

Chapter 5

Implementation of Preventive Maintenance

From theory and data cause of machine breakdown in chapter 4, the preventive maintenance system can be set up. At first the part must be identify the activity of maintain because each part need difference activity. Some parts just clean it proper, some need lubricant due to the schedule and some inspect carefully. Each part has difference working life and period in maintain. So preventive maintenance can be separated in to three major topics:

- 1) Activity, position and period for maintain the part form
- 2) Plan or schedule for maintain the part in long term
- 3) Maintenance instruction

5.1 activity, position and period for maintain the part schedule

The data of machine breakdown is the guide to set up activity and position in order to maintain each part of the machine. In order to indicate the activities of maintain the part the sign of activity should be set up first. So the sign of activity is showing in table 5.1.

Activity	detail	sign
1. Clean	cleaning	C
2. Lubricant	(a) Refill lubricant	L
3. Inspect	(a) Inspect the physical	Ip
	(b) Function test	If
4. Adjust	Tightening or positioning	A
5. Replace (change)	Change the part	Rp
	Repair	Rr

Table 5.1: the size of activity for maintenance

The detail of maintenance activity can be explained as follows:

1. Cleaning, by washing the part with solvent, removing dust by brush or by blowing air.
2. Lubricants, by refilling the particular types of lubricant or inject the grease at the particular point.
3. Inspection, it can separated in to two type:
 - 3.1 Physical Inspect, by looking at the part that it is still clean or stay at the correct position.
 - 3.2 Function Inspect, by turning on and off the function to test the part that still work or not or inspect by the meter.
4. Adjust, by tightening or positioning the part.
5. Replace, there are two type of replace:
 - 5.1 Change the part by put the new one instead of the old one.
 - 5.2 Repair, some time the broken part can be use again by removing some useless part or set it in to the correct position.

In order to ease the specification the period of working life or Mean time between failures (MTBF) in each part of the machines. The sign can be set up as follows:

1. xD = every x day
2. xW = every x week
3. xM = every x month
4. xY = every x year

After the sign for maintenance in particular part is set up. The next table that needs to be set up is position, activity, and period for maintenance. From chapter 4 “Problem and cause of breakdown in each part of each machine” is very useful data to set up the form of position, activity, and period for maintenance. During collecting data some parts are not breakdown so it will have not enough data to calculate the working life of that particular part or Mean time between failures (MTBF). The average of working life in each part is used to set up the maintenance and preventive maintenance plan or schedule. The part that has not enough data it can estimate by the experience of the head of maintenance department, the technicians and data from the machine manual. After the position, activity, and period for maintenance form is set up. It is used to be one of the importance tools to implement prevent maintenance system and set up Plan or schedule for maintain the part in long term. The form of position, activity, and period for maintenance can be separated in to two type the first is period of replace in each part. Second is activity and period of activity in each part.

The data of working life in the parts of blow molding machine are shown in table 5.2

Detail of the part	Case of breakdown	Activity	Period
1. Carriage			
1.1 Hydraulic cylinder			
a) slider ring	wear	Rp	8000 hrs
b) DAS 50.40/1	lose	Rp	8000 hrs
c) O-ring 55mmx3mm	crack or cut	Rp	5000 hrs
d) seal kw 1000	crack or cut	Rp	5000 hrs
e) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	crack or cut	Rp	5000 hrs
f) relay	burn	Rp	1 y
g) solenoid valve	lose	Rp	1 y
2. Clamping			
2.1 Hydraulic cylinder			
a) DAS 40.30/1	lose	Rp	80000 hrs
b) seal kw 1000	crack or cut	Rp	5000 hrs
c) O-ring 38mmx1.78mm	crack or cut	Rp	5000 hrs
d) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	crack or cut	Rp	5000 hrs
e) relay	burn	Rp	1 y
f) solenoid valve	lose	Rp	1 y
3. Blow pin			
3.1 Hydraulic cylinder			
a) seal kw 1000	crack or cut	Rp	4000 hrs
b) o-ring 38mmx1.78mm	crack or cut	Rp	4000 hrs
c) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	crack or cut	Rp	4000 hrs
d) DAS 40.30/1	lose	Rp	15000 hrs
e) relay	crack or cut	Rp	1 y
f) solenoid valve	lose	Rp	1.5 y
4. Hydraulic flow tube system			
4.1 Clamp (Hydraulic tube 3/8")	crack or cut	Rp	5000 hrs
4.2 Carriage (Hydraulic tube 3/8")	crack or cut	Rp	1 y
4.3 Blow pin (Hydraulic tube 3/8")	crack or cut	Rp	2 y
4.4 Pump out (Hydraulic tube 3/8")	crack or cut	Rp	3 y
4.5 Pump in (Hydraulic tube 1/4")	crack or cut	Rp	3 y
4.6 Cooling (Hydraulic tube 1/4")	crack or cut	Rp	5 y

5. Hydraulic pump			
5.1 O-ring 150mmx3mm	crack or cut	Rp	3 y
5.2 seal 30mmx43mm	crack or cut	Rp	3 y
6. Heater & Die head			
6.1 Heater band 380V 5000W	burn and short circuit	Rp	2 y
6.2 Temp control	burn	Rp	3 y
6.3 Relay	broken	Rp	1 y
6.4 die head	dirty	Rp	15 y
7. Flow control valve			
7.1 pin valve (Pin \varnothing 5mmX21.4mm)	bend or punch	Rp	6000 hrs
7.2 solenoid valve (220V)	lose	Rp	20000 hrs
8. Cuter			
8.1 Air cylinder seal	crack or cut	Rp	2 y
8.2 Proximity switch	broken	Rp	5 y
8.3 Stainless knife	crack or sharp less	Rp	200 hrs
8.4 Relay control	crack or cut	Rp	5 y
9. Relief valve			
9.1 coil of solenoid valve 220V0.2w	burn	Rp	1 y
10. Oil cooler system	leak	-	-
11. Pressure reduce valve			
11.1 pin valve(Pin \varnothing 5mmX21.4mm)	bend or punch	Rp	1600 hrs
11.2 solenoid valve (220V)	lose	Rp	50,000 hrs
12. Drive coupling	crack or cut	Rp	5 y
13. Main motor (Bearing)	dead	Rp	5 y
14. screw gear box			
14.1 Bearing 32312	dead	Rp	3 y
14.2 Bearing 6309	dead	Rp	3 y
14.3 Bearing 6310	dead	Rp	3 y
14.4 Bearing 6311	dead	Rp	3 y
14.5 Bearing 6312	dead	Rp	3 y
14.6 Oil seal 55mmX75mmX10mm	crack or cut	Rp	3 y

Table 5.2: Position, activity, and period for maintenance schedule of blow molding machine

The data of working life in the parts of the cutter are shown in Table 5.3

Detail of the part	Case of breakdown	Activity	Period
Cuter			
1. Knife (Stainless still 2"x12")	sharp less	Rp	1 M
2. Belt (2.5x125 La)	slip	Rp	1 M
3. Motor bearing	dead	Rp	3 Y

Table 5.3: Position, activity, and period for maintenance schedule of cutting machine.

The data of working life in the parts of silk screen printing machine are shown in Table 5.4

Detail of the part	Case of breakdown	Activity	Period
1. Air filter	lose	Rp	5 Y
2. Flame treatment system			
2.1 Flame treatment head	lose	Rp	5 Y
2.2 air valve	lose	Rp	3 Y
2.3 Limit switch	lose	Rp	3 Y
3. Motor			
3.1 Bearing	dead	Rp	3 Y
4. Conveyor			
4.1 Moving stainless bar	lack	-	-
4.2 Spring	lose	Rp	6 M
4.3 Bearing	dead	Rp	6 M
4.4 Belt	lose	Rp	1 Y
5. Printing unit			
5.1 Squeegee air cylinder Seal	crack or cut	Rp	8 M
5.2 Limit switch	lose	Rp	6 M

Table 5.4: Position, activity, and period for maintenance schedule of silk screen printing machine

The data of working life in the parts of oven are shown in Table 5.5

Detail of the part	Case of breakdown	Activity	Period
1. Conveyor			
1.1 Chain pin (\varnothing 5mmX55mm)	Bend and wear	Rp	1 Y
2. Heater			
2.1 Heater (380ACV 5000Watt)	burn	Rp	2 Y
2.2 Temp. control element	lose	Rp	1 Y
2.3 Heat resistance insulator	crack or cut	Rp	6 M
3. Blower			
3.1 Bearing	dead	Rp	2 Y
3.2 wire	cut	Rp	1 Y

Table 5.5: Position, activity, and period for maintenance schedule of oven.

The form of position, activity, and period about normal activity of blowing machine is shown in Table 5.6.

Detail of the part	Case of breakdown	Activity	Period
1. Carriage			
1.1 Hydraulic cylinder	oil leak	IP	48 hrs
a) slider ring	crack or cut	-	-
b) DAS 50.40/1	lose	IP	168 hrs
c) O-ring 55mmx3mm	crack or cut	-	-
d) seal kw 1000	crack or cut	-	-
e) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	crack or cut	-	-
f) relay	burn	Ip	720 hrs
g) solenoid valve	lose	Ip	720 hrs
2. Clamping			
2.1 Hydraulic cylinder	oil leak	IP	48 hrs
a) DAS 40.30/1	lose	IP	168 hrs
b) seal kw 1000	crack or cut	-	-
c) O-ring 38mmx1.78mm	crack or cut	-	-
d) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	crack or cut	-	-
e) relay	burn	Ip	720 hrs
f) solenoid valve	lose	Ip	720 hrs
3. Blow pin			
3.1 Hydraulic cylinder	crack or cut	IP	48 hrs
a) seal kw 1000	crack or cut	-	-
b) o-ring 38mmx1.78mm	crack or cut	-	-
c) seal 1"x1 $\frac{3}{8}$ "x $\frac{5}{16}$ "	lose	-	-
d) DAS 40.30/1	burn	Ip	168 hrs
e) relay	lose	Ip	720 hrs
f) solenoid valve		Ip	720 hrs
4. Hydraulic flow tube system			
4.1 Clamp (Hydraulic tube 3/8")	crack or cut	Ip	720 hrs
4.2 Carriage (Hydraulic tube 3/8")	crack or cut	Ip	720 hrs
4.3 Blow pin (Hydraulic tube 3/8")	crack or cut	Ip	2160 hrs
4.4 Pump out (Hydraulic tube 3/8")	crack or cut	Ip	2160 hrs
4.5 Pump in (Hydraulic tube 1/4")	crack or cut	Ip	2160 hrs

4.6 Cooling (Hydraulic tube 1/4")	crack or cut	Ip	2160 hrs
5. Hydraulic pump	noisy	Ip	168 hrs
5.1 O-ring 150mmx3mm	crack or cut	-	-
5.2 seal 30mmx43mm	crack or cut	-	-
6. Heater & Die head	dirty	C	48 hrs
6.1 Heater band 380V 5000W	burn	If	2880 hrs
6.2 Temp control	lose	If	2880 hrs
6.3 Relay	burn	Ip	720 hrs
6.4 die head	dirty	C	168 hrs
7. Flow control valve		Ip	48 hrs
7.1 pin valve (Pin \varnothing 5mmX21.4mm)	bend or punch	If	2880 hrs
7.2 solenoid valve (220V)	burn	Ip	2160 hrs
8. Cuter	out of position	Ip	48 hrs
8.1 Air cylinder seal	crack or cut	-	-
8.2 Proximity switch	crack or cut	Ip	168 hrs
8.3 Stainless knife	crack or cut	Ip	168 hrs
8.4 Relay control	crack or cut	Ip	720 hrs
9. Relief valve	change position	Ip	48 hrs
9.1 coil of solenoid valve 220V0.2w	burn	Ip	2160 hrs
10. Oil cooler system	dirty	C	2880 hrs
11. Pressure reduce valve	change position	Ip	48 hrs
11.1 pin valve(Pin \varnothing 5mmX21.4mm)	Bend or punch	If	2880 hrs
11.2 solenoid valve (220V)	burn	Ip	2160 hrs
12. Drive coupling	crack or cut	Ip	168 hrs
13. Main motor (Bearing)	dead	Ip	168 hrs
14. screw gear box	noisy	Ip	168 hrs
14.1 Bearing 32312	dead	Ip	4320 hrs
14.2 Bearing 6309	dead	Ip	4320 hrs
14.3 Bearing 6310	dead	Ip	4320 hrs
14.4 Bearing 6311	dead	Ip	4320 hrs
14.5 Bearing 6312	dead	Ip	4320 hrs
14.6 Oil seal 55mmX75mmX10mm	crack or cut	-	-

Table 5.6: Detail of activity period of blow molding machine

The form of position, activity, and period about normal activity of cutting machine is showing in Table 5.7

Detail of the part	Case of breakdown	Activity	Period
Cuter			
1. Knife (Stainless still 2"x12")	dirty	C	168 hrs
2. Belt (12.5x1250 La)	slip	Ip	48 hrs
3. Motor bearing	dead	Ip	168 hrs

Table 5.7: Position, activity, and period for maintenance schedule of cutting machine.

The form of position, activity, and period about normal activity of silk screen printing machine is showing in table 5.8

Detail of the part	Case of breakdown	Activity	Period
1. Air filter	dirty	C	4320 hrs
2. Flame treatment system	Not work	A	168 hrs
2.1 Flame treatment head	dirty	C	168 hrs
2.2 air valve	dirty	C	8640 hrs
2.3 Limit switch	out of position	A	168 hrs
3. Motor	noisy	Ip	168 hrs
3.1 Bearing	noisy	Ip	168 hrs
4. Conveyor	out of position	A	720 hrs
4.1 Moving stainless bar	lack	Ip	720 hrs
4.2 Spring	lose	If	720 hrs
4.3 Bearing	dead	Ip	168 hrs
4.4 Belt	lose	Ip	720 hrs
5. Printing unit	noisy	Ip	24 hrs
5.1 Squeegee air cylinder Seal	crack or cut	-	-
5.2 Limit switch	lose	Ip	168 hrs

Table 5.8: position, activity, and period for maintenance schedule of silk screen printing machine.

The form of position, activity, and period about normal activity of oven is shown in table 5.9

Detail of the part	Case of breakdown	Activity	Period
1. Conveyor			
1.1 Chain pin (\varnothing 5mmX55mm)	bend	Ip	2160 hrs
2. Heater	dirty	C	168 hrs
2.1 Heater (380ACV 5000Watt)	burn	If	2880 hrs
2.2 Temperature control	lose	If	2880 hrs
2.3 Heat resistance sleeve	crack or cut	Ip	168 hrs
3. Blower	dirty	C	2880 hrs
3.1 Bearing	broken	If	2880 hrs
3.2 wire	cut	Ip	168 hrs

Table 5.9: position, activity, and period for maintenance schedule of oven.

The Weekly maintenance plan of the machines in production line of milk container 200 cc. is showing in Table 5.10

Detail of the unit	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1. Carriage hydraulic cylinder	Ip		Ip		Ip		Ip
2. Clamping hydraulic cylinder	Ip		Ip		Ip		Ip
3. Blow pin hydraulic cylinder	Ip		Ip		Ip		Ip
4. Heater	Ip		Ip		Ip		Ip
5. Die head	C		C		C		C
6. Flow control valve	Ip		Ip		Ip		Ip
7. Cutter	C		Ip		Ip		Ip
8. relief valve	Ip		Ip		Ip		Ip
9. Pressure reduce valve	A		Ip		Ip		Ip
10. Cutter belt	Ip		Ip		Ip		Ip
11. Cutter knife	C		Ip		Ip		Ip
12. Printing set	Ip	Ip	Ip	Ip	Ip	Ip	Ip

Table 5.10: Weekly plan for maintenance.

The Yearly maintenance plan for silk screen printing machine is showing in Table 5.12

Detail of the part	January	February	March	April	May	June	July	August	September	October	November	December
1. Air filter	C						C					
2. Flame treatment system	A	A	A	A	A	A	A	A	A	A	A	A
2.1 Flame treatment head	C	C	C	C	C	C	C	C	C	C	C	C
2.2 air valve	C											
2.3 Limit switch	A	A	A	A	A	A	A	A	A	A	A	A
3. Motor	I	I	I	I	I	I	I	I	I	I	I	I
3.1 Bearing	P	P	P	P	P	P	P	P	P	P	P	P
4. Conveyor	A		A		A		A					
4.1 Moving stainless bar	I		I		I		I		I		I	
4.2 Spring	R		I		I		I		R		I	
4.3 bearing	P	P	P	P	P	P	P	P	P	P	P	P
4.4 belt	R		I		I		I		I		I	
5. Printing unit												
5.1 Squeegee air Seal	R								R			
5.2 Limit switch	P	P	P	P	P	P	P	P	P	P	P	P

Table 5.12: Yearly activity plan of silk screen printing machine.

The Yearly maintenance plan for cutting machine is shoeing in Table 5.13

Detail of the part	January			February			March			April			May			June			July			August			September			October			November			December					
Cuter																																							
1. Knife (Stainless still 2"x12")	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C	R	C	C
	p			p			p			p			p			p			p			p			p			p			p			p			p		
2. Belt (12.5x1250 La)	R			R			R			R			R			R			R			R			R			R			R			R			R		
	p			p			p			p			p			p			p			p			p			p			p			p			p		
3. Motor bearing	I			I			I			I			I			I			I			I			I			I			I			I			I		
	p			p			p			p			p			p			p			p			p			p			p			p			p		

Table 5.13: Yearly activity plan of cutting machine.

The Yearly maintenance plan for oven is shoeing in Table 5.14.

Detail of the part	January	February	March	April	May	June	July	August	September	October	November	December
1. Conveyor												
1.1 Chainpin(∅ 5mmX55mm)	R p				I p							
2. Heater	C	C	C	C	C	C	C	C	C	C	C	C
2.1 Heater(380ACV 5000W)	I f						I f					
2.2 Temperature control	R p						I f					
2.3 Heat resistance sleeve	R p	I p	I p	I p	I p	I p	I p	I p	I p	I p	I p	I p
3. Blower	C						C					
3.1 Bearing	I f						I f					
3.2 wire	R p	I p	I p	I p	I p	I p	I p	I p	I p	I p	I p	I p

Table 5.14: Yearly activity plan of oven.

5.2 Step of implementation in preventive maintenance

The steps of implementation in preventive maintenance are describe as follows:

1. Study the environment of the plant
2. Set up the maintenance schedules and plans
3. Training staffs about related skill and maintenance plan
4. Preparing the changing parts
5. Start preventive maintenance

After the position, activity, and period for maintenance schedules are setup, the detail of the activity in each part is the indicator of the responsibility in each staff. The staff will take action following the activity in the table. For example, the hydraulic system staff will take care of the hydraulic part and the electric system staff will do his job in the electric part.

Before we let the staffs follow the position, activity, and period for maintenance schedules the staffs has to train the way to use the schedule. The staffs should know every sign in the schedule. At the same time the staffs have to train the way to repair the part that he takes responsibility.

The activity start at the beginning of April by the chief of maintenance section concentrates the part that has working life about six months. At first he searches the data by looking at the maintenance daily report in order to find the last change of that particular part. Second if it is changed over six months or longer than its working life. He will have a work order to replace it. Another way if the part is changed less than six months. He will wait until the end of working life of the part.

The chief of maintenance section has to prepare the parts that are going to change before it was used for a few days. In order to make sure that the staff will complete his mission.