HEURISTIC
Vol. 21, No. 2, October 2024
ISSN(p) 1693-8232
ISSN(e) 2723-1585

Quality Control Analysis of Wood Pellet Products at PT XYZ Using the Seven Tools and New Seven Methods

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Article history:
Received: 4 January 2025
Accepted: 13 January 2025
Published: 13 January 2025

Keywords:
Quality;
Wood Pellet;
Seven Tools;
New Seven Tools

ABSTRACT

Quality is a factor that determines the success of a product in market competition. PT XYZ, which produces wood pellets, is experiencing problems related to the quality of its products. The company wants to control the quality of its products in order to reduce losses due to product defects. Product quality control is carried out using the seven tools method to determine the causes of defects and the new seven tools method which is used to see the corrective actions that must be taken based on the factors that cause product defects. The results showed that there are 3 types of defects in wood pellet products, namely water content that is too high, less density, and shape that is too small. From the total amount of 12,782 kg of defective products, 34.24% of them are the types of defects of too high moisture content, 30.50% defects of insufficient density, and 35.26% defects of too small shapes. The proposed improvements to prevent errors that can cause product defects can be done by tightening the implementation of company SOPs, improving worker performance and skills, optimizing machine performance, and improving the quality of the raw materials used.

INTRODUCTION

The development of the times forces a company both in the field of services and manufacturing to enter the era of globalization, required to improve the quality of services or products in order to maintain competition with other companies. The emergence of industrial development on a large and small scale both private companies and companies managed by the state will be a milestone that will advance the nation [1]. This is in line with what was conveyed by [2] that Indonesia is one of the developing countries in the world that requires massive development to support infrastructure and improve the people's economy.

One of the companies that experience challenges related to quality issues is PT XYZ. PT XYZ is a company engaged in manufacturing that produces wood pellets. According to [3] wood pellets are an alternative fuel made from wood waste, is one of the renewable fuels that is environmentally friendly has a cylindrical shape and hard. The problem faced by the company is the occurrence of defects in the products produced. Defects that occur in wood pellet products include moisture content that is too high, density and shape that is too small. The defect problem causes losses for the company because defective products cannot be sold. Therefore, PT XYZ needs an appropriate quality control method to overcome these problems.

To maintain the quality of products produced by PT XYZ, it is necessary to control the quality of the products produced. Quality control is an effort to maintain the quality or quality of the goods produced, so that it is in accordance with the product specifications that have been determined based on the company's leadership policy [4]. The methods used to control process stability and control production quality are the seven tools method and the new seven tools. According to [2] the seven tools method is a statistical tool to find the root cause of quality problems so as to control quality. While the new seven tools method is a tool in mapping problems in a structured manner, to help improve production quality. Quality control with the seven tools method can be analyzed using Microsoft Excel software to process existing defect data.

The quality control process is a very necessary step in maintaining the quality of a product. Based on research conducted by [5] related to the application of the seven tools method to minimize consumer returns at PT XYZ. To complement the application of quality control, this research applies quality control using the seven tools method to determine the causes of defects and the new seven tools method which is used to see the corrective actions that must be taken based on the factors that cause product defects. Researchers want to identify the types of defects in wood pellet products, find out how much defect rate or presentation of each type of defect that occurs in wood pellet products, and then determine the proposed improvements or preventive actions that can be taken to reduce defective wood pellet products.

MATERIALS AND METHODS

This research was conducted at PT XYZ which is located at Jl. Kandangan, Ngepeh, Rejoagung, Ngoro District, Jombang Regency, East Java. Data collection was carried out by observing the production area, then continued with secondary data collection through interviews and documentation conducted in November 2024 by taking data on wood pellet production defects from August 2024 to November 2024. The dependent variable in this research is the number of wood pellet products produced by PT XYZ that have defects. While the dependent variable in this research is the type of defect in wood pellet products such as too high moisture content, less product density, and the shape of the product is too small. The population of this research itself includes all wood pellet production results at PT XYZ in August - November 2024.

Identification from the beginning was carried out to map the problems until the proposed improvements were formulated using the seven tools method and the new seven tools. The first data processing is done using tools from the seven tools method to find out the causes of defects, the seven tools method basically consists of seven control tools including check sheets, histograms, scatter diagrams, stratification, pareto diagrams, control charts, fishbone [6]. Then further analysis is carried out to see the corrective actions that must be taken based on the factors that cause product defects using the new seven tools method, where the tools used are affinity diagrams, tree diagrams, arrow diagrams, process decision program charts (PDPC), relationship diagrams, matrix diagrams, and matrix data analysis [7].

The steps in this research begin with field studies and literature studies. Then the formulation of existing problems in the company is carried out, determining the objectives of the research, and identifying operational variables. After that, data collection is carried out which includes production process data, types of defects, and the number of defects. The data is then processed using the seven tools method and the new seven tools with the help of Microsoft Excel software. The results of data processing are used in making conclusions from the research.

RESULTS AND DISCUSSIONS

Results

Seven Tools Data Processing

Data processing using the seven tools method is analyzed with tools such as check sheets, data stratification, histograms, scatter diagrams, control charts, pareto diagrams, and fishbone diagrams.

1. Check Sheet

A Check Sheet is a simply designed sheet that lists things that are necessary for data recording purposes so that users can collect data easily, systematically and in an organized manner. [8]. The following is a check sheet table at PT XYZ :

Table 1. Check Sheet

CHECK SHEET						
No.	Defect Type	Month				Total
		August	September	October	November	
1	Too high water content	1122	1157	1129	969	4377
2	Density	937	852	1147	962	3898
4	Too Small Shape	1064	947	1434	1062	4507
Total		3123	2956	3710	2993	

It can be seen in Table 1. that the data used in this research includes data on the types of defects, namely too high moisture content, density, and too small a shape as well as production data from August to November.

2. Data Stratification

Stratification is a table that classifies problems (in this case defects) into several groups [9]. This research categorizes defective products into the types of defects.

Table 2. Stratification of Wood Pellet Defects

STRATIFICATION				
NO.	*Defect* Type	Quantity (kg)	*Defect* Percentage (%)	Cumulative Percentage (%)
1	Too High Water Content	4377	34,24%	34,24%
2	Density	3898	30,50%	64,74%
3	Too Small Shape	4507	35,26%	100,00%
Total		12782	100,00%	

It can be seen in table 2. explaining about the types of defects or defects that are most in the form of too small as much as 4507 kg, too high water content as much as 4377 kg, and less density as much as 3898 kg. Besides that it can also be seen the percentage of defects that occur in wood pellet products.

3. Histogram

Histogram is a tool that helps to determine variation in the process. In the form of bar charts that show tabulations of data organized by size [10]. The types of defects on the check sheet are then recapitulated and presented in the form of a histogram.

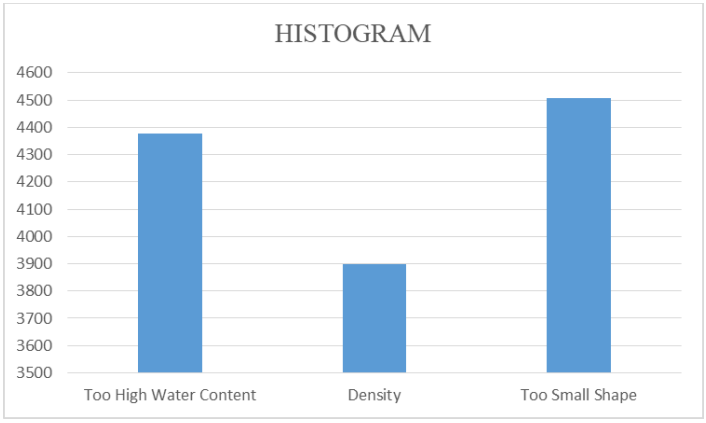

Figure 2. Histogram of Wood Pellet Defects

It can be seen in Figure 2. explaining about the types of defects or defects that are most in the form of too small as much as 4507 kg, too high water content as much as 4377 kg, and less density as much as 3898 kg.

4. Pareto Diagram

Pareto diagram is a tool that can help identify and prioritize problems by ranking them based on their level of importance [11].

Table 3. Dominant Defect Identification Calculation

NO.	*Defect* Type	Quantity (kg)	*Defect* Percentage (%)	Cumulative Percentage (%)
1	Too High Water Content	4377	34,24%	34,24%
2	Density	3898	30,50%	64,74%
3	Too Small Shape	4507	35,26%	100,00%
Total		12782	100,00%	

It can be seen in table 3. that the type of defect is dominated by shapes that are too small. Of the total number of defects of 12782 kg, 34.24% are defects of too high moisture content, 30.50% of less density, and 35.26% of too small shapes

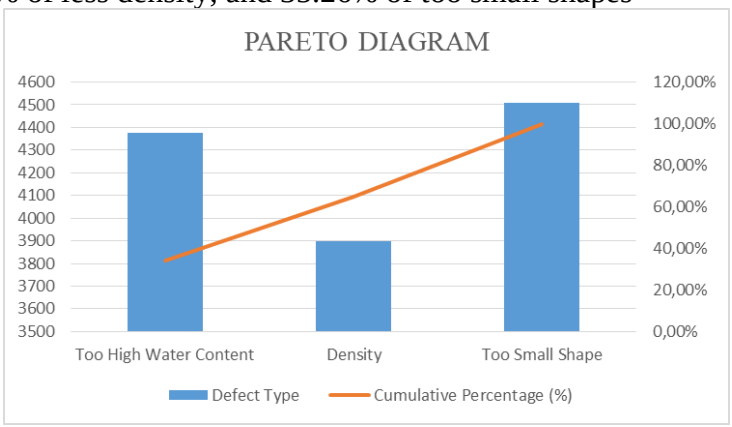

Figure 3. Pareto Diagram of Wood Pellet Defects

It can be seen in Figure 3. that the type of defect is dominated by shapes that are too small. Of the total number of defects of 12782 kg, 34.24% are defects of too high moisture content, 30.50% of insufficient density, and 35.26% of too small shapes.

5. Scatter diagram

A scatter diagram is a graph that displays the relationship between two variables whether the relationship between them is strong or not, including process factors that affect the process and product quality [12].

a. High Water Content Scatter Diagram

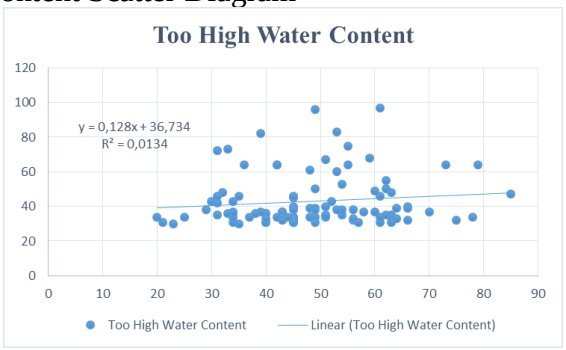

Figure 4. Scatter Diagram of High Water Content Defects

It can be seen in Figure 4. that the high water content has an even distribution of points. However, there are some points that are far from the center line of the average number of defects. These points indicate that there are many errors in production. It is also known that the distribution diagram above has the equation y = 0.128x + 36.734 with R^2 = 0.0134.

b. Density Chart

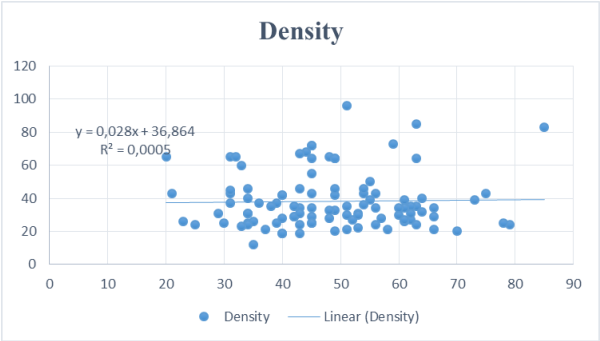

Figure 5. Scatter Diagram of Density Defects

It can be seen in Figure 5. that the density of wood pellet has an even distribution of points. However, there are some points that are far from the center line of the average number of defects. These points indicate that there are many errors in production. It is also known that the distribution diagram above has the equation y = 0.028x + 36.864 with R^2 = 0.0005.

c. Too Small Shape Diagram

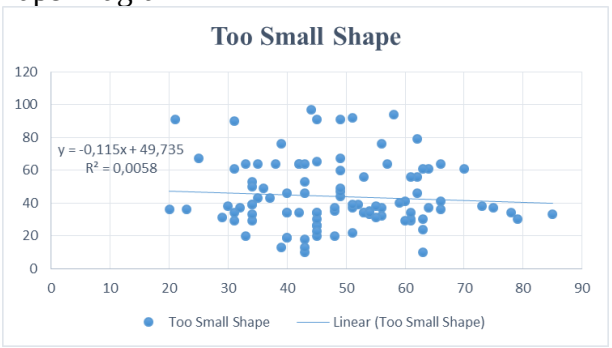

Figure 6. Scatter Diagram of Too Small Shape Defects

It can be seen in Figure 6. that the undersized shape has an even distribution of points. However, there are some points that are far from the center line of the average number of defects. These points indicate that there are many errors in production. It is also known that the distribution diagram above has the equation y = -0.115x + 49.735 with R^2 = 0.0058.

6. Control Chart

The P control chart is used to see the upper control limit and the lower control limit. If the data is still within the control limit, the data is declared controlled [13].

a. Control Chart Calculation

Table 4. Defect Control Chart

No	The Lot		Defect Type			Proportion (p=d/n)	$3\sigma = 3\sqrt{((\bar{p}(1-\bar{p}))/n)}$	UCL = $\bar{p}+3\sigma$	LCL= $\bar{p}-3\sigma$	CL
	Observation (n) (kg)	d (defect) (kg)	Too High Water Content	Density	Too Small Shape					
1	3700	34	43	25	53	0,009	0,006	0,021	-0,009	0,015
2	3200	63	48	35	30	0,020	0,006	0,021	-0,008	0,015
3	4500	85	47	83	33	0,019	0,005	0,020	-0,009	0,015
4	3200	51	40	35	22	0,016	0,006	0,021	-0,008	0,015
5	3100	49	50	33	44	0,016	0,006	0,021	-0,008	0,015
6	3090	53	60	31	34	0,017	0,007	0,021	-0,008	0,015
7	3480	40	36	42	19	0,011	0,006	0,021	-0,009	0,015
8	3370	45	34	72	26	0,013	0,006	0,021	-0,009	0,015
9	3450	42	64	29	64	0,012	0,006	0,021	-0,009	0,015
10	3100	40	31	19	34	0,013	0,006	0,021	-0,008	0,015
11	2940	56	32	43	37	0,019	0,007	0,021	-0,008	0,015
12	3430	21	31	43	91	0,006	0,006	0,021	-0,009	0,015
13	3550	73	64	39	38	0,021	0,006	0,021	-0,009	0,015
14	3820	34	34	31	39	0,009	0,006	0,021	-0,009	0,015
15	2800	52	43	27	39	0,019	0,007	0,022	-0,008	0,015
16	3050	60	37	30	41	0,020	0,007	0,021	-0,008	0,015
17	3100	48	39	33	35	0,015	0,006	0,021	-0,008	0,015
18	2950	61	46	39	29	0,021	0,007	0,021	-0,008	0,015
19	3120	54	35	43	33	0,017	0,006	0,021	-0,008	0,015
20	3210	66	40	29	36	0,021	0,006	0,021	-0,008	0,015
21	3200	35	30	26	43	0,011	0,006	0,021	-0,008	0,015
22	4150	45	40	29	65	0,011	0,006	0,020	-0,009	0,015
23	3700	62	50	27	46	0,017	0,006	0,021	-0,009	0,015
24	2850	54	53	46	35	0,019	0,007	0,022	-0,008	0,015
25	2600	42	64	29	64	0,016	0,007	0,022	-0,008	0,015
26	3400	40	31	19	34	0,012	0,006	0,021	-0,009	0,015
27	3100	31	72	43	61	0,010	0,006	0,021	-0,008	0,015
28	4300	39	82	25	76	0,009	0,006	0,020	-0,009	0,015
29	3600	62	55	35	79	0,017	0,006	0,021	-0,009	0,015
30	2900	20	34	65	36	0,007	0,007	0,021	-0,008	0,015
31	2750	43	37	24	46	0,016	0,007	0,022	-0,008	0,015
32	3200	34	31	24	29	0,011	0,006	0,021	-0,008	0,015
33	2900	61	97	26	30	0,021	0,007	0,021	-0,008	0,015
34	3200	79	64	24	30	0,025	0,006	0,021	-0,008	0,015
35	3100	49	96	42	60	0,016	0,006	0,021	-0,008	0,015
36	2800	40	36	42	19	0,014	0,007	0,022	-0,008	0,015

37	3000	45	34	72	26	0,015	0,007	0,021	-0,008	0,015
38	3100	63	35	85	24	0,020	0,006	0,021	-0,008	0,015
39	3050	33	36	23	20	0,011	0,007	0,021	-0,008	0,015
40	3200	58	37	21	94	0,018	0,006	0,021	-0,008	0,015
41	2950	53	83	22	34	0,018	0,007	0,021	-0,008	0,015
42	2755	48	34	28	20	0,017	0,007	0,022	-0,008	0,015
43	3600	61	31	27	34	0,017	0,006	0,021	-0,009	0,015
44	2960	23	30	26	36	0,008	0,007	0,021	-0,008	0,015
45	2950	45	32	25	34	0,015	0,007	0,021	-0,008	0,015
46	4500	56	33	34	32	0,012	0,005	0,020	-0,009	0,015
47	3200	64	33	32	37	0,020	0,006	0,021	-0,008	0,015
48	4100	55	64	39	38	0,013	0,006	0,020	-0,009	0,015
49	2500	34	34	31	39	0,014	0,007	0,022	-0,008	0,015
50	3000	39	37	37	13	0,013	0,007	0,021	-0,008	0,015
51	3000	54	38	36	34	0,018	0,007	0,021	-0,008	0,015
52	3100	57	31	28	64	0,018	0,006	0,021	-0,008	0,015
53	3200	66	39	34	64	0,021	0,006	0,021	-0,008	0,015
54	3300	45	31	34	30	0,014	0,006	0,021	-0,008	0,015
55	2300	43	34	34	10	0,019	0,008	0,022	-0,007	0,015
56	3400	40	33	28	46	0,012	0,006	0,021	-0,009	0,015
57	2500	30	43	25	38	0,012	0,007	0,022	-0,008	0,015
58	3250	35	46	12	64	0,011	0,006	0,021	-0,008	0,015
59	2950	31	42	65	34	0,011	0,007	0,021	-0,008	0,015
60	4100	32	48	65	37	0,008	0,006	0,020	-0,009	0,015
61	3540	45	45	55	34	0,013	0,006	0,021	-0,009	0,015
62	3000	55	75	50	31	0,018	0,007	0,021	-0,008	0,015
63	3200	51	34	30	37	0,016	0,006	0,021	-0,008	0,015
64	3600	70	37	20	61	0,019	0,006	0,021	-0,009	0,015
65	4210	64	39	40	61	0,015	0,006	0,020	-0,009	0,015
66	3650	33	73	60	64	0,009	0,006	0,021	-0,009	0,015
67	4560	44	34	68	97	0,010	0,005	0,020	-0,009	0,015
68	3000	48	61	65	37	0,016	0,007	0,021	-0,008	0,015
69	3100	63	34	24	61	0,020	0,006	0,021	-0,008	0,015
70	2350	38	36	35	64	0,016	0,007	0,022	-0,007	0,015
71	2250	49	39	46	91	0,022	0,008	0,022	-0,007	0,015
72	3100	75	32	43	37	0,024	0,006	0,021	-0,008	0,015
73	4500	45	31	43	91	0,010	0,005	0,020	-0,009	0,015
74	3500	51	67	96	92	0,015	0,006	0,021	-0,009	0,015
75	2100	31	35	45	90	0,015	0,008	0,023	-0,007	0,015
76	2400	42	34	35	34	0,018	0,007	0,022	-0,007	0,015
77	2500	29	38	31	31	0,012	0,007	0,022	-0,008	0,015
78	4200	78	34	25	34	0,019	0,006	0,020	-0,009	0,015
79	3200	66	32	21	41	0,021	0,006	0,021	-0,008	0,015
80	3100	25	34	24	67	0,008	0,006	0,021	-0,008	0,015

81	3250	36	64	37	49	0,011	0,006	0,021	-0,008	0,015
82	3250	63	31	64	10	0,019	0,006	0,021	-0,008	0,015
83	3650	43	34	31	13	0,012	0,006	0,021	-0,009	0,015
84	3220	59	68	73	40	0,018	0,006	0,021	-0,008	0,015
85	3600	37	34	21	43	0,010	0,006	0,021	-0,009	0,015
86	4200	49	38	20	47	0,012	0,006	0,020	-0,009	0,015
87	3700	56	38	24	76	0,015	0,006	0,021	-0,009	0,015
88	2800	53	38	30	56	0,019	0,007	0,022	-0,008	0,015
89	2900	34	36	40	50	0,012	0,007	0,021	-0,008	0,015
90	3500	34	37	46	33	0,010	0,006	0,021	-0,009	0,015
91	3100	51	35	21	39	0,016	0,006	0,021	-0,008	0,015
92	3100	43	37	19	53	0,014	0,006	0,021	-0,008	0,015
93	3500	62	35	31	56	0,018	0,006	0,021	-0,009	0,015
94	3500	61	34	34	56	0,017	0,006	0,021	-0,009	0,015
95	4500	49	34	64	49	0,011	0,005	0,020	-0,009	0,015
96	3350	43	34	67	64	0,013	0,006	0,021	-0,009	0,015
97	4210	49	31	64	67	0,012	0,006	0,020	-0,009	0,015
98	3200	43	32	46	18	0,013	0,006	0,021	-0,008	0,015
99	3215	45	38	64	20	0,014	0,006	0,021	-0,008	0,015
100	2900	31	46	37	29	0,011	0,007	0,021	-0,008	0,015
101	3000	45	46	25	23	0,015	0,007	0,021	-0,008	0,015
102	3000	60	49	34	29	0,020	0,007	0,021	-0,008	0,015

It can be seen in table 4. that the defect control chart or P control chart on wood pellet products is used to determine data that is out of control or exceeds the upper limit and also the lower limit.

b. Control Chart P

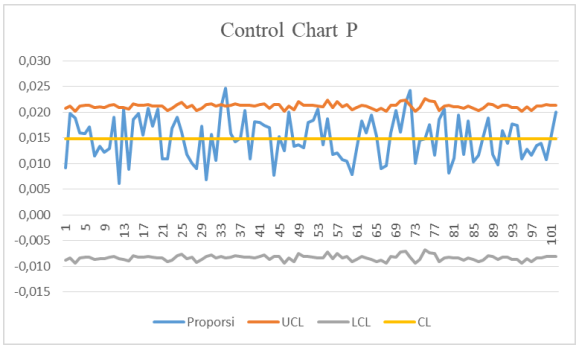

Figure 7. Control Chart P

It can be seen in Figure 7. of the P control Chart that there is data that is out of control or crosses the upper limit and also the lower limit, namely on data 34 with a proportion value of 0.025 and on data 72 with a proportion value of 0.024. This means that the data on the P chart is still not under control so it is necessary to take revision action on the control map.

c. Control Chart Revision P

Based on the P control map, it is known that there is still data that exceeds the control limits, so corrective action is needed so that no one exceeds the predetermined control limits.

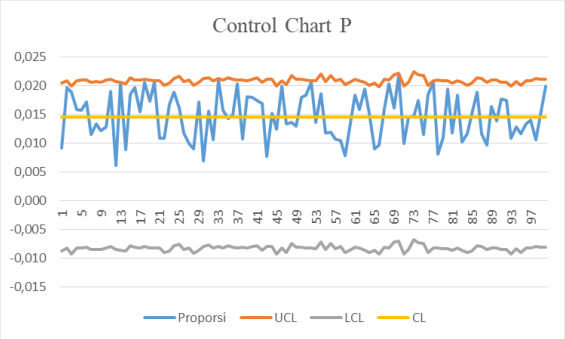

Figure 8. Revised P Control Map

It can be seen in Figure 8. that the revised P control chart can be seen that there is no data that is out of control. This means that the data on the P chart is under control so that it can be said that the results of wood pellet production can be said to be good.

7. Causal Diagram (Fishbone)

Fishbone diagram is a visual tool to identify, explore, and graphically describe in detail all the causes associated with a problem [14].

a. High Water Content Fishbone Diagram

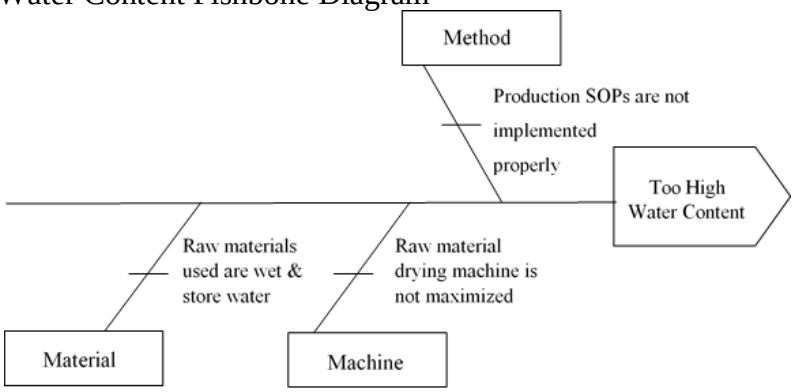

Figure 9. High Water Content Fishbone Diagram

It can be seen in Figure 9. explaining the fishbone of high water content defects that the cause and effect diagram or fishbone diagram is a diagram that explains the reason why defects can occur in wood pellets with high water content. There are 3 factors in the high water content fishbone diagram, namely the method factor, which is caused by the production SOP for processing raw materials not being implemented properly. The material factor is caused by very wet wood raw materials and some types of wood have high moisture content. Then the machine factor where the drying machine or dryer works less than optimal so that the wood raw material does not dry optimally before printing.

b. Density Fishbone Diagram

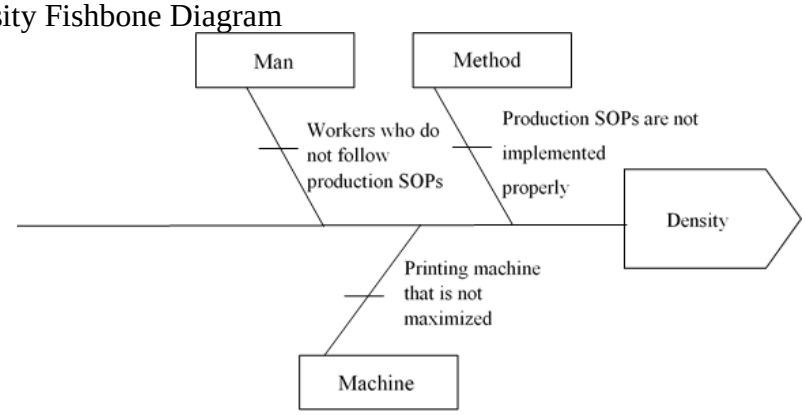

Figure 10. Density Fishbone Diagram

It can be seen in Figure 10. explaining the density defect fishbone that the cause and effect diagram or fishbone diagram is a diagram that explains the reason why the defect can occur in wood pellets whose density is less. There are 3 factors in the fishbone diagram of less density, namely the method factor, which is caused by the production SOP on mixing raw materials between hardwood and ordinary wood not according to standard. The human factor is caused by negligence of workers in carrying out production SOPs. Then the machine factor where the wood pellet printing machine works less than optimal so that the wood pellets produced do not have maximum density.

c. Fishbone Diagram Too Small Shape

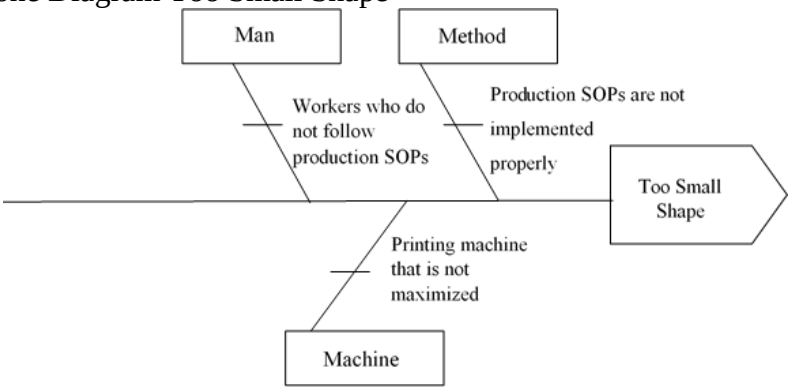

Figure 11. Fishbone Diagram of Too Small Shape

It can be seen in Figure 11. explaining the fishbone defect of too small a shape, it is known that the cause and effect diagram or fishbone diagram is a diagram that explains the reason why the defect can occur in wood pellets that are too small. There are 3 factors in the fishbone diagram of too small a shape, namely the method factor, which is caused by the production SOP on mixing raw materials between hardwood and ordinary wood not according to standard. The human factor is caused by negligence of workers in carrying out production SOPs. Then the machine factor where the wood pellet printing machine works less than optimal so that the wood pellets produced have a small size.

Discussions

Data Processing New Seven Tools Method

New Seven Tools is a tool to map or describe problems, organize data in a diagram so that it is easier to understand and find out the factors that cause these problems[15].

1. Affinity Diagram

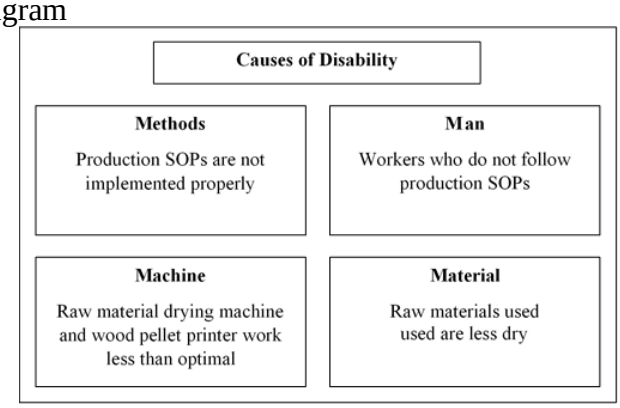

Figure 12. Affinity Diagram

Affinity Diagram is a method that can help collect large amounts of data and organize them into groups or themes based on their relationships [16]. In Figure 12. it is known that there are 4 factors that cause defects in wood pellet products, including

methods, people, machines, and materials. For example, a drying machine that does not work optimally is a problem caused by machine factors.

2. Interrelationship Diagram

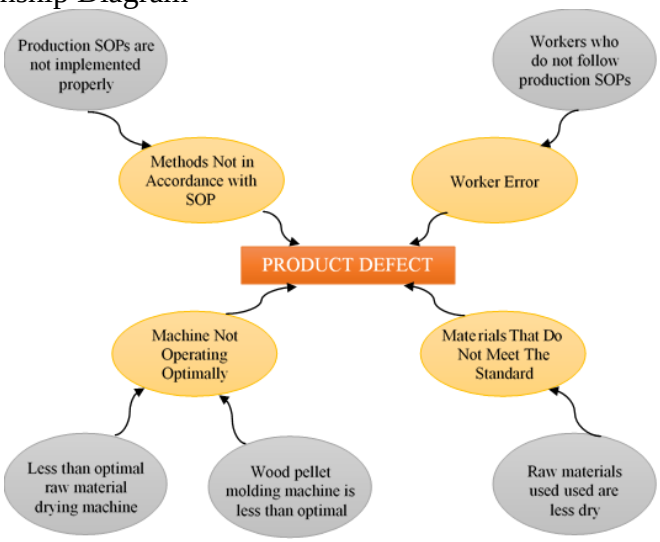

Figure 13. Interrelationship Diagram

Interrelationship diagrams or digraphs, commonly referred to as network diagrams, are tools for analyzing the cause and effect relationships of various complex problems so that it can be known which problems trigger the problem and which problems are the outcome of the problem [17]. In Figure 13. it is known that the cause and effect relationship exists regarding the problem of defects in wood pellet products. For example, worker error is caused by workers who do not mix raw materials according to the SOP.

3. Tree Diagram

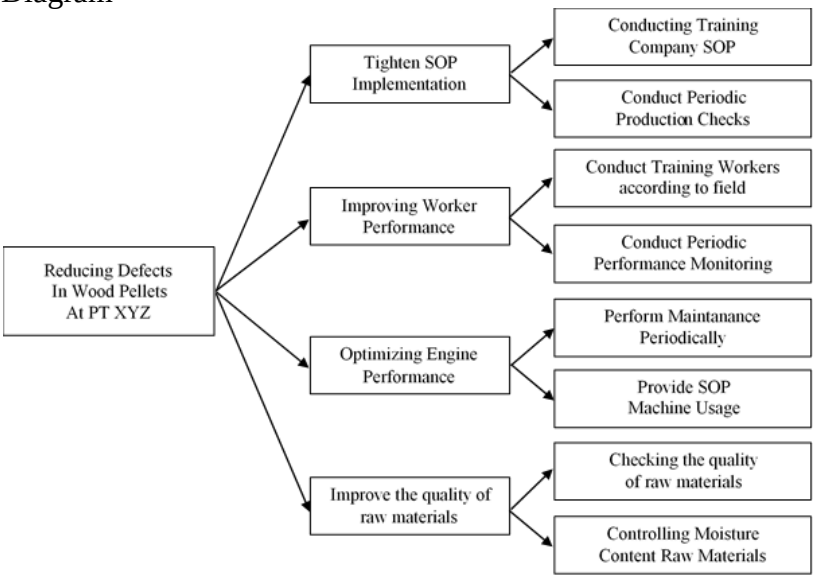

Figure 14. Tree Diagram

Tree diagram is a method used to identify the cause of a problem. Tree diagram analysis is carried out by forming a more structured mindset regarding the causal components associated with problems that have been prioritized [18]. Based on Figure 14. it can be seen that to be able to reduce defects in wood pellet products, several ways can be done on production methods, employee performance, machine performance, and quality of raw materials. The improvement solution is broken down again based on the problems that occur.

4. Matrix Diagram

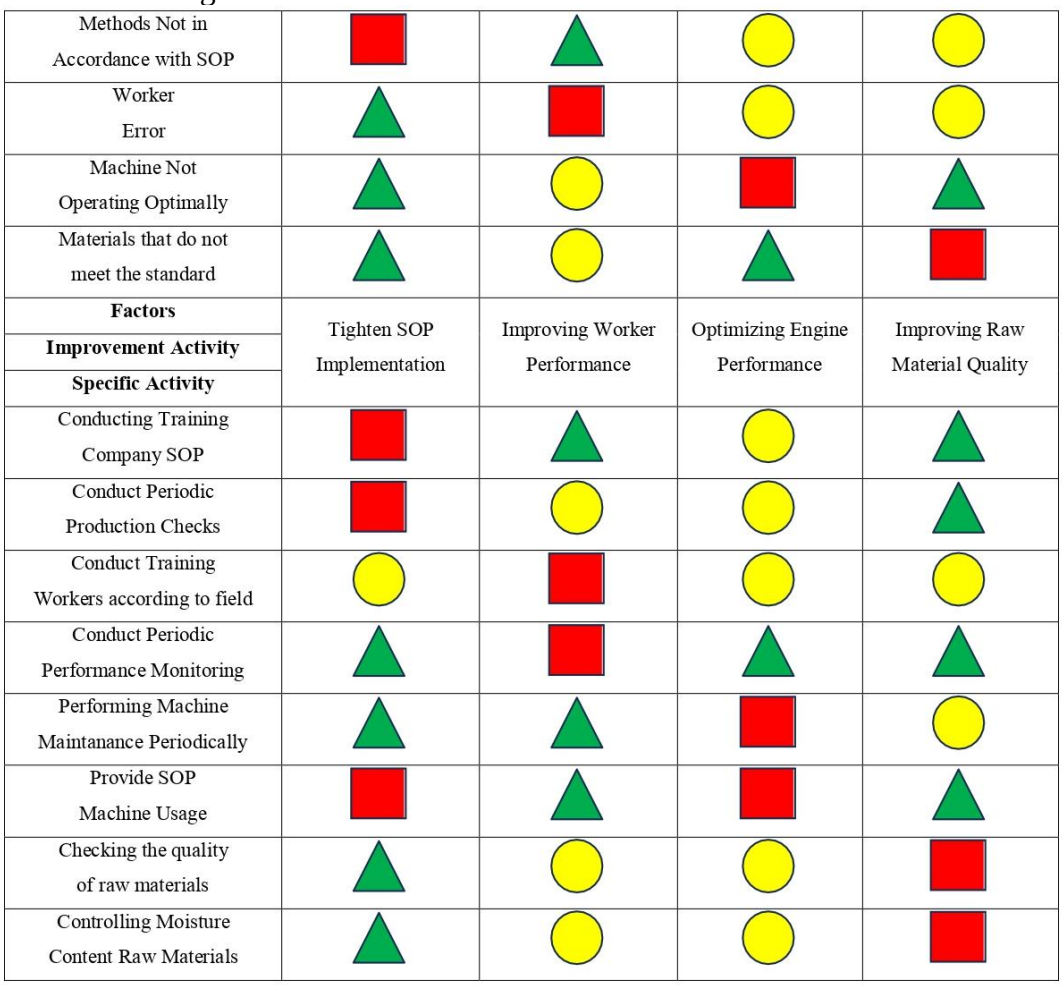

Figure 15. Matrix Diagram

Figure 15. shows the interrelationships between improvement activities, specific activities, and problem factors. The magnitude of the relationship is depicted by a square symbol which means highly related, a triangle which means related, and a circle which means unrelated. For example, improving worker performance is not related to materials that do not meet standards.

5. Data Analysis Matrix

Table 5. Data Analysis Matrix

Primary	Secondary	Importance	PT XYZ
Tighten SOP Implementation	Conducting Company SOP Training	3	2
	Conduct Periodic Production Checks	3	3
Increase Worker Performance	Conducting Worker Training in accordance with the field	3	2
	Conduct Periodic Performance Monitoring	3	3
Optimizing Engine Performance	Perform Maintanance Periodically	3	3
	Provide SOP for Machine Usage	3	2
Improve the quality of raw materials	Checking the quality of raw materials	3	2
	Controlling Raw Material Moisture Content	3	3

Description:

1 : Not yet done 2 : Done 3 : Often done

Based on table 5. it is known that the comparison between the importance rating and the production process at PT XYZ has a difference of 4 points. This indicates that the wood pellet production process at PT XYZ needs to be improved.

6. Activity Network Diagram

Table 6. Wood Pellet Manufacturing Process

Type of activity	Code activities	Previous activities	Duration (Minutes)
Cutting wood logs into beams	A	-	5
Crushing wood blocks into *wood chips*	B	A	2
Crushing *wood chips* into sawdust	C	B	3
Drying sawdust	D	C	10
Turning sawdust into *wood pellets*	E	D	5
Storing *wood pellets*	F	E	5

Based on the production process that occurs in the table above, the activity network diagram is described as follows:

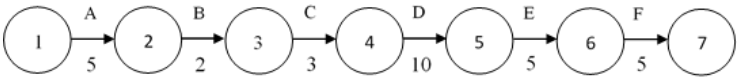

Figure 16. Activity Network Diagram

Activity Network Diagram is a diagram that describes the relationship between various activities and identifies critical activities and critical paths [19]. Based on Figure 16. it is known that there are 6 processes in making wood pellet products per kilogram (kg). Cutting wood logs into blocks with code A duration of 5 minutes, Crushing wood logs into wood chips with code B duration of 2 minutes, Crushing wood chips into sawdust with code C duration of 3 minutes, Drying sawdust with code D duration of 10 minutes, Turning sawdust into wood pellets with code E duration of 5 minutes, Storing wood pellets with code F duration of 5 minutes. So that the total production time is 30 minutes per kilogram (kg).

7. Process Decision Program Chart (PDCP)

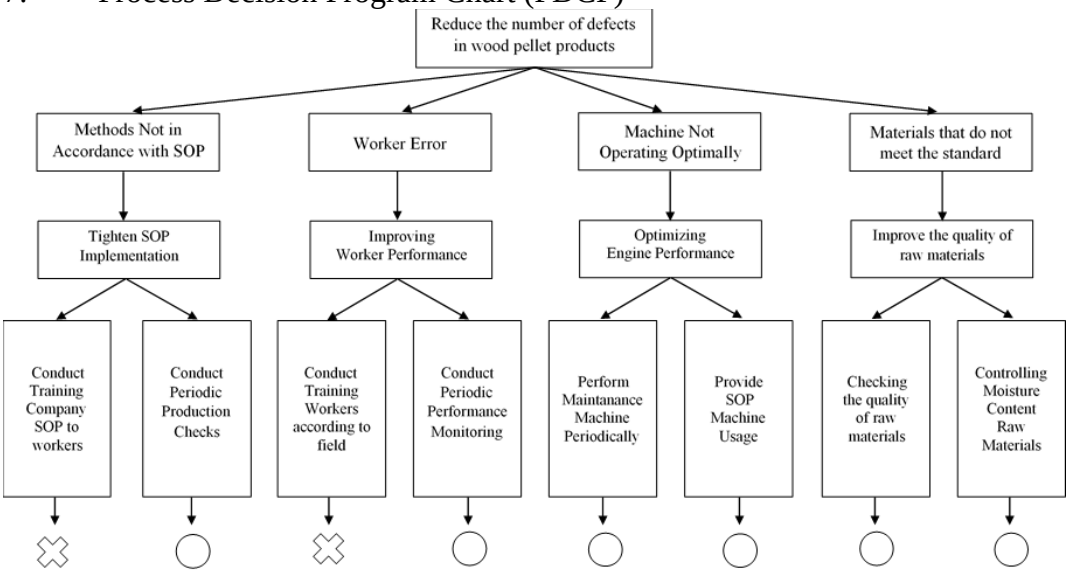

Figure 17. Process Decision Program Chart

Description:

◯ = Feasible ⛒ = Difficult to do

Process decision program chart (PDPC) is a diagram used to chart activity plans accompanied by situations that may occur. PDPC is not only used for the final solution to a problem, but can overcome risks that may occur in the future [20]. Based on Figure 17. the corrective action plan is determined to minimize defects in wood pellet products at PT XYZ. The sign (X) in the figure above means that the improvement suggestion is difficult to do, while the sign (O) means it is feasible or practical to do.

CONCLUSION

Based on the research conducted, it is known that there are 3 types of defects in wood pellet products produced by PT XYZ, namely moisture content that is too high, less density, and shape that is too small. From these three defects, it is known that there are several influencing factors, namely method, human, machine, and material factors. Based on data processing using the Seven Tools method, it is obtained that the percentage of wood pellet product defects at PT XYZ is that the type of shape defect is too small to dominate the number. From a total of 12,782 kg of defective products, 34.24% defects of too high moisture content, 30.50% defects of insufficient density, and 35.26% defects of too small shapes, which are then used as a reference in the improvement analysis.

Through the results of data processing using the New Seven Tools method, the causes of defects that occur in the production of wood pellets are known. The errors that occur are caused by several factors such as method, human, machine, and material factors, such as employees who do not comply with SOPs, lack of machine maintenance, wood raw materials or wood powder that does not meet the standards, worker errors in mixing the composition of wood powder. To prevent errors that can cause defects products can be done by tightening the implementation of the company's SOP , improving worker performance and skills, optimizing machine performance, and improving the quality of the raw materials used.

ACKNOWLEDGMENT

Thanks to PT XYZ for providing the opportunity, time, information, data, which are needed to conduct research in accordance with the topic to be raised. thanks also to Mrs. Isna as the supervisor and friends who have helped this research.

REFERENCES

[1] P. Wisnubroto And A. Rukmana, "Pengendalian Kualitas Produk Dengan Pendekatan Six Sigma Dan Analisis Kaizen Serta New Seven Tools Sebagai Usaha Pengurangan Kecacatan Produk," *J. Teknol.*, Vol. 8, No. 1, Pp. 65–74, 2015.

[2] D. Diniaty, "Analisis Kecacatan Produk Tiang Listrik Beton Menggunakan Metode Seven Tools Dan New Seven Tools (Studi Kasus: Pt. Kunango Jantan)," *J. Tek. Ind. J. Has. Penelit. Dan Karya Ilm. Dalam Bid. Tek. Ind.*, Vol. 2, No. 2, P. 157, 2016, Doi: 10.24014/Jti.V2i2.5102.

[3] E. Y. Setyawan, A. Lomi, And C. Saleh, "Penggunaan Wood Pellet Untuk Bahan Bakar Produksi Tahu Di Ukm Kab. Kediri," *J. Apl. Sains Teknol. Nas.*, Vol. 2, No. 2, Pp. 22–28, 2021.

[4] Y. N. Latifah, P. S. Indhira, I. M. Nabila, And I. Nugraha, "Analisis Pengendalian Kualitas Produk Roti Ud. Xyz Dengan Total Quality Control (Tqc)," *Waluyo Jatmiko Proceeding*, Vol. 15, No. 1, Pp. 180–185, 2022, Doi: 10.33005/Waluyojatmiko.V15i1.41.

[5] I. Nursyamsi And A. Momon, "Analisa Pengendalian Kualitas Menggunakan Metode Seven Tools Untuk Meminimalkan Return Konsumen Di Pt. Xyz," *J. Serambi Eng.*, Vol. 7, No. 1, Pp. 2701–2708, 2022, Doi: 10.32672/Jse.V7i1.3878.

[6] Somadi, B. S. Priambodo, And P. R. Okarini, "Evaluasi Kerusakan Barang Dalam Proses Pengiriman Dengan Menggunakan Metode Seven Tools," *J. Intech Tek. Ind. Univ. Serang Raya*, Vol. 6, No. 1, Pp. 1–11, 2020.

[7] F. Rozi And A. J. Nugroho, "Upaya Perbaikan Kualitas Produk Batik Di Batik Allussan Menggunakan Metode Six Sigma Dan New Seven Tools," *J. Cakrawala*

Ilm., Vol. 1, No. 11, Pp. 2971–2982, 2022.

[8] S. M. Wirawati, "Analisis Pengendalian Kualitas Kemasan Botol Plastik Dengan Metode Statistical Proses Control (Spc) Di Pt. Sinar Sosro Kpb Pandeglang," *J. Intent*, Vol. 2, No. 1, Pp. 94–102, 2019.

[9] T. P. Matondang And M. M. Ulkhaq, "Aplikasi Seven Tools Untuk Mengurangi Cacat Produk White Body Pada Mesin Roller," *J. Sist. Dan Manaj. Ind.*, Vol. 2, No. 2, P. 59, 2018, Doi: 10.30656/Jsmi.V2i2.681.

[10] E. Haryanto And I. Novalis, "Analisis Pengendalian Kualitas Produk Bos Rotor Pada Proses Mesin Cnc Lathe Dengan Metode Seven Tools," *J. Tek.*, Vol. 8, No. 1, 2019, Doi: 10.31000/Jt.V8i1.1595.

[11] D. A. Nurjanah, I. L. Kusminah, A. N. Rachmat, And N. Nabella, "Analisis Penentuan Komponen Kritis Small Excavator Menggunakan Metode Fmea Dan Diagram Pareto," *J. Safety, Heal. Environ. Eng.*, Vol. 1, No. 1, Pp. 7–15, 2024, Doi: 10.33863/Jshee.V1i1.19.

[12] S. Nazia, Safrizal, And M. Fuad, "Peranan Statistical Quality Control (Sqc) Dalam Pengendalian Kualitas: Studi Literatur," *J. Mhs. Akunt. Samudra*, Vol. 4, No. 3, Pp. 125–138, 2023, Doi: 10.33059/Jmas.V4i3.8079.

[13] H. Dewi, Maryam, And D. Sutiyarno, "Analisa Produk Cacat Menggunakan Metode Peta Kendali P Dan Root Cause Analysis," *J. Teknol. Pertan.*, Vol. 7, No. 2, Pp. 10–18, 2018.

[14] A. Kuswardana, N. Eka, And H. Natsir, "Analisis Penyebab Kecelakaan Kerja Menggunakan Metode Rca (Fishbone Diagram Method And 5 – Why Analysis) Di Pt . Pal Indonesia (Analysis Of The Causes Of Work Accidents Using The Rca Method (Fishbone Diagram Method And 5 - Why Analysis) In Pt. Pal Indon," *Conf. Saf. Eng. Its Appl.*, Vol. 1, No. 1, Pp. 141–146, 2017.

[15] A. S. P. Albertus, R. Rochmoeljati, And I. Nugraha, "Analisis Kualitas Defect Produk Pupuk Dolomit Dengan Metode New Seven Tools Dan Failure Mode And Effect Analysis (Fmea) Di Pt. Xyz," *Tekmapro*, Vol. 19, No. 2, Pp. 194–205, 2024, Doi: 10.33005/Tekmapro.V19i2.414.

[16] H. Ilham, B. Wijayanto, And S. P. Rahayu, "Analysis And Design Of User Interface/User Experience With The Design Thinking Method In The Academic Information System Of Jenderal Soedirman University," *J. Tek. Inform.*, Vol. 2, No. 1, Pp. 17–26, 2021, Doi: 10.20884/1.Jutif.2021.2.1.30.

[17] A. Miftahul Putra And I. Prakoso, "Pengendalian Kualitas Produk Bubble Window Dengan Metode New Seven Tools (Studi Kasus: Pt. X) Bubble Window Product Quality Control With New Seven Tools Method (Case Study: Pt X)," *J. Rekayasa Sist. Ind.*, Vol. 8, Pp. 97–103, 2021.

[18] D. A. Anggraini And W. Wijaya, "Analisa Kualitas Crude Palm Oil (Cpo) Dan Usulan Perbaikan Menggunakan Metode Tree Diagram Di Pt. Johan Sentosa Bangkinang," *J. Surya Tek.*, Vol. 5, No. 02, Pp. 57–62, 2017, Doi: 10.37859/Jst.V5i02.645.

[19] Y. Zakariya, M. F. F. Mu'tamar, And K. Hidayat, "Analisis Pengendalian Mutu Produk Air Minum Dalam Kemasan Menggunakan Metode New Seven Tools (Studi Kasus Di Pt. Dea)," *Rekayasa*, Vol. 13, No. 2, Pp. 97–102, 2020, Doi: 10.21107/Rekayasa.V13i2.5453.

[20] P. T. Ayudia And Y. Helianty, "Perbaikan Proses Produksi Berdasarkan Metode Failure Mode And Effect Analysis Dan Process Decision Program Chart," *Pros. Disem.*, Pp. 1–11, 2023.

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