CHAPTER IV
THE PROPOSED FMEA TECHNIQUE

In order to reduce the percentage of broken rice in coating and drying process, and the process time, potential problems must be identified and eliminating in a systematic way. One of the engineering techniques used to solve problems in a process is the failure mode and effect analysis (FMEA). The FMEA technique can be used in the studied factory in order to define, identify and eliminate potential failures that impact to the coating and drying processes.

4.1 Problem Analysis By Means of FMEA

There are four types of FMEA: system, design, process and service. The coating and drying processes in the studied factory employs the process FMEA because it is directly involved with analysis in manufacturing process. It focuses on failure modes caused by process deficiencies.

4.1.1 The FMEA Team Selection

The FMEA concept is a team function, not individually. An appropriate team is required and the team must be cross-functional. The team members have to be willing to contribute to the project. The team must be set up properly for a particular project. Therefore a team for the rice coating and drying processes in the studied factory needs to be established based on education qualification and experience in manufacturing process, particularly coating and drying fields. The FMEA team in this project consists of 7 persons with multi functional background as described as follows:

1. **Process Engineer**

He received a Master Degree in Chemical Engineering with a research topic involving with drying process. He has been working with the company for

2 years and has been trained in France about coating processing. He has also been trained in-housed about quality control techniques. He had worked as a Chemist in a food factory before studying his Master degree. In the rice operational process he has a main responsibility for process equipment design and development (i.e. a silo feed) and process optimisation. His responsibility also includes troubleshooting in the manufacturing line which includes coating and drying processes.

2. Coating-Based Production Engineer

He graduated from a university in Production Engineering in 2000 with the second class honour. He has jointed the studied factory in 2002. He has been trained about coating technology abroad. His main responsibility is to control the production of paste coated organic rice, starting from duct collection process until the coating process.

3. Drying-Based Production Engineer

He graduated from a university in Chemical Engineering in 2002 and has jointed the studied factory since then. He has been trained about drying technology. His main responsibility is to control the production of paste coated organic rice, starting from drying process until the packing process.

4. Quality Control Chemist

She received a Bachelor's degree in Chemistry from a university in Thailand in 2004. She has been attended several training programs about drying technology organised by several organisations in Thailand. Her main responsibility is to control the quality of raw materials (organic rice and ingredient to make paste) and also finished products (paste-coated rice).

5. Line Supervisor

He has received a Master Degree in Food Science and has been working with the company for more than 12 years. He has attended several training programs both inside and outside the countries. His main responsibility is to manage the overall production line.

6. Production Foreman

He received the diploma from a Technical School in Instrumental Control in 1995. He has jointed the company more than 7 years. He has responsibility to assist the production engineers and line supervisor and directly control workers in the production line.

7. Mechanical Engineer

He has a Bachelor degree in Mechanical Engineering and has been working with the company for 4 years. He has been trained about machine maintenance and control from suppliers of machines of this factory. His main responsibility is directly involved with maintaining, controlling and solving problems occurring with the machines and equipments used in the production line.

4.1.2 The Process of Conducting FMEA

After the FMEA team is established, the flowchart and description of the rice operational process is given and explained to all members of the team. This ensures that everyone understands the process in the same direction. Next the team starts to collect the data of failures and categorised them appropriately. Problem identification in coating and drying processes is first carried out. Then the failures caused by problems in each process are brainstormed as shown in Appendix II. The information from the team's analysis will be filled in the columns of the FMEA form in Appendix II. The score of severity, occurrence, and detection is rated based on team judgment.

The ranking of each criterion in severity (S), occurrence (O) and detection (D) of process FMEA is presented in Table 4.1-4.3. The score of 1 to 10 which is mostly used in the literature due to its ease of interpretation, accuracy and precision is given for severity, occurrence and detection. All of criteria presented in Table 4.1-4.3 are determined by the FMEA members.

Table 4.1: Severity (S) evaluation criteria

Effect	Criteria	Score
Extremely Serious Effect	Extremely serious effect on product/process performance in terms of quality off-spec. 80-100% of product needs to be scraped or sold as lower grade.	10
Serious Effect	Serious effect on product/process performance in terms of quality off-spec. 60-80% of product needs to be scraped or sold as lower grade.	9
Extreme Effect	Extreme effect on product/process performance in terms of quality off-spec. 40-60% of product needs to be scraped or sold as lower grade.	8
Major Effect	Major effect on product/process performance in terms of quality off-spec. 20-40% of product needs to be scraped or sold as lower grade.	7
Significant Effect	Significant effect on product/process performance in terms of quality off-spec. 0-20% of product needs to be scraped or sold as lower grade.	6
Moderate Effect	Moderate effect on product/process performance in terms of quality adjustment. All products need quality adjustment but don't need to be scraped. After quality adjustment, the products can be sold as normal.	5
Minor Effect	Minor effect on product/process performance in terms of quality adjustment. 50%-100% of product needs quality adjustment. After quality adjustment, the products can be sold as normal.	4
Slightly Effect	Slightly effect on product/process performance in terms of quality adjustment. 20-50% of product needs quality	3

	adjustment. After quality adjustment, the products can be sold as normal.	
Very Slightly Effect	Very slightly effect on product/process performance in terms of quality adjustment. 0-20% of product needs quality adjustment. After quality adjustment, the products can be sold as normal.	2
No Effect	No effect on product/process performance	1

Table 4.2: Detection (D) evaluation criteria

Effect	Criteria	Score
Almost Impossible	No known controls available to detect the failure	10
Remote	Remote likelihood current work instruction and controls will detect the failure	9
Very Slight	The current work instruction and control are not applicable to detect the failure	8
Slight	The current work instruction and control are applicable but not effective to detect the failure. (Slight likelihood current controls will detect the failure)	7
Low	The current work instruction and control are applicable and effectiveness, but lack of training to user. (Low likelihood current controls will detect the failure)	6
Medium	The current work instruction and control are applicable and effectiveness. They are trained to users, but they are not fully clear and understanding. (Medium likelihood current controls will detect the failure)	5
Moderately High	The current work instruction and control are applicable and effectiveness. They are trained to users, but they might not follow instruction strictly. (Moderately high likelihood current controls will detect the failure)	4
High	The current work instruction and control are applicable and effectiveness. They are trained to users, but they perform with low skill. (Good likelihood current controls will detect the failure)	3

Very High	The current work instruction and control are applicable and effectiveness. They are generated in form of controlled document and are trained to users. The users understand and perform as the instruction with high skill. (Very high likelihood current controls will detect the failure)	2
Almost Certain	The current work instruction and control are applicable and effectiveness. They are generated in form of controlled document and are trained to users. The users understand and perform as the instruction strictly. (Current controls almost always detect the failure. Reliable detection controls are known and used in similar processes)	1

Table 4.3: Occurrence (O) evaluation criteria

Effect	Criteria	Score
Almost Certain	Failure almost certain. It is inevitable. History of failures exists from previous or similar design	10
Very High	Very high number of failure likely (80-90%)	9
High	High number of failure likely (70-79%)	8
Moderately High	Frequent number of failure likely (60-69%)	7
Medium	Moderate number of failure likely (50-59%)	6
Low	Occasional number of failure likely (30-49%)	5
Slight	Few failure likely (20-29%)	4
Very Slight	Very few failure likely (10-19%)	3
Remote	Rare number of failure likely (1-9%)	2
Almost Never	Failure unlikely. History shows no failure	1

After the criteria of the severity, occurrence and detection is set up by the FMEA team, the team quantify each failure modes happening in the rice operational process. The priority of the failure is determined by the Risk Priority Number (RPN) which is the outcome of the severity (S), occurrence (O) and detection (D) as shown below:

$$RPN = S * O * D$$

The RPN value is used for ranking all failure modes happening in the rice operational process. According to the definition of RPN and the minimum and maximum scores of the severity, occurrence and detection, the RPN value will range between 1 and 1000. The result of quantification of severity, occurrence, detection, and RPN of all failure modes in coating and drying processes are summarised in Appendix II.

The FMEA team has agreed to pursue failures or problems based on 90 percent confidence. It means that 90 percent of all failure must be addressed for a very critical process. Since the highest score of RPN is 1000 (10 * 10 * 10 from severity, occurrence, and detection). Ninety percent of 1000 is 900. After subtracting 1000 with 900, the RPN score of 100 is finally obtained. Therefore the failures or problems that have RPN score of 100 or higher will be examined in this research.

In some cases when the RPN scores is lower than 100 but if the severity score is high (such as RPN = S*O*D = 9*2*3), such failures need to be taken for consideration (Devadasan et al., 2003). However in this research, the researcher has focused on the RPN higher or equal to 100. Although severity score is high but if the RPN score is lower than 100, such failure will not be taken into consideration in this research. This is because in this research, high severity score does not endanger operators or affect the consumers. High severity score in this research means that there is a lot of broken rice. This broken rice is still good rice that can be eaten but just does not pass the specification required by customers. Therefore failures that have high severity score does not seriously affect any life of operators or customers, unlike in the research of Devadasan et al. (2003), and these failures will not taken be considered.

To deal with the failures having RPN scores of 100 or higher, the failure with the highest score of RPN will be addressed first. In the case of failures with have equal scores of RPN, the first address is the failure that has high severity score, followed by detection score and occurrence score respectively. It is noted that severity is given more importance because it directly affects failures. Compared with occurrence, detection is more important because detection is involved with customers who are important for all business while the occurrence relates to the frequencies of the failure (Stamatis, 1995).

4.1.3 Quantification of Severity, Occurrence and Detection

The FMEA team has ranked the score of severity, occurrence and detection of coating and drying processes in the studied factory based on Table 4.1-4.3. There are many failure modes occurring in coating and drying processes, however, only two of them will be explain in details as examples and shown how to rank the score of severity, occurrence and detection.

4.1.3.1 Coating Process

In the coating process of rice with several kinds of pastes, there are several potential failure modes as shown in Appendix II. One of the main critical failure modes which has the highest RPN score is contaminates in rice such as fine sands, stones, or metal. This will have a direct impact on the instruments inside the coating drum, in the worst case, the contaminates can stuck in the machine and cause it shutting down. It also impact on the amount of broken rice and process time since the coating drum has to be shut down for removal of stuck contaminates. However this failure mode does not cause any danger to operators or machines or process. According to the criteria of severity given in Table 4.1, therefore, the severity score of 8 is assigned. In terms of detection, the present control is to use visual observation. Although this process control is applicable but not effective to detect all the failure. Therefore the detection score of 7 is given according to Table 4.2. In terms of occurrence, it was found from previous experience that this failure mode happens quite often, approximately about half of the total operation. Therefore the occurrence score of 6 is given. Multiplying the severity score with detection score and occurrence score, the RPN score of 336 is obtained (8 * 7 * 6).

Another example which has the second highest score of RPN is the deviation of viscosity of pastes used for coating batch by batch. The impact of this is the quality of coated rice cannot meet the requirement such as percent of coating is lower than expected due to insufficient amount of coating. In the worse case, all products after coating need to be coated again. Therefore the severity score of 5 is given according to criteria in Table 4.1. In terms of detection, there is no control of the paste viscosity in the work instruction but based on operators' experiences. Paste viscosity is measured regularly. The control based on personal experience is not totally effective. Paste viscosity sometimes is too high or too low causing the coating process difficult. According to criteria in Table 4.2, therefore the detection score of 7 is given. In terms of occurrence, it was found from previous experience that this failure mode happens often, approximately about 70% of the total operation since there are many changes in types of paste according to fluctuation of the customers' requirements. Therefore the occurrence score of 8 is given. Multiplying the severity score with detection score and occurrence score, the RPN score of 280 is obtained (5 * 7 * 8).

The criteria for giving S, O, D scores to other failures is the same as above and reported in Appendix II.

4.1.3.2 Drying Process

In the drying process of coated rice, there are several potential failure modes as shown in Appendix II. One of the main critical failure modes is the long drying time due to ventilation system in the drying rooms is not good. The impact of this is that the products are too dry, some are broken. The energy is also higher than required which affect the energy cost of the process. In this case, some of the too dried products cannot be sold, some need to be re-mixed with the paste. According to criteria in Table 4.1, the severity score of 4 is given. In terms of detection, the detection score of 8 is given since there is no inspection and control over the ventilation system at present. In terms of occurrence, this failure mode happens very often, approximately more than 70%. Therefore the occurrence score of 8 is given. Multiplying the severity score with detection score and occurrence score, the RPN score of 256 is obtained (4 * 8 * 8).

Another example which has the second highest score of RPN is poor distribution of coated rice on belt due to improper design of hopper. This decreases the drying efficiency and make some products are off-spec in terms of higher humidity than required after drying process. In the worse case, when hopper does not work, more than half of the products need to be dried again. This in turn will affect the drying time, energy cost, and also amount of broken rice. According to criteria given in Table 4.1, the severity score of 4 is given. In terms of detection, the detection score of 6 is given since the current work instruction and control are applicable and effectiveness, but sometimes operators do not follow the instruction or neglect the importance of this phenomenon. In terms of occurrence, this failure mode happens very often, approximately more than 70%. Therefore the occurrence score of 8 is given. Multiplying the severity score with detection score and occurrence score, the RPN score of 192 is obtained (4 * 6 * 8).

The criteria for giving S, O, D scores to other failures is the same as above and reported in Appendix II.

4.1.4 Results of Conducting The Process FMEA

The results of conducting the FMEA are shown in Appendix II. The outcome of identification and quantification of severity, occurrence, detection and RPN of each failure mode happened in the coating and drying processes are recorded in the FMEA from as shown in Appendix II. As mentioned before, the critical failure modes that have RPN scores higher than 100 (90% confidence) have to be addressed to take the action. All of the critical failure modes are presented in Table 4.4 and Figure 4.1.

Table 4.4: Summary of the process FMEA having RPN scores equal to 100 or higher (from Appendix II)

Item	Potential failure mode	Potential cause(s) of failure	RPN
1	Inconsistent quality of rice (e.g. moisture)	Different sources of rice, poor transportation	240
2	Contaminates in rice	Poor inspection procedure	336
3	Viscosity of paste varies batch by batch	Poor control procedure for paste preparation	280
4	Uncontrolled moisture in the air	Too much raining can affect moisture in air	160
5	Inaccurate temperature during coating	Poor maintenance, temperature indicator false	100
6	Solidification of paste	Poor temperature control, heat loss during transporting	196
7	Contaminates in coated rice	Cleanliness of valves, pipes and equipments	147
8	Wrong weighing of raw materials	Operators do not understand scaling procedure	105
9	Uncleanness of paste mixing tank	Cleaning procedure is not suitable	140
10	Uncleanness of paste mixing tank	Brush for cleaning is not suitable	210
11	Uncleanness of coating brush	Cleaning procedure is not suitable	175
12	Inhomogeneous paste in mixing tank	Level of impeller does not match with level of paste	100
13	Inhomogeneous paste in mixing tank	Stirring time is not suitable	100
14	Inhomogeneous paste in mixing tank	Stirring speed does not suitable with paste volume	100

15	Inhomogeneous paste in mixing tank	Operators don't follow formulation	120
16	Improper brush speed	Deviation of paste types	210
17	Improper brush speed	Operators don't follow instruction strictly	175
18	Improper conveyor speed	Deviation of paste types	245
19	Improper conveyor speed	Operators don't follow instruction strictly	175
20	Non-suitable temperature in drying rooms	Low efficiency of blowers	140
21	Non-suitable temperature in drying rooms	Heat loss of hot air during transportation	175
22	Non-suitable temperature in drying rooms	Different coated rice feeding	175
23	Non-suitable temperature in drying rooms	Operators don't follow instruction strictly	125
24	Poor distribution of coated rice on belt	Improper design of proper	192
25	Long drying time	Ventilation system in drying rooms is not good	256
26	Deposits on drying belt	Cleanness of drying belt	160

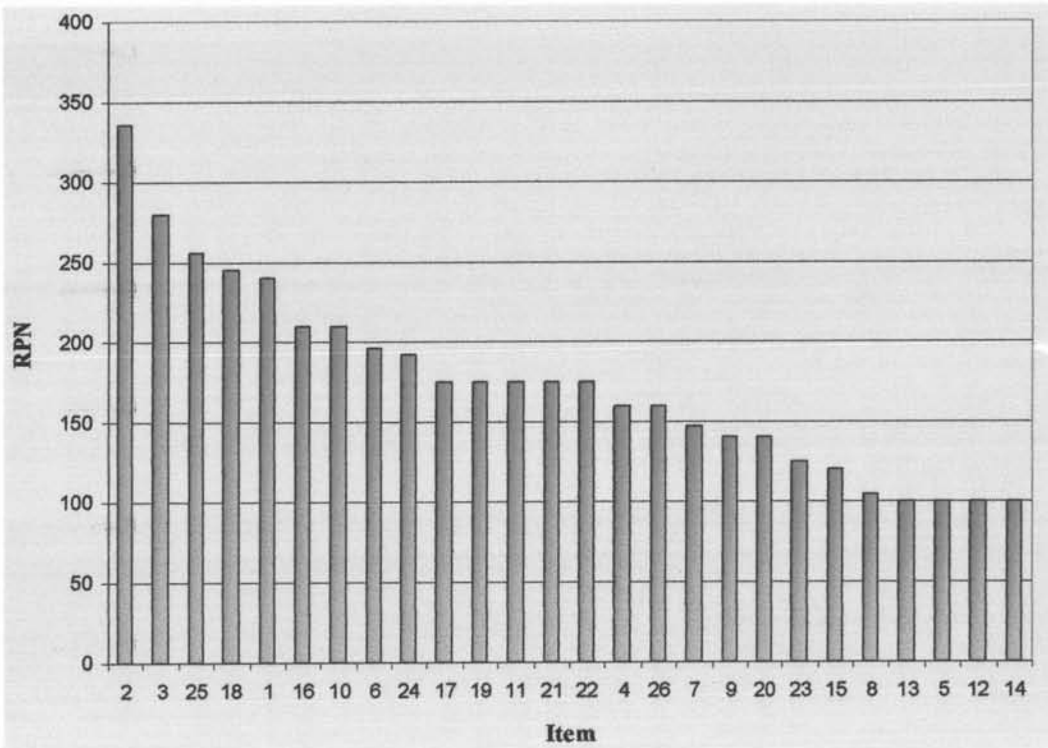

Figure 4.1: Ranking of the process FMEA having RPN scores equal to 100 or higher

As can be seen from Figure 4.1, there are 26 high-risk areas that must be addressed (these areas have RPN scores higher or equal to 100). The highest risks have RPN scores of 336 which is contaminates in rice fed to coating process (item 2). Therefore actions have to be taken toward this risk first because it directly impact to both amount of broken rice and process time. Table 4.5 represents the potential failure modes that have RPN scores higher than 100, ranked in descending order.

Process FMEA (Failure Mode and Effect Analysis)

Process name:
Product name:
Team:

Documented by:
Responsible person:

FMEA Date (Org.):
FMEA Date (Rev.):
Page: 1 of 5

Process Function & Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential Cause(s)/ Mechanism(s) of Failure	O	Current Process Controls	D	RPN	Recommended Actions(s)	Resonsibility & Target Completion Date	Expected			
											S	O	D	RPN
Coating	Contaminates in rice	Machine damage	8	Poor inspection procedure	6	Manual inspection	7	336	Set up work instruction	QC (11/6/07)				
Coating	Viscosity of paste varies batch by batch	Deviation of coating quality	5	Poor control procedure for paste preparation	8	Loose control	7	280	Set up work instruction	QC (11/6/07)				
Drying	Long drying time	Products are too dry and more energy consumed	4	Ventilation system in drying rooms is not good	8	No inspection and control	8	256	Check flow rate, set PM for ventilation	Maintenance (22/6/07)				
Coating	Improper conveyor speed	Off-spec products/ products need quality adjustment	7	Deviation of paste type	7	Indicate in work instruction	5	245	Updating work instruction	Process Eng. (5/6/07)				
Coating	Inconsistent quality of rice (i.e.moisture)	Deviation of coating quality	5	Different sources, Poor transportation	6	No inspection and control	8	240	Set up work instruction for quality control	QC (6/6/07)				
Coating	Improper brush speed	Off-spec products/ products need quality adjustment	7	Deviation of paste type	6	Indicate in work instruction	5	210	Updating work instruction	Process Eng. (5/6/07)				

Process FMEA (Failure Mode and Effect Analysis)

Process name: | Documented by: | FMEA Date (Org.):
Product name: | Responsible person: | FMEA Date (Rev.):
Team: | | Page: 2 of 5

Process Function & Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential Cause(s)/ Mechanism(s) of Failure	O	Current Process Controls	D	RPN	Recommended Actions(s)	Resonsibility & Target Completion Date	Expected			
											S	O	D	RPN
Coating	Uncleanness of paste mixing tank	Deviation of coating quality	5	Brush for cleaning is not suitable	6	Visual Inspection	7	210	Modify equipment to match with cleaning	Process Eng. (5/6/07)				
Coating	Solidification of paste	Paste plug in tubes coating process shut down	7	Poor temp control, heat loss during transporting	4	Control only paste mixing tank	7	196	Build insulation around paste line, set up work instruction	Production Eng. (19/6/07)				
Drying	Poor distribution of coated rice on belt	Products have high humidity (off-spec)	4	Improper design of hopper	8	No control	6	192	Set up PM for hopper & screw conveyor	Maintenance (22/6/07)				
Coating	Improper brush speed	Off-spec products/ products need quality adjustment	7	Operators don't follow instruction strictly	5	Indicate in work instruction	5	175	Training operators to make them realise the consequence	Production Eng. (8/6/07)				
Coating	Improper conveyor speed	Off-spec products/ products need quality adjustment	7	Operators don't follow instruction strictly	5	Indicate in work instruction	5	175	Training operators to make them realise the consequence	Production Eng. (8/6/07)				

Process FMEA (Failure Mode and Effect Analysis)

Process name:
Product name:
Team:

Documented by:
Responsible person:

FMEA Date (Org.):
FMEA Date (Rev.):
Page: 3 of 5

Process Function & Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential Cause(s)/ Mechanism(s) of Failure	O	Current Process Controls	D	RPN	Recommended Actions(s)	Resonsibility & Target Completion Date	Expected			
											S	O	D	RPN
Coating	Uncleanness of coating brush	Next coating is impossible	5	Cleaning procedure is not suitable	5	Visual Inspection	7	175	Modify coating brush system	Process Eng. (12/6/07)				
Drying	Non-suitable temp. in drying rooms	Products have high humidity (off-spec)	5	Heat loss of hot air during transportation	7	Insulation around hot air tube	5	175	Design insulation	Process Eng. (13/6/07)				
Drying	Non-suitable temp. in drying rooms	Products have high humidity (off-spec)	5	Different coated rice feeding	7	Indicate in work instruction	5	175	Updating work instruction for varying drying temp./time according to inlet humidity	Process Eng. (13/6/07)				
Coating	Uncontrolled moisture in the air	Deviation of coating quality	5	Too much raining can affect moisture in air	4	No control	8	160	Develop system that can control air moisture	Process Engineer (5/6/07)				
Drying	Deposits on drying belt	Energy loss	4	Cleanness of drying belt	8	Stop drying belt for cleaning sometimes	5	160	Set up schedule for cleaning	Production (21/6/07)				
Coating	Contaminates of coated rice	Off-spec products	7	Cleanliness of valves, pipes, equipments	3	Visual inspection	7	147	No action	-				

Process FMEA (Failure Mode and Effect Analysis)

Process name: Documented by: FMEA Date (Org.):
Product name: Responsible person: FMEA Date (Rev.):
Team: Page: 4 of 5

Process Function & Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential Cause(s)/ Mechanism(s) of Failure	O	Current Process Controls	D	RPN	Recommended Actions(s)	Resonsibility & Target Completion Date	Expected			
											S	O	D	RPN
Coating	Uncleanness of paste mixing tank	Deviation of coating quality	5	Cleaning procedure is not suitable	4	Visual inspection	7	140	Set up schedule and procedure for cleaning	Process Eng. (12/6/07)				
Drying	Non-suitable temp. in drying rooms	Products have high humidity (off-spec)	5	Low efficiency of blowers	4	No control	7	140	Set up PM	Maintenance (15/6/07)				
Drying	Non-suitable temp. in drying rooms	Products have high humidity (off-spec)	5	Operators don't follow instruction strictly	5	Indicate in work instruction	5	125	Training operators to make them realise the consequence	Production Eng. (8/6/07)				
Coating	Inhomogeneous paste in mixing tank	Deviation of coating quality	5	Operators don't follow formulation	6	Instruction in formulation sheet	4	120	Training operators to make them realise the consequence	Production Eng. (8/6/07)				
Coating	Wrong weighting of raw materials	Off-spec products/ products need quality adjustment	7	Operators do not understand scaling procedure	5	No control	3	105	Set up training for operators	Production Eng. (7/6/07)				
Coating	Inhomogeneous paste in mixing tank	Deviation of coating quality	5	Stirring time is not suitable	4	Specify into the formulation	5	100	Revise work instruction	Production Eng. (8/6/07)				

Process FMEA (Failure Mode and Effect Analysis)

Process name:
Product name:
Team:

Documented by:
Responsible person:

FMEA Date (Org.):
FMEA Date (Rev.):
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Process Function & Requirement	Potential Failure Mode	Potential Effect(s) of Failure	S	Potential Cause(s)/ Mechanism(s) of Failure	O	Current Process Controls	D	RPN	Recommended Actions(s)	Resonsibility & Target Completion Date	Expected			
											S	O	D	RPN
Coating	Inaccurate temp. during coating	Deviation of coating quality	5	Poor maintenance, temp. indicator false	5	Periodical check of temp. indicator	4	100	Set up work instruction for calibration	Maintenance (15/6/07)				
Coating	Inhomogeneous paste in mixing tank	Deviation of coating quality	5	Level of impeller does not match with level of paste	5	Control by setting the level of paste in mixing tank	4	100	No action	-				
Coating	Inhomogeneous paste in mixing tank	Deviation of coating quality	5	Stirring speed does not suit with paste volume	5	Indicate in work instruction	4	100	No action	-				

The FMEA team has meetings in order to generate recommended actions to reduce each failure mode in rice coating and drying processes of the studied factory as can be seen in Table 4.5. In addition persons who have responsibility for each action plan is included. Table 4.6 summarises actions for the FMEA project according to departments.

Table 4.6: The summarised actions for FMEA project of coating and drying processes

Process Engineers:

Topic	Due Date	Remark
1. Set up and update work instruction		
- Update work instruction for varying conveyor speed according to deviation of paste type at coating process	5/6/07	To reduce amount of off-spec products and quality adjustment cycle
- Update work instruction for varying brush speed according to deviation of paste type at coating process	5/6/07	To reduce amount of off-spec products and quality adjustment cycle
- Update work instruction for varying drying time according to humidity of feeds	13/6/07	To reduce drying time
2. Design and development		
- Modify suitable equipment for cleaning at paste mixing tank	5/6/07	To improve paste coating quality
- Modify coating brush system	12/6/07	To improve cleaning system at coating brush
- Design insulation at hot air pipes	13/6/07	To reduce heat loss and improve efficiency of drying system
- Develop system that can control air moisture	5/6/07	To improve paste coating quality and reduce coating time

Production:

Topic	**Due Date**	**Remark**
1. Set up and update work instruction		
- Work instruction for temperature control in paste lines	19/6/07	To prevent solidification of paste which make coating process is more difficult
- Revise work instruction for suitable stirring time at paste mixing tank according to varied ingredients	8/6/07	To improve paste coating quality
2. Design and development		
- Build insulation around paste line	19/6/07	To prevent solidification of paste which make coating process is more difficult
3. Training		
- Adjustment of brush speed in coating process	8/6/07	To reduce consequence of using wrong brush speeds by operators
- Adjustment of conveyor speed in coating process	8/6/07	To reduce consequence of using wrong conveyor speeds by operators
- Important of drying room temperature	8/6/07	To make operators realise the consequence of unsuitable drying temperature
- Paste formulation in mixing tank	8/6/07	To reduce error from wrong mixing formula
- Scaling procedure	7/6/07	To reduce error from wrong scaling
4. Miscellaneous		
- Set up schedule for cleaning drying belt	21/6/07	To reduce energy cost

QC:

Topic	Due Date	Remark
1. Set up work instruction		
- Procedure for removal of contaminates in rice	11/6/07	To reduce amount of off-spec products and quality adjustment cycle
- Procedure for control paste preparation more precisely	11/6/07	To improve paste coating quality
- Procedure for quality control of rice	6/6/07	To improve paste coating quality

Maintenance:

Topic	Due Date	Remark
1. Create preventive maintenance plan (PM plan)		
- Set up PM for ventilation in drying rooms	22/6/07	To reduce amount of off-spec products and quality adjustment cycle
- Set up PM for hopper in drying process	22/6/07	To reduce amount of off-spec products and quality adjustment cycle
2. Set up work instruction		
- Maintenance of blowers for drying process	15/6/07	To reduce amount of off-spec products and quality adjustment cycle
- Calibration and maintenance of temperature indicators in coating process	15/6/07	To improve paste coating quality
3. Miscellaneous		
- Measurement and calibration of ventilation flow rate in drying rooms	22/6/07	To reduce amount of off-spec products and quality adjustment cycle

After the action plan is carried out, the FMEA team implements the FMEA in coating and drying processes in July 2007. Data of average process time and amount of broken rice after implementation is collected and compared with that before implementation.