

Application of the Wheat Processing Circle Quality Control Method in Raw Wheat Bin Silos to Reduce Defective Products

Devi Susiati¹, Rivaldi²

^{1,2)}Teknik Industri, Fakultas Teknik, Universitas 45 Surabaya

e-mail: devisusiati45@gmail.com

Abstract—The food industry is an industry that ranks first in Indonesia because it is a primary need. The food industry sub-sector, at 38.38%, breaking the USD 21.35 billion mark, supported the GDP of the non-oil and gas processing industry in the second quarter of 2022. The largest investment was in the food sector, including the bakery, flour, and palm oil industries. PT. XYZ is the largest company in Indonesia in the field of milling wheat into flour. This company experienced a problem in the screening area, namely Raw Wheat Bin silos with a lot of husks in a month there were 20 incidents so it reached 80%. To overcome these problems, the QCC method approach is used. From the results of the analysis using the QCC method, it was found that the failure rate of raw wheat bin silos with lots of husks decreased from 20 in April to 0 in June by applying the standardization that had been obtained.

Keywords: Wheat, QCC, Failure, Silo Rwb

I. INTRODUCTION

The economy in Indonesia is largely influenced by increased consumption of household needs. One industry that is currently growing rapidly is the food industry because it is one part of the primary/basic needs. The food industry sub-sector, which reached 38.38%, breaking the USD 21.35 billion mark, supported the GDP of the non-oil and gas processing industry in the second quarter of 2022 [1]. The largest investment is in the food sector, including the bakery, flour, and palm oil industries. Wheat flour ranks second in the food sector with the most demand from consumers. Therefore it must be followed by quality innovations that must be improved. Wheat flour is the basic ingredient for the manufacture of food products. In 2021 the consumption of wheat flour will reach 28% and

is expected to continue in 2045 to reach 50% of the total staple food [2].

Flour Mills is a division of PT. XYZ which is engaged in milling wheat into flour[3]. The company has three mills based in Jakarta, Cibinong, and Surabaya. PT. XYZ produces various brands of wheat flour -to make bread, noodles, pasta, and biscuits. This company fulfills consumer needs for about 70% of wheat flour. Mills is one of the departments responsible for cleaning the wheat, both 1st and 2nd cleaning, as well as milling wheat into flour according to predetermined specifications [4]. First cleaning aims to separate the grain from impurities that are smaller in size than the impurities in pre-cleaning. The first cleaning process starts from the raw wheat bin to the buffer bin. Wheat stored will be removed using a volumetric by adjusting the capacity of wheat discharge from the raw wheat bin based on volume weight (tons/hour). The second cleaning machine used is the scourer and TRR (Tarara) to clean and separate the dust or wheat husk which is peeled off and still attached to the wheat from the previous process [5].

With increasing consumer demand, it is hoped that the company will be able to meet consumer demand precisely and quickly. The production process requires one of which is the smooth use of the machine. However, in reality, there were several problems faced by this company, which occurred in the screening area, including lots of husk RWB silos, turbolizer belts breaking, bucket elevator belts breaking, metal bushings wearing out, and combi sieve frequently breaking. So it results in spec flour (dirty) which results in material losses and manufacturing costs. In analyzing repairs at PT. XYZ, the authors apply the QCC (Quality Control Circle) method. QCC is a concept to improve work quality and productivity by utilizing all of the company's assets [6]. This method will produce recommendations for solving problems so that they can be more effective. Research that was carried out by [7]with the title "Application of the

QCC Method to Analyze the Causes of Damage to CD-type Cover Sifters" by establishing a standard operating procedure for cleaning and gluing damaged CD-type cover sifters, to reduce losses. Research by [8] using the QCC method can improve the effective time on the manpower factor increasing from 80.66% to 86.89%. Research conducted by [9] analyzes the quality control of flour products to reduce consumer returns using the QCC method.

II. RESEARCH METHOD

The method used in this study is the Quality Control Circle (QCC) approach. This method is for discussing and solving work problems to improve quality by implementing Quality Control Groups (GKM) [10]. Several steps to carry out quality control are determining the theme of the problem, setting targets, analyzing conditions in the field, cause and effect analysis, improvement plans, corrective actions, evaluation of results, standardization, and next steps. Metode yang dilakukan pada penelitian ini menggunakan pendekatan *Quality Control Circle* (QCC).

III. RESULT AND DISCUSSION

There is a lot of husk in the raw wheat bin, so the cleaning machines cannot run normally. The machines include grain weighing and combi cleaner machines. The problem starts with the valve opening on the wheat scale not meeting the target and the combi cleaner machine cannot accommodate the amount of wheat because it exceeds the engine capacity. So the combi cleaner separator is full of husks, wheat cannot pass through, and more impurities come out through the pathway. Here is a picture of the wheat in the raw wheat bin and the metal bin with lots of husks.



Figure 1. Wheat in Raw Wheat Bin and Metal Bin lots of husks

Step 1: Determine the Theme

Indicators of success in the screening process include screening machines running normally, wheat is not contaminated with other materials, and wheat moisture being on target. The following is a table and graphical images of constraint indicators in the screening area.

Table 1. Problems in the Screening Area

No.	Problem	Frequency (/month)	%
1.	Rwb silos have a lot of husks	20	80
2.	Turbolizer belt broken	1	4
3.	The bucket elevator belt broke	2	8
4.	Worn metal bushings	1	4
5.	Sieve combi often breaks	1	4
	Total	25	100

The following is a graph of the problems in the screening area.

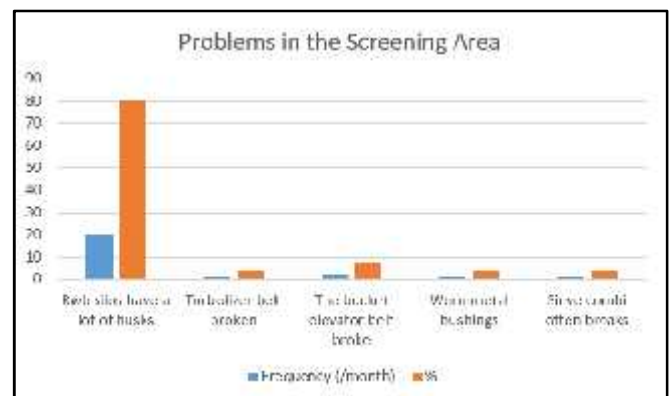


Figure 2. Problems in the Screening Area

From the problem data in the screening area, the most common is rwb silo with a lot of husks in a month, there are 20 incidents so it reaches 80%.

Step 2: Setting Targets

Determination of this target is based on April 2023 (chaff in the raw wheat bin and cleaning process of $\pm 2\%$).

Table 2. Target Setting

Element	Factor
Specific	Rwb silos have a lot of husks
Measurable	Chaff in silo raw sheat bin more than 5%
Achievable	In June silo raw wheat bin husk ±2%
Reasonable	Affects the cleaning process is not optimal
Time-Based	Completed within 1 month

Setting targets in the analysis of raw wheat bin silo problems using the SMART method approach.

Step 3: Analysis of Existing Conditions

Analysis of the condition of PT. XYZ by approaching several factors, namely man, method, material, machine, and environment. Below is a table explaining the analysis of the conditions that exist in the company.

Table 3. Condition Analysis

Factor	Items	Standard	Check Method	Actual	%	Remark
Man	Rarely pay attention to the condition of the silo outlet pipe	Rwb silo rotation	Field observation	Silo rotation if there is a new stamp with 2 or 3 types of wheat	0	No problem
Method	The capacity of the 1st cleaning wheat scale is not reduced at the start of filling wheat	Weighing capacity reduced	Field observation	The capacity of the balances at the start of the screening process is not underestimated	100	Problem
	There is no silo rotation	Silo rotation 1 week 3 times	Field observation	Rarely move silos	100	Problem
Material	Wheat broke	Whole wheat	Field observation	Wheat is not broken	11	No problem
	Wheat a lot of husks	Chaff not more than 2%	Field observation	Wheat much husk more than 5%	100	Problem
Machine	Control's separator near full of husks	No dead seeds	Check the combi cleaner machine	Normal combi cleaner	11	No problem
	Problem cleaning machine	The cleaning machine runs optimally	Field observation	Optimum engine	0	No problem
Environment	Humid and high temperature	-	Field observation	Temperature 42°C	100	Problem

It can be seen from the table above that there are problems with items including method factors (the capacity of the 1st cleaning wheat scale is not reduced at the start of grain filling and there is no silo rotation), material (wheat has lots of husks), and environment (humid and high temperatures).

Step 4: Cause and Effect Analysis

The next step is to make a causal diagram to analyze the factors that cause a lot of husk silos.

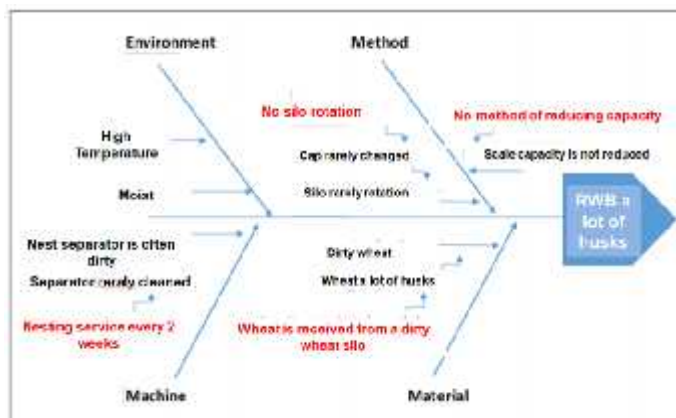


Figure 3. Cause and Effect Diagram

The table below is an explanation of the explanation of the cause and effect diagram, 5 root causes are obtained from silo RWB with lots of husks.

Table 4. Explanation of Root Causes

No.	Root Cause	Description	Validation
1.	No silo rotation	No rotation for 1 month	Yes
2.	Decreased capacity at the start of the screening process	There is no decrease in the capacity of the scales	Yes
3.	Servicing once every 2 weeks	The separator cleaning distance is too long	Yes
4.	Wheat received from dirty WS	Wheat a lot of husks	No
5.	Humid and high-temperature	High temperatures affect humidity	No

After validation, it turned out that there were 3 root causes, namely the absence of an rwb silo rotation method, decreased capacity at the start of the screening process, and servicing nests once every 2 weeks.

Step 5 : Maintenance Plan

After obtaining the root cause of the silo with lots of husks, the next step is to carry out an improvement plan using the 5W + 1H analysis.

Table 5. Improvement Plan

No.	What	Why	How	Who	When	Where
1.	Silo rotation week 2 times	To reduce the amount of husk in the silo	Create a silo rotation work procedure	Screening-man	June	Mill EF
2.	Reduce the capacity of the balance at the start of the screening process	So that at the start of the screening process, the combi cleaner engine runs normally	Make cleaning process work procedures	Screening-man	June	Mill EF
3.	Perform cleaning of the separator nest	So that the screening machine runs smoothly	Make a schedule for cleaning/ servicing the machine	Screening-man	June	Mill EF

There are 3 improvement plans to overcome rwb silos in the EF Mill screening area which was carried out in June.

Step 6: Corrective Action

To implement the improvement plan there must be a next step, namely corrective action for problem 1.

Table 6. Corrective Action on Problem 1

No.	What	Why	How	Who	When	Where
1.	Silo rotation week 2 times	To reduce the amount of husk in the silo	Create a silo rotation work procedure	Screening-man	June	Mill EF

Procedure for raw wheat bin silo rotation

1. Ensuring the wheat used is according to the RTP.
2. Ensure silos are filled with grain to be used.
3. If the grist used in a week uses 3 types of wheat, then to fill the silos next week please rotate.
4. For grist in a week use 2 types of wheat or 1 type of wheat, then in a week you need to rotate 2 times.

Table 7 below describes the corrective actions that must be implemented in problems 2 and 3.

Table 7. Corrective Actionsthere are Problems 2 and 3

No.	What	Why	How	Who	When	Where
2.	Reduce the capacity of the balance at the start of the screening process	So that at the start of the screening process, the combi cleaner engine runs normally	Make cleaning process work procedures	Screening-man	June	Mill EF
3.	Perform cleaning of the separator nest	So that the screening machine runs smoothly	Make a schedule for cleaning/ servicing the machine	Screening-man	June	Mill EF

Cleaning process work procedures

1. Start all cleaning machines
2. Wait until the metal bin is full to the high-level

3. Reduce wheat weighing capacity to 50% of the target (target 17 tons/hour)
4. Start wheat scales 1st cleaning

Step 7 : Evaluation of results

Evaluate the before and after results of several factors including quality, cost, productivity, delivery, safety, and moral factors.

Table 8. Evaluation of Results

Factor	Improvement		Results
	Before	After	
Quality	Silos a lot of husks	No husks	OK
Cost	Wheat repass fee IDR 10.000.000,-	No wheat is repassed	OK
Productivity	Wheat has a lot of husks	Wheat has no husk	OK
Delivery	Grain transfer for the cleaning process is hampered	Grain transfer for a smooth cleaning process	OK
Safety	There is a potential for work accidents when going up and down stairs	No potential for work accidents	OK
Moral	Screeningman has difficulty when the cleaning machine does not run smoothly	Screeningman works easier and more convenient	OK

The results obtained from the improvement of the raw wheat bin silo meet the improvement standards.

Step 8: Standardization and Next Steps

The next step for the company is to standardize it so that there is no husk in the raw wheat bin silo and the cleaning machine runs smoothly which has been explained in table 9 below.

Table 9. Standardization

No.	Improvement	Target	Standardization
1.	Raw silo rotation according to procedure	There is no husk in rwb silos and cleaning machines run smoothly	Vis. word of mouth between screening man and mill work reports
2.	The screening process goes according to the procedure	There is no husk in rwb silos and cleaning machines run smoothly	Vis. word of mouth between screening man and mill work reports
3.	Combi cleaner machine service is carried out week 2 times	There is no husk in rwb silos and cleaning machines run smoothly	Vis. word of mouth between screening man and mill work reports

After implementing the QCC method approach, the failure rate of silo raw wheat bins with lots of husks decreased from 20 to 0.

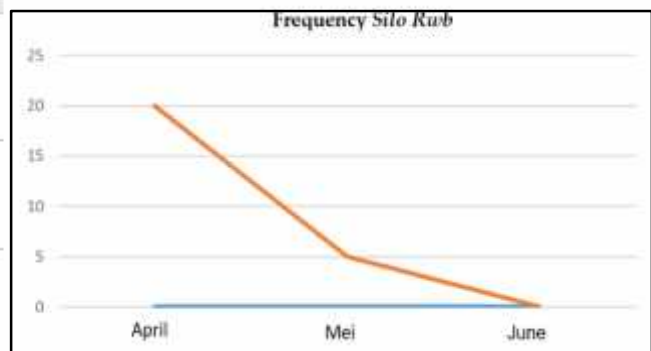


Figure 4. Frequency Silo Rwb

IV. CONCLUSION

Based on the raw wheat bin silo analysis using the QCC method, the following conclusions are obtained:

1. Making standardization so that there is no husk in the silo raw wheat bin and the cleaning machine runs smoothly, namely the silo rwb rotation according to the procedure, the screening process goes according to the procedure, and the combi cleaner machine is serviced twice a week.
2. For delivery of standardization orally between screening man and mills work reports.
3. The failure rate of silo raw wheat bin, which has lots of husks, has decreased from 20 in April to 0 in June.

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