

Chapter 7

Result of implemented preventive maintenance planning

Refer to the hypothesis at the beginning of this thesis saying that this study will concentrate in the reduction of the time loss in the machine breakdown in order to increase the opportunity in production line. As you can see in table 1.1 the major loss of time can be separated into two points. There are “repairing time” and “waiting time” in maintenance and the details of both times loss are 108 hours 40 minutes in repairing time and 334 hours in waiting time. It means that the most of time loss in maintenance is waiting time. So the improvement is pointing to reduce the waiting time. The working hours for six months are about 4320 hours and the time loss in maintenance is about 443 hours. It’s mean that the time loss is about 10.25%. In this 10.25% is compound with the loss of waiting time about 75 %and the two losses of repairing time about 25%.

After the implementation the preventive maintenance planning the result can be separated in to three parts as follow.

7.1 Maintenance document system

As showing in chapter 3 that the maintenance section is very poor in document system the section has nothing except technician daily report. So in chapter 6 is showing some important documents that maintenance section should have as a beginning stage. There are the data of job request, work order, inspection card and etc. and in chapter 6 is showing the way of document flow and how to keep. After implement the system, it has much good feedback as follow:

1. Staff know exactly what and when machine he has to fix
2. Staff not forget to fix
3. Staff know detail of breakdown before fix
4. The data of changing part is keeping in file
5. Easy to find the history of the machine
6. Easy to monitor staff

7.2 Management system

From chapter 3 shows that the management system of this section is not proper. And in chapter 6 is suggesting changes in many things such as insert the chief of section, change step of request and working and separate the skill of technician.

At first the maintenance section need to have the chief of section because the head of engineering department has overload of job to do. It causes of lack in control, training, monitor and etc. After showing the data of the waste of time for maintenance during six months and discussion with the head of department, he agrees to admit the chief of section in order to help him for the control and monitor the maintenance staffs. But the chief of section is quite importance position the new man has to train and study the envelopment and job in the plant. It takes time at least six months in this step. It is quite fortunate, that the company can get the particular person at the beginning of the year of 2002. After the chief of maintenance section is trained and what he has been studying for six months. He can understand the system of the machines. He can fix the three major systems there are hydraulic system, electric system, and pneumatic system. When he can fix the three major systems, it means that he can train and monitor the technicians. So the head of department has more time to control the section and he will have time to improve the section in the future.

Second is the skill of technicians. At first the technician has to fix every system such as electric system, hydraulic system, and pneumatic system. It is very hard for him to know every thing very well and it takes time to study. After we let the technicians concentrate in only on one system. The technicians can improve their skill very well and it is more easily to train them. It means that one technician has high skill only one system and he still has skill in other system but not much. So they know exactly what job they could do.

7.3 Technician

The quality of the staff is one of the major problems that bring the section in to such failure. In chapter 3 show that the problems of low quality staffs are as follow: long working time, low salary, conflict in the section, low education, unclear in responsibility, lack of training, and no maintenance room.

Salary is one of the major points of staff low quality. From the report of personal section show that the turnover rate of maintenance section is about 30%, it is a very high number and it is a sign of danger in the section. After showing the rate turn over of maintenance section to the head of department, he understands and is aware in this situation so he will compare the rate of salary to other plant every six months. After the head of department has individual discussion with every technician. The result is, some of them get an increase in salary but some remain constant but everybody understands why he gets more and why he doesn't get anything. So everybody feel better. And they are waiting for new review in the next year.

Another major cause of staff low quality is the education level of the staff. In the past the education of the staffs are only high school. It has problem in the limitation of study, after stepping up to admit at least diploma, the new staff is better in study and he can improve his skill very well.

When the maintenance room is finished all technicians are very excited and very happy. They can do the job in their own place, when they have free time they will stay at the room. It is very easy to call them. During the break time after lunch they has a place to relax and make a discussion to each other. It can reduce the conflict between each staff and it takes a better sign in the working atmosphere.

The working time in each day is quite high about eleven hours per day, every day. When a number of the staffs are increased the working time can be reduced by they do not to take over time every day. It makes them feel better.

The job description is one of the tools to make the clear cut in each responsibility. After every body had read their job description they know what they can do.

After the chief and the head of department has unofficial meeting with the staffs every month. The staffs look happy they are not afraid to ask for advice.

7.4 Results of implemented preventive maintenance

After implementation of the preventive maintenance at January in 2002, it takes about six months in prepare, train, and test the system. During that time it has many problem such as the technician misunderstands in accordance with the detail in maintenance data form. The requesters forget to withdraw the form. The room for maintenance staff has to build so it takes a few months. The new chief of section has to be train for four months. From the beginning the data are pick up to compare only last six months because the first six months are in implementation stage and many processes can not be done in a short term

The results will show all details of machine breakdown during the beginning of July 2002 until the end of December 2002. The data will arrange the date of machine breakdown and show number of machine, cause of breakdown, repairing time, and waiting time of each machine.

The summary of repairing time and waiting time in each group of the machine during July 2002 to December 2002 is showing in table 7.5.

The detail of machines repair and maintenance in milk container, 200 c.c., during July 2002 to December 2002 is showing in table 7.1-7.4:

Table 7.1: The detail of maintenance in blow molding machines.

Date 2002	Machine No.	Cause	Repairing time	waiting time
July 1	B16	Blow pin Hydraulic cylinder mold 2 oil leak	1hr 45 min.	4 hours
2	B25	Pressure reduce valve stuck at night	50 min.	
	B16	Change knife	20 min	
3	B26	Flow control valve stuck	50 min.	
5	B25	Clamp Hydraulic cylinder mold 2 oil leak	1 hour	
6	B26	Mold heat clean cooling system	2 hr 50 min.	
7	B16	Carriage Hydraulic cylinder mold 1oil leak	1 hours	
9	B25	Heater zone 1 not hot at night	45 min	
11	B16	Clamp mold 2 not work	1 hr 30 min.	
13	B26	Clamp Hydraulic tube mold 1 oil leak	35 min.	
15	B25	Carriage Hydraulic cylinder mold 2oil leak	1 hour	
18	B26	Clamp Hydraulic cylinder mold 2 oil leak	1 hour 30 min	
21	B16	Carriage cylinder mold 1 not move	45 min.	
22	B26	Clamp mold 1 not work at night	1 hour	
24	B16	Cutter air cylinder leak	55 min	
25	B26	Blow pin Hydraulic cylinder mold 2oil leak	1 hr 30 min.	
28	B16	Mold heat clean cooling system	2 hours	
31	B25	Carriage Hydraulic tube mold 1oil leak	40 min.	
August 1	B25	Blow pin mold 1 not move at night	1 hr 30 min.	6 hours
3	B16	Pressure reduce valve stuck	50 min	
6	B16	Relief valve not work	2 hours	
7	B26	Carriage cylinder mold 1 not move	1 hour 20 min	
10	B25	Carriage Hydraulic tube mold 2 oil leak	45 min	
11	B26	Clamp mold 2 not work	1 hr 35 min.	
14	B25	Clamp mold 1 not work at night	1 hr 30 min.	
19	B26	Carriage Hydraulic cylinder mold 2oil leak	1 hour	
23	B16	Heater zone 5 not hot at night	1 hour	
24	B25	Blow pin Hydraulic cylinder mold 1oil leak	1 hr 30 min.	
27	B16	Clamp solenoid mold 2 burn	35 min.	
28	B25	Mold heat clean cooling system	2 hr 30 min.	
30	B26	Heater zone 2 not hot	45 min	
September 2	B25	Cutter air cylinder leak	45 min.	7 hours
3	B16	Carriage solenoid mold 1 burn at night	35 min.	
5	B26	Clamp mold 1 not work	45 min.	
8	B26	Pressure reduce valve stuck	55 min.	
13	B25	Clamp relay mold 2 not work	35 min.	
14	B16	Carriage Hydraulic tube mold 1oil leak	45 min.	
17	B16	Clamp relay mold 1 not work	1 hour	
20	B26	Clamp Hydraulic cylinder mold 2 oil leak	1 hr 30 min.	
21	B25	Clamp Hydraulic tube mold 1 oil leak	50 min.	
23	B26	Blow pin relay mold 1 not work at night	35 min.	
26	B25	Carriage slider ring mold 1 lose	1 hr 35 min	
29	B16	Clamp Hydraulic cylinder mold 2 oil leak	55 min.	
				4 hours

October 3	B25	Pressure reduce valve stuck	2 hours	
6	B16	Carriage Hydraulic cylinder mold 2oil leak	1hr 15 min.	
7	B26	Blow pin Hydraulic cylinder mold 1oil leak	1hr 30 min.	
10	B26	Change knife	20 min.	
	B25	Clamp Hydraulic cylinder mold 1 oil leak	1hr 20 min.	
11	B16	Blow pin Hydraulic cylinder mold 1oil leak	1hr 25 min.	
15	B16	Heater zone 3 not hot at night	1 hour	6 hours
19	B25	Blow pin mold 1 not move	45 min.	
21	B26	Blow pin Hydraulic tube mold 1oil leak	30 min.	
25	B25	Carriage mold 2 not move	55 min.	
28	B16	Drive coupling lose	2 hr 30min	24 hours
31	B26	Carriage Hydraulic cylinder mold 1oil leak	1hr 20min.	
November 1	B16	Blow pin mold 2 not move	55 min.	
2	B25	Clamp Hydraulic cylinder mold 1 not move	1 hour	
4	B25	Chang knife	20 min.	
6	B26	Clamp DAS mold 2 lose at night	1hr 25 min.	9 hours
10	B26	Clamp Hydraulic tube mold 2 oil leak	45min.	
13	B25	Carriage Hydraulic cylinder mold 1oil leak	1hr 15 min.	
14	B16	Blow pin Hydraulic cylinder mold 1oil leak	1hr 35min	
16	B16	Pressure reduce valve pin stuck	1hour	
19	B26	Carriage mold 2 not move	45min	
23	B25	Heater zone 5 not hot	1hr 35min	
26	B26	Blow pin mold 2 not move	50 min	
27	B16	Clean cooling	2 hours	
29	B26	Clean cooling	2 hours	
December 5	B25	Clamp Hydraulic tube mold 2 oil leak	35 min.	
11	B16	Flow control valve stuck	1hour	
18	B25	Screw gear box oil leak	4 hours	
19	B26	Cutter air cylinder leak	50 min.	
	B16	Carriage Hydraulic cylinder mold 1oil leak	55 min.	
23	B26	Pressure reduce valve stuck	50 min.	
25	B16	Clamp Hydraulic cylinder mold 1oil leak	1hr 20 min.	
	B25	Blow pin Hydraulic cylinder mold 2oil leak	1hr 10 min.	
	B26	Temp control zone 4 lose at night	15 min	10 hours
	B25	Clean cooling	4 hours	
	B26	Heater zone 1 not hot	1hr 30min	
	B16	Heater zone 6 not hot	1hour	

Table 7.2: The detail of maintenance in Cutting machines

Date 2001	Machine No.	Cause	Repairing time	Waiting time
July 1	C16	Change Belt	40 min.	
2	C16	Change knife	60 min.	
	C25	Change Belt	40 min.	
3	C25	Change knife	60 min.	
	C26	Change Belt	40 min.	
21	C26	Change knife	60 min.	
	C16	Fix control bar	30 min.	
August 1	C16	Change Belt	40 min.	
2	C16	Change knife	60 min.	
	C25	Change Belt	40 min.	
3	C25	Change knife	60 min.	
	C26	Change Belt	40 min.	
	C26	Change knife	60 min.	
September 1	C16	Change Belt	35 min.	
2	C16	Change knife	50 min.	
	C25	Change Belt	35 min.	
3	C25	Change knife	50 min.	
	C26	Change Belt	35 min.	
17	C26	Change knife	50 min.	
	C25	Fix control bar	30 min.	
October 1	C16	Change Belt	35 min.	
2	C16	Change knife	50 min.	
	C25	Change Belt	35 min.	
3	C25	Change knife	50 min.	
	C26	Change Belt	35 min.	
	C26	Change knife	50 min.	
November 1	C16	Change Belt	35 min.	
2	C16	Change knife	50 min.	
	C25	Change Belt	35 min.	
3	C25	Change knife	50 min.	
	C26	Change Belt	35 min.	
	C26	Change knife	50 min.	
December 1	C16	Change Belt	35 min.	
2	C16	Change knife	50 min.	
	C25	Change Belt	35 min.	
3	C25	Change knife	50 min.	
	C26	Change Belt	35 min.	
	C26	Change knife	50 min.	
29	C26	Fix control bar	30 min.	

Table 7.3: The detail of maintenance in Silk screen printing machines

Date 2001	Machine No.	Cause	Repairing time	Waiting time
July 1 12 27 30	A 2 A 6 A 2 A 5 A 3	Change conveyor spring Squeegee air seal leak Clean Air filter Printing limit switch lose at night Printing limit switch lose	30 min 50 min. 25 min. 35 min 35 min.	5 hours
August 4 13 19	A 2 A 5 A 2	Clean Air valve Change conveyor spring Change bearing conveyor system	1 hour 30 min. 2 hours	
September 7 20 25	A 3 A 2 A 6	Change bearing conveyor system Printing limit switch lose Change conveyor spring	2 hours 35 min. 35 min.	
October 6 21	A 3 A 3	Clean Air filter Change conveyor spring	25 min. 30 min.	
November 2 23	A 5 A 6	Squeegee air seal leak Printing limit switch lose	30 min. 35 min.	
December 1 14 23	A 5 A 2 A 5	Change conveyor baring Change conveyor belt Clean Air filter	2 hour 50 min. 25 min.	4 hours

Table 7.4: The detail of maintenance in Ovens

Date 2001	Machine No.	Cause	Repairing time	Waiting time
July 3 8 20	O 2 O 3 O 2	Change heater insulator Chain slip out of gear change chain pin Temperature control breakdown	30 min. 50 min. 45 min.	
August 4	O 5 O 5	Change heater insulator Change wire	30 min. 45 min.	
September 11 30	O 2 O 6	Heater not hot at night Temperature control breakdown	2 hour 45 min.	8 hours
October 14 29	O 6 O 2	Change heater insulator Change wire	30 min. 45 min.	
November 6 23	O 5 O 2	Temperature control breakdown Chain slip out of gear change chain pin	45 min. 50 min.	
December 2 25 27	O 3 O 6 O 6	Change heater insulator Chain slip out of gear change chain pin Change blower bearing	30 min. 50 min. 1 hour	2 hours

Table 7.5: the sum of time loses in maintenance during July 2001 to December 2001

Machine type	No. of emergency breakdown	Repairing time	Waiting time
Blow molding machine	59	70 hours: 55 min.	187 hours
Cutting machine	13	7 hours: 25 min.	46 hours
Silk screen machine	20	16 hours: 40 min.	41 hours
Oven	13	13 hours: 40 min.	60 hours
<i>Total</i>	<i>105</i>	<i>108 hours: 40 min.</i>	<i>334 hours</i>
		Total	442 hrs: 40 min.

Table 7.6: the sum of time loses in maintenance during July 2002 to December 2002

Machine type	Repairing time of PM	No EB	Repairing time of emergency breakdown	Waiting time
Blow molding machine	65 hours: 15 min.	38	30 hours: 35 min.	95 hours
Cutting machine	28 hours: 30 min.	0	0 hour.	0 hour.
Silk screen machine	10 hours: 40 min.	6	4hours: 10 min.	9 hours
Oven	6 hours: 45 min.	4	4hours: 30 min.	10 hours
<i>Total</i>	<i>111 hours: 10 min</i>	<i>48</i>	<i>39 hours:15 min</i>	<i>114 hours</i>
			Total	264 hrs: 25 min.

As you can see the number of emergency breakdown is decreasing from 105 to 48. It means that the implementation of preventive maintenance can reduce the number of emergency breakdown. The repairing time can be separated in to two types. The first is repairing time for Preventive maintenance and second is repairing time for emergency breakdown. From Table 7.6 show that the repairing time for emergency breakdown is reducing from 108hours and 40 min. to 39 hours and 15 min. It means that Preventive maintenance can reduce the number of emergency breakdown and repairing time of

emergency breakdown. After sum up the two repairing times it show that the total number of repairing time is increasing. It increases from 108 hours 40 min. to 150 hours 25 min. In the opposite way the waiting time is reducing a lot. As you can see the comparison between two tables the waiting time is reduce from 334 hours to 114 hours. It reduces 220 hours and the total loss time in maintenance is reducing from 442 hours to 264 hours. It reduces about fifty percent. It means that the company will have more opportunity in producing milk container. As you can see at the beginning the machine can produce about 1666 pieces per hour. The loss time in maintenance is reduced by about 178 hours so the company can produce more about 296,548 pieces or □ 296,548 in six months.

As you can see, the implementation of preventive maintenance has increase in member of staff from five staffs to six staffs, adjusts the salary, inserts the chief of maintenance section and changes the part before its loss. So the company has to pay more in this improvement. In order to compare to the benefit and loss in term of money. It can separated the cost in to topic as follows:

1. Increases staff one person □ 6,000 per month.
2. Insert chief of maintenance staff □ 9,000 per month.
3. Change the part before it breakdown. In this topic is quite hard to identify because the broken part still has to change. So if the part is changed before it breakdown it is not much difference in working life. And the changing part is not high value such as O-ring, seal, wire, knife, spring, and limit switch. From the detail of maintenance record found that it has 87 changing parts refer to the preventive maintenance plan during six months. And the data from the account & finance section show that the total cost of changing part during six months is □ 25,380.

Table 7.7: The detail of cost in implementation preventive maintenance.

Implementation	□ / 6 months
Increase staff	36,000
Increase salary	12,000
Insert chief of section	56,000
Change the part before breakdown	25,380
Total	129,380

Table 7.8: The Comparison between the cost of the implementation of preventive maintenance and the increment of opportunity in producing the product during July to December 2002.

	□ / 6 months
Cost of Implementation	-129,380
Cost of increment in opportunity	296,548
Advantage	167,168

From Table 7.8, the company can get more opportunity in producing the product □ 167,168 in six months. This number is concentrated in only one production line and insert of chief of section and increase staff are advantage to every line in the company. So the Improvement in maintenance section is giving more advantage than the showing number in Table 7.8 to the company.