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A Case Study of Maintenance Management System for Bread Baking Plant

Mukhtar Ahmed*

ABSTRACT

Maintenance Management System is the back bone of any plant. It helps to arrange Preventive Maintenance, predict for Breakdown Maintenance and hence evaluate the reliability of Maintenance. Bread Plant is selected for the case study but can be modified for any other technology. Important maintenance issues are addressed in this paper. Maintenance Management System will not only reduce maintenance cost but will minimize emergency repairs and downtime, resulting in an increase in overall profitability.

Key words: Preventive maintenance, Breakdown maintenance, Predictive maintenance, Schedule, Work Order Forms etc.

1. INTRODUCTION

The objective is to provide a guideline for bakery plant maintenance. Some equipment may be different in bakery plants, because these are from different manufacturers and for different types of products. For example, if a bakery plant produces bread-crumbs, then special grinding machine is required and also special packing machine is needed. In general common equipment are selected for plant maintenance.

*Senior Fellow, Department of Industrial Engineering & Management, Institute of Business Management, Karachi.
Email: mukhtar.ahmed@iobm.edu.pk

Many sample tables are given, which may be maintained on personal computer. A computer operator can maintain data, update it and inform all concerned people. This information may be distributed by sharing files [7].

Different types of maintenance procedures are given below:

Breakdown Maintenance:

It means that people wait until equipment fails and repair it. It is selected when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

Preventive Maintenance:

Preventive Maintenance has long been recognized as extremely important in the reduction of maintenance costs and improvement of equipment reliability. The written preventive maintenance procedure is the document that tells the workers what needs to be done. This document must contain all of the tasks that will provide the most thorough inspections and lubrication of machines in planned down time [5].

Predictive Maintenance:

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It conveys trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designated to monitor conditions through an on-line system [3].

Proactive Maintenance:

Proactive maintenance is the sum of preventive maintenance and predictive maintenance. Proactive maintenance focuses

primarily on determining the root cause of machine failure, and dealing with those issues before problems occur. It is often seen as a cost-effective practice since it allows a company to avoid machine failure and solves issues before they become problems [2].

Reliability Centered Maintenance (RCM):

Plant and equipment are installed and employed to do what the users want to do. Maintenance is undertaken in a variety of forms, to ensure that the plant and equipment continues to do what the users want it to do. Reliability Centered Maintenance determines the maintenance testing and inspection needs to be performed to support the maintenance strategy. The outcomes of an RCM analysis can result in changes to existing preventive maintenance tasks, the use of condition monitoring, inspections and functional testing, or addition or elimination of such tasks. [4]

World Class Maintenance:

World class maintenance can be defined as a tool used to search for and allow a company to perform at a best-on-class level. Strategic considerations and operational decisions are influenced by other corporate functions such as production, finance, quality and human resources. It is true that the information gathered by these systems at the operational level and actions taken are in fact strategic- improved asset availability, productivity, and quality, as well as resource management, inventory control, planning and so on. [1]

2. PROCESS

The basic ingredients for bread are flour, sugar, yeast, preservatives, milk, salt etc. Ingredients may vary for different types of bread. The general steps to make bread are as follows: Flour is passed through the sifter to remove particles. The

ingredients are mixed in a fixed proportion in dough kneading machine. The dough is then kept in a warm room for some time to go through the fermentation process after which it is poured into a dough cutting machine which makes pieces of desired weight e.g. one pound, half pound etc. These pieces are then transferred to pans. The pans are placed in a chamber called proofer, which provides controlled humidity and temperature. Thereafter the pans are passed through the conveyor belt of the baking oven, where temperature is set in different sections of the oven. After baking the pans are transferred to a cooling conveyor belt. The breads are then taken out of the pans, sliced and packed in bags.

3. MAINTENANCE ACCESSORIES

An essential requirement for a sound maintenance plan is to prepare a list of all spares parts for each machine. For example: mesh, belt, piston, seals, air filter, chain, chain links, sprocket, belts, burner, blowers, slicer blades, electric motors, micro-switches, transformers, fuses, etc. The number of each part to be kept in store is considered according to frequency of failure. Minimum inventory is also decided upon, so that the parts are ordered in time. All maintenance tools to be used are also kept with maintenance department e.g. multimeter, tongue, hand tools, welding machine (different types), lathe and milling machine. Special diagnostic equipment and calibration instruments are also required e.g. calibration of pressure, humidity meter, condition monitoring for bearing etc. Necessary information is given in Table 1.

4. MAINTENANCE SCHEDULE

Maintenance schedules, on daily, weekly and annual basis are prepared as per specific requirements. The daily maintenance includes cleaning of machinery, oiling and greasing before the start of the shift. Repair work which is not possible during shift

operations is planned after the shift is completed and the plant is not in operation. On weekly basis a schedule is prepared and a check a list of equipment is made. Each item is thoroughly observed e.g. gear oil level, belt tension, and lubrication of those parts which are not done on daily basis. During annual maintenance complete plant is overhauled. Bearings, belts and other parts are replaced. The maintenance team must be prepared for any breakdown at any time. However, unanticipated failures may also occur for which safety systems have to be built in. Therefore, suitable ventilation & exhaust systems must be provided in the plant to avoid accumulation of gas. A sample schedule is given in Table 2.

5. MAINTENANCE TEAM

Maintenance team should comprise very experienced and qualified members. The team leader should be a graduate engineer. A sample is given in Table 3.

6. WORK ORDER FORM

Supervisor issues different work orders when needed. For example if electric motor winding facility is not available in house then a work order is issued to a vendor outside. Similarly if an X-ray welder is not available in house then one can be hired from outside. There are many forms which are filled when certain job is carried out. The team member will write a report after maintenance is completed, which is given in the Report column of Table 4.

7. INVENTORY

All spare parts needed to run the plant smoothly should be kept in store. A minimum balance should also be mentioned so that the purchase order can be issued when minimum balance is reached.

Codification of spares is a scientific record keeping and information system which is essential for proper identification, reducing duplication, material planning, procurement, storage, use and inventory control etc. It adopts a specific numbering system for each spare and component which is called a catalogue number. Generally, a catalogue number gives essential information necessary for identification of each spare/component [6]. A sample is given below:

Unit----------Item #

Ten----------Equipment #

Hundred----------Shop #

Thousand----------Procurement code Imported or Indigenous

Ten Thousand----------Consumable or non-consumable

Hundred Thousand----------Type (mechanical or electrical)

Million----------Color code (Black=1, Red =2, Yellow=3 etc.)

Ten Million----------Extra digit to accommodate any new code

The detail is given in Table 5.

If the following command is typed on function in Microsoft Excel =IF(C2<=D2, "Order", "OK"),

then it will show OK when we have required number and Order when balance is less than minimum balance. Additional columns may be added such as unit price, suppliers information etc.

8. METER READINGS

Meter readings are taken daily before the start of the shift and after the shift. Any abnormal reading will indicate some problem in the plant. A format is shown in the Table 6.

9. ROOT CAUSE ANALYSIS

Maintenance Management System also provides a database, which may be used to analyze why a problem is occurring from time to time. For example, in one plant a transformer was not functioning properly, after thorough investigation it was found that voltage variation is causing this problem.

Table 1

Maintenance Accessories

Part Number	Item	Types	Quantity
	Lubricants		
2001		General purpose grease	5kg
2002		Graphite grease	5kg
2003		Graphite oil	5litre
2004		Gear oil	5litre
	Lubricating tools		
2005		Oil can	5 No
		Grease gun	5 No
	Cleanings		
2006		Duster	50 No
2007		Cotton	50 packets
	Protective cloths		
2008		Gloves	20 pairs
2009		Welding masks	5 No
2010		Protective glasses	10 No
2011		Dungarees	20 No
2012		Hats	20 No
	Hand tools		
2013		Pliers	5 sets
2014		Screw drivers	5 sets
2015		Mallet	2 sets
2016		Hammers	3 sets

Table 1 (Cont.)

2017		Bearing pullers	2 sets
2018		Allen keys	2 sets
2019		Drill machines	3 No
2020		Drill bits	2 sets
2021		Welding transfer	2 sets
2022		Electric welding kit	2 sets
2023		Gas welding set	2 No
2024		Oxygen cylinder	2 No
2025		Acetlyne cylinder	2 No

Table 2

Maintenance Schedule

Serial Number	Equipment	Maintenance required	Duration
1	Sifter	Check mesh	Monthly
		Check motor	Weekly
		Check driving belt	Weekly
2	Kneading Machine	Check Spiral	Annually
		Check Bowl driving motor	Weekly
		Check spiral motor	Weekly
		Check arm lifting motor	Weekly
		Check Bowl driving motor belt	Weekly
		Check spiral motor belt	Weekly
		Check spur gears	Monthly
3	Lifter	Check oil pressure	Weekly
		Check seals	Weekly
		Check locking arrangements	Weekly
4	Dough cutter	Check blades	Weekly
		Check piston	Monthly
		Check compressor	Weekly
		Check seals	Weekly
		Check diaphragm	Weekly
5	Rack Trolley	Check caster wheels	Weekly

Table 2 (Cont.)

		Check mesh	Weekly
6	Proofer	Check heating rods	Weekly
		Check steamer	Weekly
		Check humidity meter	Annually
		Check thermometer	Annually
		Check immersion heater (steamer)	Weekly
		Check float valve	Weekly
7	Oven	Check oven belt plates	Weekly
		Check burners	Weekly
		Check ignition switch	Monthly
		Check exhaust fan	Weekly
		Check PIV gear	Monthly
		Check ignition switch	Monthly
		Check exhaust fan	Weekly
		Check PIV gear	Monthly

Table 3
Team Members

Designation	Qualifications
Maintenance Supervisor	BS (Engineering)
Associate Engineer Mechanical	Diploma
Associate Engineer Electrical	Diploma
Technician Mechanical	Technical Certificate
Technician Electrical	Technical Certificate
Welder	Technical Certificate

Table 4
Work Order Form

Machine	**Type**	**Work required**	**Team Member**	**Report**
Sifter	SX 001	Check belts	Peter	Belts changed
Mixer	MX002	Check motor	Paul	Motor rewind
Oven	OX 003	Check Burner	Mike	Thermostat changed

Table 5
Inventory

Item Number	Name of Part	Quantity	Minimum balance	Remarks
10111201	Sifter motor	2	1	OK
10022201	Sifter belt	2	1	OK
10032201	Sifter mesh	2	1	OK
10011202	Kneading driving motor	2	1	OK
10411202	Kneading spiral motor	1	2	Order
10511202	Kneading arm motor	2	1	OK
10182203	Seals	2	1	OK
10192204	Blades	12 sets	2 sets	OK
10202204	Piston	2	1	OK
10072204	Diaphragm	2	1	OK
10082205	Caster wheels	12	2	OK
10091206	Heating rods	6	1	OK
10111206	Immersion heater	2	1	OK
10102206	Float valve	2	1	OK
10222207	Burner	6	2	OK
10241027	Ignition switch	6	2	OK
10211207	Oven exhaust fan	2	1	OK
10252207	PIV gear	2	1	OK
10261208	Chain links	6	2	OK
10132209	Slicer blades	12	6	OK
10271209	Slicer driving motor	2	1	OK
10282209	Packing blower	2	1	OK

Table 6
Meter Readings

Type of meter	Reading at start of shift	Reading at finish of shift
Electricity meter #123456		
Electricity meter # 34567		
Gas meter # 789654		

10. CONCLUSION

Maintenance in a modern plant is a sophisticated science which, when properly implemented, can yield significant improvements in plant efficiency and economy. Maintenance management can be used to achieve this objective.

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