. The overall average moisture content ranges from three to fourteen percent (13-14%) and even as high as.

Table 1: *Number of arrivals of dolomite and moist*

Supplier	Arrival and Moist Dolomites						Average *Moist* (%)
	January 2021		February 2021		March 2021		
	Amount (Kg)	*Moist* (%)	Amount (Kg)	*Moist* (%)	Amount (Kg)	*Moist* (%)	
PT. PMU	5.921.830	13.37	4.028.520	13.28	5.810.390	12.76	13.11
PT. KTB	3.477.980	13.29	2.525.320	13.31	3.764.200	13.39	13.32

Source: The results of data processing PT. MGF 2021.

There are still quite a few damp faults in the dolomite raw material in 3 (three) months from January, February, and March 2021, with an average of 13.32 percent (percent) from the data from the two suppliers. According to data gathered from the business where PT. Muliaglass Float works, the moist dolomite process is difficult to regulate. The researchers hope to be able to determine the source of the defect and obtain solutions to reduce or reduce the moist dolomite to match the company's target, namely the ideal amount of moist used from seven to eight percent (7-8 percent) and with a maximum of three percent. As a result, this problem must be overcome by knowing in advance the factors that affect the quality of dolomite.

The selection of more effective and efficient raw material quality control procedures should be used to carry out moist dolomite quality control. The organization can therefore use the Six Sigma method to conduct quality control to solve these issues. Gasperz (2002) describes Six Sigma as a business process improvement technique that seeks to identify and eliminate the root causes of mistakes and defects, boost productivity, cut down on cycle times and operating expenses, better satisfy customer expectations, and reach greater levels of asset misuse. and get higher production and service returns on investment.

Researchers are considering performing a study titled "Analysis of Quality Control To Reduce Moist Defects in Dolomite Raw Materials With the Six Sigma Method at PT. Muliaglass" in response to this occurrence.

II. LITERATURE REVIEW

Quality

According to Irwan and Haryono (2015: 34), quality is a rule in factual investigations for satisfying value needs by customer-desired norms. Control also seeks to enable properties to finish what has been controlled to meet management goals and objectives. Garrison (2003:97) defines control as the process of figuring out what is being accomplished, or standards, what is being done, or implementation, or implementation assessment, or improvement, so that the plan is carried out by standards.

Raw material

Raw materials or raw materials are important materials in an organization engaged in assembly because this is the initial stage in the processing process. As explained by Mulyadi (2011: 275) raw materials are materials that form a part as a whole. Quality is a relative measure of goodness (Don R. Hansen and Maryanne M. Mowen, 2001: 963). Without paying attention to the quality of the products produced, it means turning off hope for the company in the future, so that the company will produce lower quality products, including PT. Muliaglass Float where to obtain products with standardized quality, the company must carry out supervision even before the production process begins.

Dolomite

Dolomite, which has the chemical formula CaMg (CO3)2 and can increase the availability of Ca and Mg in the soil, is dolomite lime, according to Prayitno (2015). Additionally, it can lower soil pH, which raises soil fertility and enhances the physical characteristics of the soil. One of the raw materials used in the production of glass is dolomite, which helps the glass mixture melt more easily, prevents detritification, and prolongs the life of the glass.

Defect

A relative yardstick for goodness is the quality (Don R. Hansen and Maryanne M. Mowen, 2001: 963). Materials, people, and machines are the three categories in which flaws can be caused. Understanding the causes of faults and employing strategies to address them will help reduce flaws more effectively and efficiently. The most crucial component of the manufacturing process is the availability of raw materials, which must be available when needed. The second most crucial element is the availability of machines that are prepared to run and transform raw materials into completed products that are ready for sale. All of this needs to be monitored and controlled throughout use and operation so that the business.

Six Sigma

The Greek symbol sigma stands for a cycle's standard deviation. The number of conveyances or variations from a typical encounter is estimated by the standard deviation. The average value (mean) of each cycle or circumstance is circulated using the factual estimation unit known as sigma (Gesperz, 2005).

Pete and Holpp (2002:45–58) assert that the DMAIC idea, which stands for Define, Measure, Analyze, Improve, and Control, can be used to apply Six Sigma, a methodology that consists of five steps. The idea of Failure Mode and Effect Analysis (FMEA), which is a systematic method to identify and prevent failure modes, may also be used to analyze quality. FMEA can be used in numerous industries, including manufacturing and assembling.

The phase of Six Sigma Quality Control Method Implementation

Pete and Holpp (2002:45–58) assert that the DMAIC idea, which stands for Define, Measure, Analyze, Improve, and Control, can be used to apply Six Sigma, a methodology that consists of five steps.

1. Define

Its distinctive trait is the ability to pinpoint the activities that would best increase Sigma quality. The primary method for interpreting the design of the actions that need to be taken to enhance each stage of the business process (Gaspersz, 2005: 322). The phase of Six Sigma Quality Control Method Implementation According to Pete and Holpp (2002:45–58), Six Sigma can be used to complete the stages of implementation that seek to improve quality.

2. Measure

Measures a consistent progression for the specified step and extends to the following stage. The DPMO (Defect Per Million Opportunities) and sigma level will be determined at this point. For attribute data, it is possible to calculate DPMO and sigma levels as follows:

a. A The Defect per Opportunity (DPO) statistic displays the ratio of defects to all of the opportunities in a group.

$$DPO=DPU\ X\ O$$

b. Defects per Million Opportunities (DPMO)

DPMO = DPO x 1,000,000

3. Analyze

Analyze is the third stage in the Six Sigma quality improvement process. The actions conducted at this point consist of determining the need for improvement and identifying the root and primary causes of failure.

***Failure Mode and Effect Analysis*(FMEA)**

FMEA, or failure mode and effect analysis, is a systematic method for identifying and preventing failure modes. The following factors need to be taken into account when creating FMEA:

1) A process-related failure mode is a departure from a predetermined point brought on by adjustments to the variables influencing the process.
2) The main probable cause is a change in elements that may have an impact on the process and cause it to create a product outside of the parameters specified.
3) Describe the corrective measures taken by the existing organization to detect deviations or stop them from happening.
4) The probability that a cause would manifest itself and result in a failure mode with a specific impact is measured abstractly by the concept of occurrence. The value given to the occurrence can be anywhere between 1 and 10.
5) The bigger the value of the provided Severity scale, the more likely it is that the results of a failure will be drastically worse or extremely harmful (Gasperz 2010).
6) A scale of incidence, severity and severity assessment yields a risk priority number (RPN).
7) A suggested restorative activity is a plan or proposal to lessen the possibility of a failure mode occurring or to increase the efficiency of a certain avoidance or identification approach.

4. Improve

An improvement is the fourth phase in the six-sigma process of raising quality. At this point, after becoming aware of the sources and sources that underlie present issues, ideas for development or activity plans are formed. The creation of an activity plan is one of the key exercises in implementing quality improvement using the six sigma technique. Each activity plan must then provide a functional justification for why the activity plan is important to do, how to carry out the activity plan, where the activity plan will be carried out, who will be responsible for the planned activities if they are implemented, and how much it will cost to carry out the planned activities, as well as what it will cost to implement the activity plan.

5. Control

The fifth stage involves using a six sigma process control system to improve quality. The sigma team group's ownership or responsibility is transferred to the owner or person in charge of the process to ensure product quality ensure product or service quality is by the regulation with the provisions that have been improved at this point, and the results of quality improvement can be documented and used as work rules.

III. RESEARCH METHODS

Because it enables data collecting for data analysis by describing or describing data from reports on the number of moist flaws in raw materials in January, February, and March 2021, the research was carried out using a descriptive method with a quantitative approach.

The research variables must be taken into account before moving on to the study's goals. The study's operational variables are an increase in:

1. Quality (X1) Quality demonstrates that the

dolomite raw material satisfies the requirements established by the business.

2. Lowering the moisture level of dolomite raw materials is one technique to improve the quality of those materials (X2).
3. Quality Control (Y) Quality control includes employee training, setting quantifiable requirements for output quality, and routinely testing tools for spotting inconsistencies.

The population in this study was based on the number of wet dolomite arrivals and defects (defects) throughout three months. Data were collected from PT. KTB since has the most moisture, and the greatest moisture in the March 2021 sample is 13.39 percent.

Table 2: *The number of arrivals and moist dolomites with PT. KTB supplier*

Arrival and Moist Dolomites						Average *Moist* (%)
January 2021		February 2021		March 2021		
Amount (Kg)	*Moist* (%)	Amount (Kg)	*Moist* (%)	Amount (Kg)	*Moist* (%)	
3.477.980	13.29	2.525.320	13.31	3.764.200	13.39	13.32

Source: The results of data processing PT. MGF (2021)

This study used a purposive sampling method as its sampling strategy. Research frequently uses the sampling approach known as purposeful sampling. Utilizing secondary data, the data processing method uses a statistical or mathematical methodology. The idea of analysis as quality control is applied to this data analysis, specifically:

1. DMAIC (define, measure, analyze, improve, and control)
2. FMEA (Failure mode and effects)

An overview of the process of lowering wet dolomite is obtained using data analysis to test using a control chart.

This control chart is used to determine if a process for raising raw material quality is operating under strict control or not. The following is how researchers go about analyzing data:

1. Observing directly the process of drying out damp dolomite
2. In January, February, and March, retrieve moist data.
3. Conduct interviews with the lab, logistics, and quality control departments.

IV. RESULTS AND DISCUSSION

Research results and discussion

1. DMAIC (Define, Measure, Analyze, Improve, Control)

The DMAIC (Define, Measure, Analyze, Improve, Control) steps of the Six Sigma methodology are used to speed up the process of improvement and incorporate quality control tools together with mathematical and statistical techniques at each stage.

a. Define stage

The potential reasons for high moist dolomite are impacted by 3 (three) elements, namely weather, lighting, and air circulation, according to data and interviews from companies done directly with three sources, namely the Laboratory, Logistics, and Quality Control.

Due to the three factors that might result in damp dolomite flaws, it takes more than 14 days to dry out the material, which affects how quickly manufacturing can move along.

b. Measure Stage

Measurement is the second phase in the Six Sigma approach for enhancing quality. The DPMO (Defect Per Million Opportunities) and the sigma level will be determined at this point.

The table of results from the DPMO value to the Sigma value is used to calculate the sigma level.

DPMO = DPO x 1000000
Defect per Opportunity 1000000

$$DPO = \frac{Defect}{\text{Total Opportunities}}$$

Table 3: *Calculation of DPMO and Sigma Level*

	Date	Number of arrivals of dolomite raw material (KG2)	The number of defects of moist dolomite	DPO	DPMO	Sigma Level
1	1/3/2021	212.77	12.93	0.02026	20,257	3.5
2	2/3/2021	106.44	13.55	0.04243	42,434	3.2
3	3/3/2022	162.61	13.57	0.02782	27,817	3.4
4	4/3/2021	101.13	12.8	0.04219	42,190	3.2
5	5/3/2021	113.22	13.37	0.03936	39,363	3.3
6	6/3/2021	216.3	13.93	0.02147	21,467	3.5
7	7/3/2021	156.88	13.93	0.0296	29,598	3.4
8	8/3/2021	211.79	13.15	0.0207	20,697	3.5
9	9/3/2021	103.01	14.1	0.04563	45,627	3.2
10	10/3/2021	96.95	13.2	0.04538	45,384	3.2
11	11/3/2021	105.31	13	0.04115	41.148	3.2
12	12/3/2021	53.32	13.57	0.08483	84,834	3.9
13	13/3/2021	135.31	13.03	0.0321	32,099	3.4
14	14/3/2021	154.37	13.3	0.02872	28,719	3.4
15	15/3/2021	108	13.05	0.04028	40,728	3.2
16	16/3/2021	101.69	13.15	0.0431	43.105	3.2
17	17/3/2021	98.47	13.5	0.0457	45,699	3.2
18	18/3/2021	191.93	12.68	0.02202	22.022	3.5
19	19/3/2021	55.47	13.7	0.08233	82.327	3.9
20	20/3/2021	266.56	13.28	0.01661	16,607	3.6
21	21/3/2021	203.5	14.1	0.0231	23.096	3.5
22	22/3/2021	196.51	13.93	0.02363	23,629	3.5
23	23/3/2021	110.99	13.1	0.03934	39,343	3.3
24	24/3/2021	300.37	13.47	0.01495	14,948	3.7
25	25/3/2021	201.3	13.5	0.02235	22,355	3.5
	Total	**3.764**	**13.39**			**3.3**

Source: *Results of 2022 dolomite raw material data processing.*

The dolomite raw material arrivals were 3.764, the moisture content was 13.39 percent, the DPMO value was 35,802, and the sigma level was 3.3. This suggests that there may be room for improvement by lowering the amount of moist dolomite and raising the sigma level value. A control chart referring to the portions of raw materials that are unsuitable or substandard is required for the subsequent measure stage, which is carried out by measuring process performance.

1. Looking for value $\bar{p}$ bar

$$\bar{p} = \frac{np}{n}$$

$$= \frac{334.89}{3,764}$$

$$= 0.089$$

2. Finding the UCL value

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$UCL = \bar{p} + 3 = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} 0.089 + 3\sqrt{\frac{0.089(1-0.089}{3,764}}$$

$$= 0.1496$$

3. Finding the LCL value

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$= \bar{p} - 3 = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} 0.089 + 3\sqrt{\frac{0.089(1-0.089}{3,764}}$$

$$= 0.0289$$

Table 4: *Moist dolomite control chart data* $\overline{P}$

NO	Date	Number of arrivals of dolomite raw materials (Kg)	Number of defects in moist dolomite(%)	Proportion of defects	$\bar{p}$	LCL	UCL	Note
1	1/3/2021	212.77	12.93	0.061	0.089	0.0304	0.1475	
2	2/3/2021	106.44	13.55	0.127	0.089	0.0062	0.1718	
3	3/3/2022	162.61	13.57	0.083	0.089	0.0220	0.1559	
4	4/3/2021	101.13	12.8	0.127	0.089	0.0040	0.1739	

5	5/3/2021	113.22	13.37	0.118	0.089	0.0087	0.1692	
6	6/3/2021	216.3	13.93	0.064	0.089	0.0309	0.1470	
7	7/3/2021	156.88	13.93	0.089	0.089	0.0208	0.1572	
8	8/3/2021	211.79	13.15	0.062	0.089	0.0303	0.1477	
9	9/3/2021	103.01	14.1	0.137	0.089	0.0048	0.1731	
10	10/3/2021	96.95	13.2	0.136	0.089	0.0022	0.1757	
11	11/3/2021	105.31	13	0.123	0.089	0.0057	0.1722	
12	12/3/2021	53.32	13.57	0.255	0.089	0.0280	0.2059	out
13	13/3/2021	135.31	13.03	0.096	0.089	0.0155	0.1624	
14	14/3/2021	154.37	13.3	0.086	0.089	0.0202	0.1577	
15	15/3/2021	108	13.05	0.121	0.089	0.0068	0.1712	
16	16/3/2021	101.69	13.15	0.129	0.089	0.0043	0.1737	
17	17/3/2021	98.47	13.5	0.137	0.089	0.0029	0.1750	
18	18/3/2021	191.93	12.68	0.066	0.089	0.0273	0.1506	
19	19/3/2021	55.47	13.7	0.247	0.089	0.0257	0.2036	out
20	20/3/2021	266.56	13.28	0.050	0.089	0.0367	0.1413	
21	21/3/2021	203.5	14.1	0.069	0.089	0.0291	0.1488	
22	22/3/2021	196.51	13.93	0.071	0.089	0.0280	0.1499	
23	23/3/2021	110.99	13.1	0.118	0.089	0.0079	0.1700	
24	24/3/2021	300.37	13.47	0.045	0.089	0.0397	0.1382	
25	25/3/2021	201.3	13.5	0.067	0.089	0.0288	0.1492	
	□	3,764	13.39					
	$\bar{p}$	0.089						
	1-p	0.911						

Source: Results of 2022 raw material data processing

According to table 4, the value of p is 0.089 for each observation, with varying amounts of dolomite. Two samples were excluded from the analysis because they were outside the statistical control limits, according to the UCL and LCL estimates.

Here is a control chart with information on the moisture content before quality control:

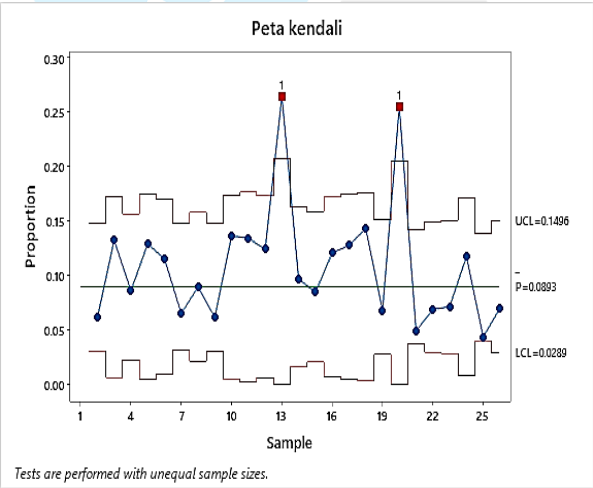

Figure 1: *Moist dolomite control chart (p-chart)*
Source: Result of Processing of raw material control map data 2022

The p-chart graph in figure 1 demonstrates that damp dolomite is deemed unstable since two points have crossed the statistical control limit. based on attribute data, evaluation of the impact of process capabilities on dolomite quality.

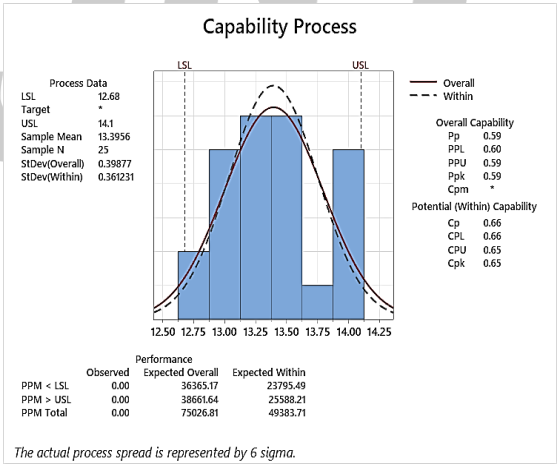

Figure 2: *Moist dolomite capability graph*
Source: Results of Processing Data Processing Capability of Raw Materials 2022

It can be seen from the process capability (Cp) graph that the reduction efficiency for damp dolomite is 0.66. According to the assessment indicators for Cp, 0.66 1.00 indicates that the processability is poor or that the process isn't operating as it should. 13.3 is the sample mean value.

a. Analyze Stage

The following analysis table applies the Why Why Analysis approach to the high moist dolomite:

Table 5: *Analysis of the cause of moist dolomite with Why Why Analysis*

Factor	Problem	*Why1*	*Why2*	*Why3*	*Why4*	*Why5*
Weather	Most high dolomite moist raw material	Dolomite haul truck leak	Getting hit by raindrops	Dolomite easily absorbs water	Lack of supervision	Fix dew/rain drain
Sunlighting	Fiberglass lighting is lacking	Moisture reduction takes quite a long time	The number of raw materials included in one warehouse is not regulated	The need to arrange the placement of raw materials is not right	The source of light/heat only relies on sunlight	Need to add roof/zinc and fiberglass
Air Circulation	Lack of ventilation or air windows	Moisture storage	The air entering the room/warehouse is uneven	It is difficult to control the dry raw material	The warehouse is left open during the rainy season	It is necessary to add air ventilation and control raw materials
Method	1.The method of placing raw materials is less effective 2.Repair and addition of roof/zinc and fiberglass as a source of sunlight and less air circulation	1. Moist warehouse 2. It's hard to lose moist dolomite	1. Inappropriate scheduling of raw material orders 2. Uneven air and sun circulation	1.Inspection of raw materials before entering the warehouse 2.*Settings* quality control	1. Lack of control 2. Inappropriate method	1. Check regularly 2. Need revision method

Source: Results of data processing (2022)

The high moist dolomite factor can be traced back to the lack of adequate raw material supervision from receipt to placement, which makes it challenging to manage and time-consuming to reduce moist dolomite levels. According to data gathered from the business, it takes more than 21 days to lower the humidity before the dolomite raw material is ready to be used in the manufacturing of glass sheets.

Revisions should be made to method issues such as improper placement of raw materials, which need periodic supervision, and the lack of air circulation and fiberglass procurement.

b. Improve Stage

The next step in this improvement stage is to work on FMEA to provide improvement suggestions. Three departments were represented on the FMEA team for this study: the Laboratory Manager, the Quality Control Manager, and the Logistics/Material Supervisor.

The next step in this improvement stage is to work on FMEA to provide improvement suggestions. The Severity x Occurrence x Detection (SOD) value will be multiplied to obtain the RPN value from the FMEA process, as indicated in the following table:

Table 6: *FMEA analysis of potential moist dolomite*

Potential Cause	S	O	D	RPN	Proposed Corrective Action
Rainy weather is high so moist high dolomite moist raw material	6	6	4	144	Receiving and storing raw materials should not be wet with water/dew. If it is raining when loading dolomite into the truck, it must be covered with a protective tarpaulin and ensure that it is stored in an impermeable room.
Fiberglass lighting, roof/zinc is lacking	7	7	7	343	- Addition of roofing/zinc and fiberglass in each warehouse and raised to the roof of the warehouse. - Replacement of damaged roof/zinc and fiberglass
Poor ventilation/windows	6	7	4	168	It is necessary to add warehouse windows on each side of the room so that the process of sending raw materials is evenly distributed.
The method of placing raw materials is less effective	5	4	4	80	- Laying raw materials near warehouse windows and under roofs/zinc and fiberglass to get air circulation and sunlight. - Warehouse supervision is carried out regularly

Source: Results of data processing (2022)

According to table 5, the potential causes of moist dolomite in the ranking are a lack of lighting from the roof, zinc, and fiberglass, which slows down the process of decreasing moist dolomite (RPN=343), ventilation/windows are still lacking, resulting in uneven air circulation (RPN=168), the amount of rainfall is high, which makes moist dolomite more prevalent, and moist raw materials happen as a result of leaks in dolomite transport.

c. Control Stage

The FMEA analysis has been carried out, then the improvement plan and control proposal are based on the FMEA analysis ranking, as shown in the following table:

Table 7: *Proposed priority of corrective and control actions*

Potential Cause	RPN	Proposed corrective action	Proposed Control
Fiberglass lighting is lacking	343	- Adding a roof/zinc and fiberglass in each warehouse and raising the roof of the warehouse. - Replacement of damaged roof/zinc and fiberglass	Periodic checking of the roof to ensure that no water/dew sources enter.
Poor ventilation/windows	168	It is necessary to add warehouse windows on each side of the room so that the drying process of raw materials is evenly distributed.	Monitor moist dolomite every day by checking in the laboratory to determine the amount or percentage of moist decrease.
Most high dolomite Moist raw material	144	Receiving and storing raw materials should not be wet with water/dew. If it is raining when loading dolomite into the truck, it must be covered with a protective tarpaulin and ensure that it is stored in an impermeable room.	Monitor the dolomite collection schedule and check the warehouse periodically.

Source: Results of data processing (2022)

Table 6, which contains the corrective action plans, lists each corrective action plan along with the recommended method of control.

According to the ranking of the FMEA analysis, there are four (three) improvement priorities based on serial numbers of the dolomite raw materials, including periodic control of insufficient fiberglass illumination, insufficient ventilation/air windows, and high moist dolomite.

On the FMEA team, which carried out the discussions, inquiries, and brainstorming that resulted in these modifications, the department representatives were the laboratory manager, quality control manager, and logistics/materials manager.

Process performance evaluation following repair

After putting the suggested changes into practice, the process of reducing damp dolomite will be measured for performance in February 2022 to ascertain whether the process capability is operating within the control limits for each sample observation.

When repairs are completed within 14 (fourteen) days, the graph of the control chart with p = 0.025 indicates the moist dolomite data as follows:

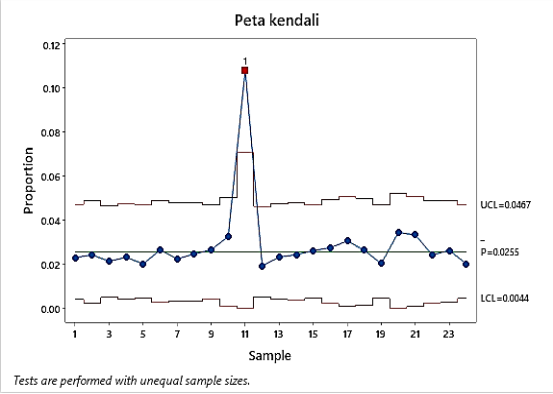

Figure 3: *P-control map following maintenance, February 2022.*
Source: Information derived via data processing (2022)

The observation of sample 11 with a proportion value of 0.1081 in Figure 3 illustrates an improvement in the decrease in moist dolomite throughout February 2022. The number of points that are outside the control limits found increased by one point during this time.

Continuous progress is still required to develop a more stable process, as evidenced by the point that is still outside of the control limit. Additionally, the control chart is measured once again the following month, in March 2022, as follows:

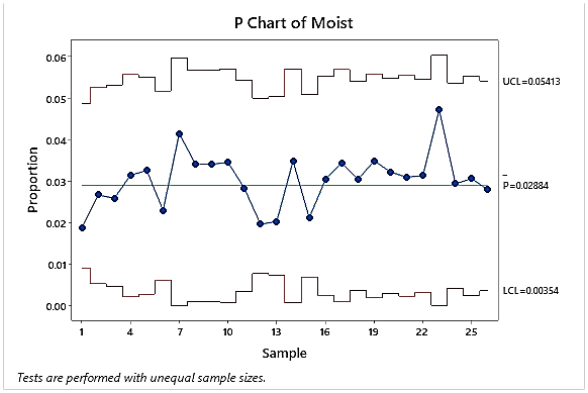

Figure 4: *P control graph following restoration, March 2022*
Source: Information derived via data processing (2022)

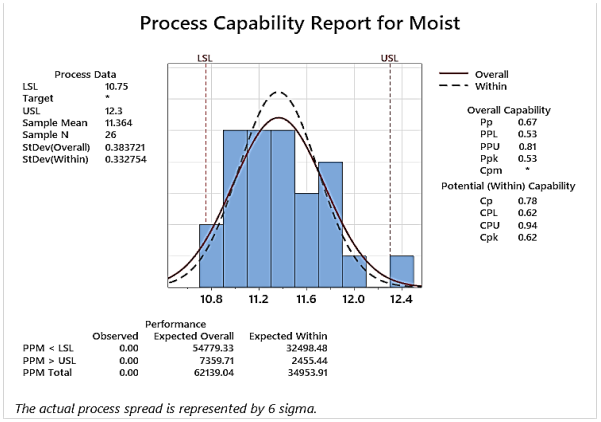

Figure 5. *After repair, the process capability graph*
Source: Information derived via data processing (2022)

No samples are outside the control limit line, as shown in Figure 4.6's p control chart graph with = 0.02884 moist dolomite data after quality improvement in March 2022.

This suggests that the process of reducing damp dolomite is improving and will be better in March 2022.

Process Capability (Cp) Attribute Data Measurement

To ascertain whether the corrective actions applied to the process are capable enough, calculations of process capacity are performed.

When process capability was measured in March 2022, the value of process capability (Cp) was determined as follows:

The processing capability (Cp) in February 2022 was 0.69, and the Cp value in March 2022 was 0.78, as shown in Figure 5 Improvements were made throughout February and March 2022. According to the Cp assessment indicator, the ability or process is not functioning properly if Cp 1. Since the process still has trouble reducing wet dolomite, the business must constantly innovate in the area of quality control to ensure that the raw materials satisfy the required criteria.

Dolomite performance evaluation following repair

After measuring process performance, the raw material performance is measured to discover that the dried raw material does not meet the requirements or standards established by the company that will be employed at the stage of the production process. The following table displays the findings from the measurement of moist dolomite data:

Table 8: *Data on the decrease in moist dolomite after repair*

No	Date	Number of arrivals of dolomite raw material (Kg)	Number of defects of moist dolomite (%)	DPO	DPMO	Sigma Level
1	1/3/2022	643.39	12.08	0.00626	62.585	4.0
2	2/3/2022	450.17	11.70	0.00866	86.634	4.0
3	3/3/2022	425.99	11.20	0.00876	87.639	4.0
4	4/3/2022	349.7	10.90	0.01039	103.899	3.8
5	5/3/2022	369.02	11.63	0.01051	105.053	3.8
6	7/3/2022	480.12	11.03	0.00766	76.578	4.0
7	8/3/2022	265.04	10.92	0.01373	137.338	3.7
8	9/3/2022	323.67	11.33	0.01167	116.683	3.8
9	10/3/2022	322.6	11.00	0.01137	113.660	3.8
10	11/3/2022	319.49	11.00	0.01148	114.766	3.8
11	12/3/2022	389.4	11.40	0.00976	97.586	3.8
12	14/3/2022	561.55	11.44	0.00679	67.907	4.0
13	15/3/2022	542.83	11.28	0.00693	69.267	4.0
14	16/3/2022	315.64	10.80	0.01141	114.054	3.8
15	17/3/2022	520.68	11.10	0.00711	71.061	4.0
16	18/3/2022	362.31	11.46	0.01054	105.435	3.8
17	19/3/2022	319.78	10.75	0.01121	112.056	3.8
18	22/3/2022	394.79	11.56	0.00976	97.605	3.8
19	23/3/2022	344.08	11.70	0.01133	113.346	3.8
20	24/3/2022	373.47	11.76	0.0105	104.962	3.8
21	25/3/2022	356.28	11.28	0.01055	105.535	3.8
22	26/3/2022	382.71	11.70	0.01019	101.905	3.8
23	28/3/2022	254.05	12.30	0.01614	161.386	3.6
24	29/3/2022	409.39	11.60	0.00944	94.449	3.8
25	30/3/2022	360.2	11.30	0.01046	104.572	3.8
26	31/3/2022	393.64	11.23	0.00951	95.095	3.8
Total		10229.99	11.36			

Source: *Results of 2022 dolomite raw material data processing.*

According to table 8, there were 10229.99 Kg2 of dolomite arrivals, and the moisture content was 11.36 percent. Following restoration, the dolomite performed as expected, with values of DPO = 0.26212 and DPMO = 26.210, resulting in a 4.0 sigma.

Dolomite performance evaluation following repair

Following the use of the DMAIC, and FMEA approach to enhance processes, it is possible to compare the process performance data before and after implementation as follows:

Table 9: *Results of evaluating the efficiency of the repair process*

No	March 2021	February 2022	March 2022
1	Due to the discovery of two points that exceeded the statistical control limit, the process performance of the p-control chart was deemed unstable. There are 13 and 20 points.	Due to the discovery of two points that exceeded the statistical control limit, the process performance of the p-control chart was deemed unstable. The total is 11.	No point on the p control chart for process performance is outside the control limit line.
2	Processing capacity for dolomite Cp = 0.66. Cp < 1.00 then the processability is low or the process is not running properly	Processing capacity for dolomite Cp = 0.69. Cp < 1.00 then the process's processability is poor or it isn't functioning properly.	The processing capacity of dolomite Cp = 0.78 is close to 1. However, if Cp < 1.00 the process is either not executing properly or has a limited processing capacity.

Source: Data Processing Results (2022)

According to table 9, the DPMO value changed from DPMO = 35,802 in March 2021 to DPMO = 28,620 in March 2022 as a result of the dolomite's improved performance, and it is now DPMO = 26,210. After repairs were made to the suspected cause of the damp dolomite problem, the sigma level value increased from 3.3 to 3.8 to 4, becoming 4.

Relationship of Six Sigma research methods with other Six Sigma research methods

According to several earlier studies, the Six Sigma method is a useful strategy for resolving the issue of product flaws or, in this case, raw materials. According to research done at PT. Muliaglass, Float is still not implemented optimally because it is constrained by the expense of repairing the warehouse as a location for storing raw materials and the workforce's ignorance of the significance of preventing and controlling the quality of raw materials, especially in the logistics department, as shown by the results of the process capability value (Capability Process) = 0.78 or the process capability is low or that the process capability is low. Six Sigma is a very effective tool for managing and enhancing the quality of raw resources.

V. CONCLUSION

1. The application of the Six Sigma method demonstrates that the method can shorten the time of moist dolomite decline, where previously the repair took >21 (twenty-one) days and now only takes 14 (fourteen), but the continuous improvement of the raw material's quality of dolomite is still required until it reaches the capability process performed by species fiction.
2. The problem is that people don't understand how to use the Six Sigma approach for quality control, which means that it must be done sustainably.
3. The company has accepted the efforts made to manage the quality of dolomite raw materials by making repairs to the replacement of the dolomite storage roof, specifical advancements like:
   a. Every warehouse will have a new roof, zinc, and fiberglass added to it. The roof of each warehouse will also be raised, and any broken roof, zinc, and fiberglass will be replaced.
   b. Adding warehouse windows to both sides of the room to disperse the drying of raw materials uniformly.
   c. Raw materials shouldn't be moist when being received or stored. Dolomite must be covered with a protective tarpaulin and kept in an impermeable room if it is being loaded into a truck when it is raining.

Further Research Advice

From the outcomes of the author's data processing utilizing the Six Sigma approach at PT. Muliaglass Float, it is expected that this research will be taken into consideration by the company and also the readers to continue increasing the quality of dolomite raw materials. To focus on the quality of raw materials, which are the foundational component utilized to create high-quality sheet glass products, training must be conducted in all corporate divisions. It is hoped that the advances already made will be maintained.

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