Risk Management to Identify and Analyze Risks in Bio briquette Production Operational Activities

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Abstract. Bio-briquettes are derived from organic materials consisting of sawdust, coconut shells, and other organic waste. Bio-briquette production is also an effort to preserve the environment so as not to use fossil fuels. The production process of bio-briquettes is inseparable from risks that can interfere with the smooth running of the production process. Therefore, the risks in the production process need to be identified involving all stages of the process in bio-briquette production. The identification process in this study uses the Failure Mode and Effect Analysis (FMEA) and Risk Matrix. The approach uses the Failure Mode and Effect Analysis (FMEA) method, namely severity, occurrence, and detection, and calculating the RPN value to determine the priority of errors in the production process. Then all risks are categorized according to the risk matrix into three risk levels, namely high risk, medium risk, and low risk. The use of methods of Failure Mode and Effect Analysis (FMEA) and Risk Matrix is to improve safety in bio-briquette production process activities and product quality. The results of the research show that the risk identification results show that there are 79 risks in all bio-briquette operational activities. The identification results are categorized based on risk levels, namely very low-risk level, namely 1%, low, namely 32%, medium, namely 16%, high, namely 30% and 21% are classified as high risk. Then the results of the proposed type of treatment are mitigation by 60% and risk retention by 40%.

Keywords: Bio-briquettes, Failure Mode and Effect Analysis (FMEA), Production Process, Risk Matrix.

1 Introduction

Bio-briquettes are solid fuels produced through the compression process of organic materials such as coconut shells, wood powder, or other biomass. Usually making bio-briquettes involves compacting the materials with a machine or mold and followed by drying to reduce the water content and increase the compaction ability. Bio-briquettes are used as an alternative fuel that is environmentally friendly and efficient compared to fossil fuels, bio-briquettes also include organic materials or compressed biomass.

The bio-briquettes are produced by one of the charcoal bio-briquette company companies with the main raw materials being coconut shell and wood waste. The production process goes through various preparations starting from raw material

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preparation to the marketing process. Of course, various stages of the production process did not go well, work accidents occurred during the process. Events that occur in the production process are of course referred to as risks. These risks must be controlled so that the bio-briquette production process is safe and complies with work safety procedures. The charcoal bio-briquette company has not yet conducted a risk study on the bio-briquette production process, if this risk is not carried out further, it is feared that it will have an increasingly bad effect, especially for working operators.

Risk is something that cannot be avoided and can never be separated from humans, so risk can be defined as an adverse event. The risks that arise in the bio-briquette production process cover the entire production process, each activity causes risks that need to be properly identified [2]

2 Literature Review

2.1 Risk Management

Risk Management is an important and increasingly important general element in the functioning of a company because it is related to various activities. This ensures increased safety, the ability to predict the consequences of threats, and appropriate decision-making and strategic planning. In addition, *risk management* helps identify all areas of an organization's activities, monitor dangers, and prepare for dangerous crises that occur within the company. *Risk Management* identifies company weaknesses and strengths and enables continuous improvement. The *risk management* process consists of several stages, namely activity definition, risk identification, analysis, assessment, and response as well as ongoing monitoring and communication [3]

2.2 Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a systematic method for identifying and resolving product and process problems. FMEA focuses on reducing errors, improving quality, and increasing customer satisfaction. FMEA is most effective when performed during the design or product development stages, but applying FMEA to existing products and processes can also provide significant benefits. FMEA aims to determine the possibility of process or product failure. Product failure occurs when the product does not function as intended or does not function properly in some way. Even the simplest products have a high probability of failure. Evaluating the risk of failure is determined by three factors, namely:

Severity: the consequences of failure if the risk occurs
Occurrence: the occurrence or probability of the frequency of failure
Detection: the probability of failure being detected

2.3 Risk Matrix

Risk Matrix is *a tool* used and determined in analyzing risk. The application of *the Risk Matrix* is to pay attention to and assess every event that is included in the risk, then *the*

Risk Matrix allows the risk to be identified through the process of assessing *the likelihood* and *consequence,* this is the axis in *the Risk Matrix. In its assessment, the Risk Matrix* provides colors including low (green), medium (yellow), and high (red) risk levels [5].

3 Method

The direct data collection stage includes interviews, namely the method used to obtain data by asking questions directly to relevant experts to obtain information such as a general description of the bio-briquette company, input and output flows in the bio-briquette production process, and other information as a reference in this research. Observational data collection is a method of obtaining data by conducting direct observations of the company such as material flow data, production information flow, and *defective products,* and *brainstorming* to collect ideas obtained from solutions to problems in the bio-briquette production process.

The data processing stage uses the *Failure Mode and Effects Analysis* (FMEA) method and the formula for calculating *Failure Mode and Effects Analysis* (FMEA), namely:

Risk priority number = severity x occurrence x detection

The steps in the problem-solving process using the FMEA method are:

1. Determining process or product: determining the process in this research is the entire bio-briquette production process
2. *brainstorming* step to determine what potential dangers affect the entire bio-briquette production process.
3. Make a list of potential impacts for each failure mode: the next step is to include all information related to any risks that cause production process failure.
4. Determine the intensity of severity of each effect: create a *severity assessment scale* by estimating how serious the effect of failure occurs in the bio-bracket production process.
5. Determine the occurrence rating for each failure mode: create an *occurrence assessment scale* by estimating how serious the effects of failure are in the bio-briquette production process.
6. Determine the detection level for each mode and/or effect: create a *detection assessment scale* by estimating how serious the effects of failures that occur in the bio-briquette production process are.
7. Calculating the risk priority number for each event: the next step is after identifying the risk and determining the assessment of *severity, occurrence,* and *detection*, the next step is calculating the RPN (*Risk Priority Number*)
8. Prioritizing problem-solving modes for solutions: the next stage is prioritizing the highest to low risks, risks that require more attention
9. Implement steps to prevent or reduce high-risk behavior.
10. Calculates the resulting RPN when failure modes are reduced or eliminated.

The steps in the problem-solving process using the risk matrix method are:

1. Identify using Occurrence and Severity tables in each bio-briquette production process.

2. Determine assessments based on high risk, low risk, and medium risk for each severity and occurrence assessment.
3. Record the results according to the colors on the risk matrix

The next step is to make recommendations for improvements using risk management, including mitigating risk, avoiding risk, transferring risk, and retaining risk.

4 Result

4.1 Bio-briquette Operational Activities

Bio-briquette operational activities start from the preparation of raw materials to finished products. This series of activities consists of preparing raw materials from wood and coconut shells to become bio-briquettes. Table 1 is as follows:

Table 1. Bio-briquette operational activities

No	Activity
1	Raw Material Collection
2	Raw Material Storage
3	Raw Material Drying
4	Wood Cutting
5	Writing Process Stages
6	Enumeration Process
7	Water Heating
8	Mixing Raw Materials with Adhesive
9	The process of inserting raw materials into a mold
10	First Pressing Process
11	Second Pressing Process
12	Taking Finished Products From Machines
13	Drying Process
14	Packaging
15	Marketing
16	Delivery of finished products

4.2 Severity, occurrence, detection rating scale

Table 2. Severity

Ranking	*Severity*	Description
10	Very dangerous	It has very dangerous system failure effects
9	Dangerous with warning	Potentially harmful effects with warning
8	Very high	Not operating
7	Tall	The high impact seriously affects the performance
6	Currently	The effects were severe requiring major repairs
5	Low	The impact is affecting performance and quality
4	Very low	The effect decreases gradually
3	Small	Having small effects requires some improvements
2	Very small	It has mild effects and can be repaired easily
1	No effect	Has no effect

Table 3. Occurrence

Ranking	*Occurrence*	Description
10	Very high	Chances of failure/accidents often fail
9		Chances of failure/accidents often fail.
8	Tall	Chances of repeated failures/accidents
7		Chances of repeated failures/accidents
6	Currently	The chances of failure/accidents are rare
5		The chances of failure/accidents are rare.
4	Seldom	The chance of failure/accident is small
3		The chance of failure/accident is small.
2	No effect	No effect
1		No effect

Table 4. Detection

Ranking	*Detection*	Description
10	Almost impossible	Unable to detect failure
9	Very difficult	It may be very difficult to detect failure
8	Difficult	It may be difficult to detect failure
7	Very high	Very high probability of detecting failure
6	Tall	High probability of detecting failure
5	Currently	Possibility of detecting a failure
4	Low	Low probability of detecting failure
3	Very low	Very low probability of detecting failure
2	Easy to detect	Possible easy to detect failure
1	Very easy to detect	The possibility of failure is very easy to detect

4.3 **Risk Priority Number Calculation Results**

Table 5. Risk Priority Number

Risk Source	**Code**	**Mark**	**Code**	**Mark**	**Code**	**Mark**	**RPN value**
Raw materials are not available	S1	7	O1	7	D1	5	245
	S2	6	O2	7	D2	1	42
Supplier commits fraud against the company	S3	3	O3	5	D3	5	75
The quality of raw materials does not meet specifications	S4	4	O4	7	D4	8	224
	S5	4	O5	3	D5	3	36
During the journey, raw materials fell from the vehicle	S6	2	O6	5	D6	1	10
	S7	3	O7	5	D7	2	30
	S8	2	O8	5	D8	2	20
The raw material owner did not respond	S9	7	O9	9	D9	2	126
Transport accident	S10	5	O10	5	D10	2	50
	S11	5	O11	5	D11	2	50
Collection fees are too expensive	S12	7	O12	5	D12	5	175
	S13	3	O13	6	D13	1	18
The car tire is punctured	S14	3	O14	5	D14	2	30
Car broke down	S15	4	O15	5	D15	2	40
	S16	5	O16	4	D16	3	60

Delay in picking up raw materials	S17	4	O17	7	D17	2	56
	S18	7	O18	5	D18	2	70
Risk of the material getting wet	S19	6	O19	5	D19	3	90
	S20	6	O20	7	D20	3	126
Raw materials must be shrunk first (raw materials from wood)	S21	2	O21	5	D21	3	30
The quality of raw materials is not good	S22	4	O22	5	D22	1	20
Drying is not optimal	S23	3	O23	3	D23	2	18
	S24	4	O24	3	D24	2	24
	S25	5	O25	3	D25	5	75
Requires quite a long time to dry	S26	5	O26	5	D26	6	150
Operator accident	S27	5	O27	7	D27	2	70
	S28	7	O28	7	D28	3	147
Machine failure	S29	5	O29	9	D29	5	225
	S30	6	O30	5	D30	2	60
Respiratory problems due to dust released during the cutting process	S31	6	O31	5	D31	2	60
Risk of fire	S32	8	O32	7	D32	8	448
	S33	7	O33	7	D33	3	147
There is no monitoring process	S34	6	O34	3	D34	2	36
Air pollution	S35	5	O35	7	D35	2	70
	S36	5	O36	5	D36	3	75
Operator accident	S37	5	O37	7	D37	3	105
	S38	7	O38	7	D38	3	147
Breathing is disturbed by smoke	S39	4	O39	7	D39	2	56
	S40	4	O40	5	D40	2	40
The results of the writing process are too mature	S41	7	O41	3	D41	7	147
The results of the writing process are less mature	S42	5	O42	4	D42	4	80
	S43	4	O43	3	D43	1	12
Hands will peel due to handling raw materials that are still hot	S44	4	O44	5	D44	3	60
	S45	5	O45	7	D45	3	105
The writing process takes a long time	S46	4	O46	7	D46	4	112
	S47	2	O47	5	D47	2	20
	S48	4	O48	5	D48	2	40

Operator Accidents (caused by machines such as hand injuries)	S49	5	O49	7	D49	3	105
Noise due to the sound of machines during the chopping process	S50	5	O50	3	D50	2	30
	S51	7	O51	3	D51	2	42
Shredding machines emit dust (from materials and machine fumes)	S52	2	O52	3	D52	2	12
	S53	5	O53	2	D53	2	20
There is no check on the condition of the machine	S54	4	O54	9	D54	3	108
	S55	6	O55	5	D55	4	120
Machine or tool damage	S56	7	O56	5	D56	3	105
	S57	6	O57	9	D57	2	108
Inappropriate results (too smooth or too rough)	S58	4	O58	3	D58	7	84
	S59	3	O59	3	D59	3	27
Environmental pollution due to dust	S60	3	O60	7	D60	2	42
	S61	4	O61	3	D61	5	60
Unavailability of fuel	S62	3	O62	7	D62	3	63
	S63	5	O63	3	D63	3	45
Waste of fuel	S64	3	O64	5	D64	3	45
Fire risk	S65	6	O65	5	D65	2	60
Hands peel from holding hot water	S66	3	O66	5	D66	3	45
	S67	5	O67	4	D67	3	60
Not evenly distributed in the mixing process	S68	5	O68	5	D68	2	50
	S69	2	O69	3	D69	2	12
The entry of other particles such as soil or dirt into the mixture	S70	3	O70	3	D70	3	27
	S71	4	O71	5	D71	3	60
The dough is too runny	S72	5	O72	5	D72	2	50
	S73	3	O73	4	D73	3	36
The dosage does not comply with existing regulations	S74	5	O74	3	D74	2	30
Container not cleaned	S75	3	O75	5	D75	3	45
The operator's hand may be pinched if he is not careful with the machine	S76	7	O76	7	D76	6	294
Machine failure	S77	5	O77	9	D77	3	135

	S78	6	O78	7	D78	2	84
Less pressure when inserting raw materials into the machine	S79	5	O79	5	D79	3	75
Environmental pollution due to waste	S80	7	O80	3	D80	7	147
A lot of raw materials are wasted	S81	6	O81	7	D81	3	126
	S82	4	O82	5	D82	3	60
There is trash or other particles in the raw material	S83	3	O83	3	D83	3	27
	S84	4	O84	3	D84	5	60
Risk of operator accident	S85	7	O85	7	D85	6	294
	S86	4	O86	7	D86	6	168
Sticky Pressing	S87	4	O87	5	D87	3	60
	S88	6	O88	3	D88	6	108
Noise from the machine	S89	5	O89	5	D89	2	50
Risk of hand entrapment	S90	5	O90	7	D90	2	70
	S91	4	O91	7	D91	5	140
The risk of engine damage is slight	S92	5	O92	5	D92	2	50
Risk of serious machine damage	S93	7	O93	9	D93	3	189
	S94	8	O94	7	D94	3	168
There is no check on the condition of the machine	S95	5	O95	7	D95	4	140
The machine is not turned off	S96	6	O96	7	D96	2	84
Unbalanced emphasis in the pressing process	S97	3	O97	3	D97	4	36
	S98	4	O98	3	D98	3	36
Risk of operator accident	S99	7	O99	7	D99	2	98
	S100	4	O100	7	D100	5	140
The product does not come out of the mold	S101	7	O101	5	D101	3	105
Noise with sound from the machine	S102	5	O102	5	D102	2	50
Risk of hand entrapment	S103	5	O103	5	D103	2	50
The risk of engine damage is slight	S104	7	O104	7	D104	3	147
Risk of serious machine damage	S105	8	O105	9	D105	4	288
	S106	5	O106	5	D106	3	75

There is no check on the condition of the machine	S107	6	O107	7	D107	4	168
The machine is not turned off	S108	3	O108	7	D108	3	63
Unbalanced emphasis in the pressing process	S109	4	O109	3	D109	5	60
	S110	3	O110	4	D110	5	60
Risk of overheating hands	S111	6	O111	3	D111	2	36
	S112	5	O112	7	D112	2	70
Risk of hand entrapment	S113	5	O113	7	D113	2	70
	S114	6	O114	7	D114	5	210
Drying is not optimal	S115	4	O115	7	D115	4	112
Risk of hand entrapment	S116	3	O116	5	D116	2	30
	S117	4	O117	5	D117	5	100
Humidity of the finished product storage area	S118	7	O118	9	D118	2	126
The product doesn't sell	S119	4	O119	7	D119	3	84
	S120	2	O120	7	D120	4	56
Too much product buildup	S121	7	O121	7	D121	3	147
	S122	6	O122	5	D122	4	120
Product returns	S123	7	O123	5	D123	2	70
	S124	3	O124	7	D124	3	63
	S125	6	O125	5	D125	4	120
Packaging is not attractive	S126	2	O126	3	D126	4	24
	S127	2	O127	5	D127	6	60
There is no bookkeeping	S128	3	O128	5	D128	4	60
Too high shipping costs	S129	6	O129	7	D129	5	210
	S130	5	O130	7	D130	2	70
	S131	7	O131	4	D131	3	84
Total		631		713		418	11470

4.4 **Risk Level Results**

Risk analysis consists of identifying each risk activity, and then identifying risk assessments based on a predetermined frequency. It has been found through risk identification that there are 79 risks in different activities in bio-briquette operations.

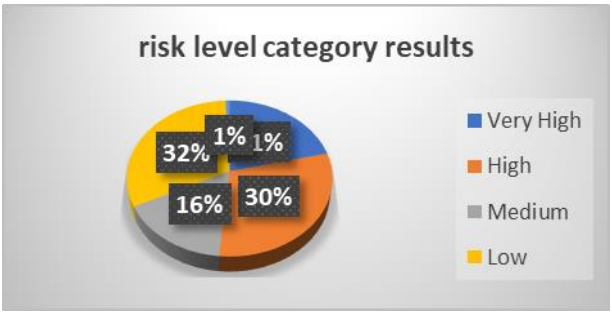

Fig. 1. Risk level category result

Fig. 1. The category results for this risk level appear to show that the risk level is *very low*, namely 1%, *low,* namely 32%, *medium*, namely 16%, *high*, namely 30%, and *very high*, namely 21%. It can be seen that many risks still fall into the *medium* and *high-risk level categories*, which means that if these risks are ignored, they will have an impact on bio-briquette operational activities as a whole.

Fig. 2. Steps for handling

Fig. 2. These treatment steps can be seen that the *mitigation type of treatment* provides the largest percentage, namely 60%, while the handling of *retaining* is only 40%. In *the mitigation* type of treatment, some of these risks can still be handled by the owner of the bio-briquette. *Mitigation* means reducing the impact of the frequency of risks that arise, while the *retaining type of treatment* is a type of treatment where the frequency of occurrence is small so that no handling steps are needed.

5 Conclusion

Risk identification in bio-briquette operational activities is carried out by direct observation and interviews with operators. These activities start from taking raw materials to delivering finished products. Every production of bio-briquettes has a risk of events that cause failure. After carrying out the identification, the risks to bio-briquette production were determined as many as 79 types of risks with different bio-briquette operational activities. The approach used in analyzing risk is Failure Mode And Effect Analysis (FMEA). The risks identified are then carried out to continue identifying the factors causing the risks contained in bio-briquette operational activities.

The causal factors (severity) for each risk are 131 and the causal factors are found in different risks for bio-briquette operational activities.

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