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A Preventive Maintenance Methodology for CMH 400 Machine

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ABSTRACT

The technological advancements in field of Computer aided design and manufacturing have led to development of conventional numeric control. The conceptual framework initially designed during the early developments still undergoes few small customized changes as per the challenges. CNC Machines are the contrast to the conventional machining operations which were initially either hand operated, lever operated or semi-automated by the use of the cams. Machines though numerically controlled are not failure proof and failures are uncertain in nature and a necessary evil which hampers the normal operation of machine by increasing the down time. To counter such real problems effective maintenance strategies are planned to reduce the chances of failure and thus increase the MTTF (mean time to failure) and MTBF (mean time between failure).This paper emphasizes on the preparation of Preventive Maintenance strategy plans of a CNC Machine at an Automobile Industry considering various causes of failure, diagnosis, remedies and maintenance tasks to be performed. A detailed Preventive Maintenance plan is prepared for the machine which includes daily activities, weekly tasks and half yearly plans for the machine.

Keywords: CNC, Preventive Maintenance, diagnosis, MTTF, MTBF.

I. INTRODUCTION

The numerical control system are defined as form of automation which is controlled by set of letters, numbers and symbols [1]. A program of instruction is designed for a particular task or job which is a combination of the numbers. The basic flexibility of the machine provides us with an advantage to change the set of instructions each time as per the application permits, and writing a program or recalling it from memory through few controls is much easy which has led to the tremendous usage of such machines in the metal working industry for over 25 years now[2].

NC technology has been applied to numerous operations in manufacturing industries namely fine machining, drafting, assembly, inspection, sheet metal operations, welding etc. The machine provides with the enormous advantages like reduced nonproductive time, reduced fixturing, greater flexibility, improved quality[6].

The maintenance of a CNC machine is desired for the smooth working of the asset, which lies on top priority of the management and the maintenance staff [8]. So a series of operations are coordinated in respect to achieve the desired goals called the maintenance strategies. The CNC machines are generally initiated with a Preventive Maintenance (PM) Plans. As over maintenance and under maintenance both are undesired so a mid way plan is planned and implemented to cover the economic aspect as well.

The Column moving horizontal (CMH-400) is a general purpose compact, flexible, productive, Robust and high precision machine equipped for working to cater the different types of prismatic/circular components suitable for tool rotating and indexing process[10]. The machine is inculcated with Automatic Tool Changer and the Automatic Pallet Changer to reduce the unproductive time.

This machine is used for face milling, slot drilling, rough boring, profile slot milling.

II. PREVENTIVE MAINTENANCE

The foremost important principle of the maintenance lays to be the regular and systemic approach of

inspection activities coordinated by knowledge and maintenance attention to completely ensure the normal functioning of the asset to avoid catastrophic failures [10].

Efficiently PM programs are efforts of engineering knowledge which in result optimizes the asset ownership and the profits earned with the maintenance costs associated with the breakdown in terms of potential profit loss[1]. The ownership cost encompasses the purchase price of the asset, maintenance cost associated with the asset and the parameter which governs the equipment life of asset. The maintenance cost is sum of the value of potential profit loss due to breakdown, the wages of labor insisted and the cost of spare required[4].

The PM methodology works with a philosophy of fix it when it needs thus eliminating the chances of any sudden failures or breakdowns[2].

The reason of Preventive Maintenance being so favorite among the industry personals includes:

- Reliability: The PM strategies are so focus and carried out that it doesn't compromise on the reliability of asset and aims at every bit of time to maintain a system reliable of to increase the reliability of asset in many applications too.
- Safety: The PM programs include the daily Check sheets to safeguard the operating conditions by proper inspection of the pressure valves and the oil status in case of pneumatically controlled and hydraulically controlled operations.
- Performance: The PM schedule ensures that even a small though vital component should not fail after the planned schedule to accommodate the performance characteristics of asset
- Economies: Every coordinated activity in Plan is accessed as per the economic aspect also to navigate that plans should not overcome the ownership cost. It is well understood that over and under Preventive Maintenance both are not desired at workplace as it obstructs the performance[9].

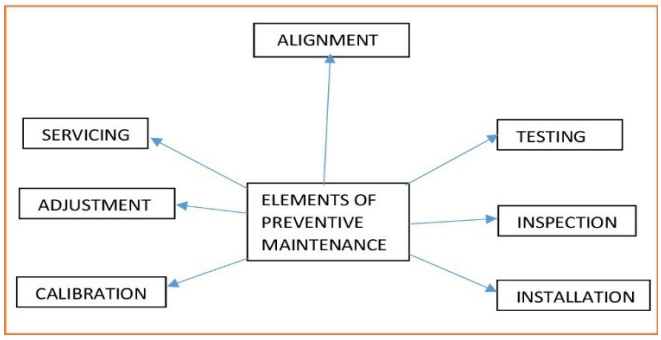

Figure 1: Elements of Preventive Maintenance [3]

A. Elements of Preventive Maintenance

- Inspection: The serviceability of the item is determined and it is achieved by comparing the physical, mechanical condition of the different components of the asset with the standards including life and working hours.
- Servicing: It includes basic maintenance sequence like cleaning, lubricating, charging etc. of different components and main motto is to avoid incipient failures caused.
- Calibration: The periodic determination of the various values linked to the component of asset is done and same characteristics are compared to the laid down standards. The comparison is done with the standard instrument to check for any anticipated error in system cause due to miscellaneous reasons.
- Testing: The sequence of dedicated operations to detect the degradation of components.
- Alignment: Making changes to an item's specified variable elements for the purpose of achieving the optimum performances.
- Adjustment: Periodically adjusting specified variable elements of material for the purpose of achieving the optimum system performances.
- Installation: The replacement of item or the worn out components is done to maintain it to the specified tolerance[3].

B. Indicators of Ineffective Preventive Maintenance

- Low equipment utilization due to unscheduled stoppages
- High wait or idle time for machine operators during outages

- High scrap and rejects indicative of quality problems
- Higher than normal repair costs due to neglect of proper lubrication, inspections or service.
- Decrease in the expected life of capital investments due to inadequate maintenance.[5]

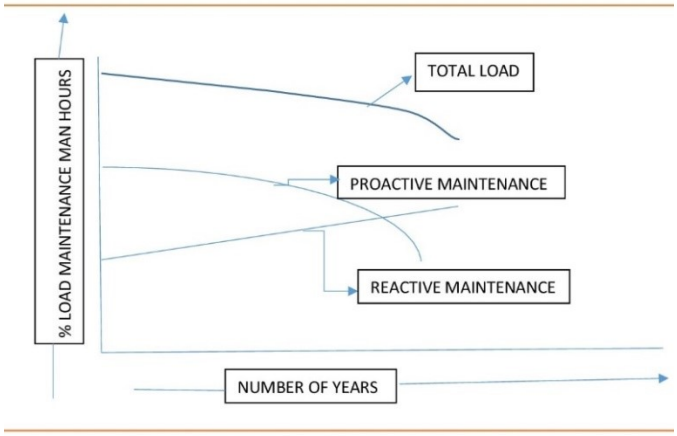

Figure 2: Maintenance total load reduction [8]

Figure 2 shows the graph between the no of years of service of an asset and the percentage load maintenance man hours. As seen it illustrates that the Reactive maintenance increases the load maintenance hours and the proactive maintenance reduces the man load hours so as deciphered the proactive maintenance strategy is encouraged in form of Preventive Maintenance. The Preventive Maintenance on the other hand reduces the total load of maintenance hours to approximately 25% as it manages the asset in periodic format which leads to the early detection of faults during the course of maintenance schedule.

III. MAINTENANCE METHODOLOGY FOR CMH

The Preventive Maintenance check list or sequence of operations is carried out generally daily, weekly, half yearly or yearly depending upon the component undertaken. So keeping the operations and the life span of each entities the PM schedule is planned for the Hydraulic, Pneumatic circuit components.

Table 1: Preventive Maintenance Check list for Pneumatic and coolant chip disposal

Activity	Checking Method	Standard Parameter	Freq.	Observation	Action Taken With Final Status	Remarks
PNEUMATICS						
Check and clean FRL unit	Manually	clean	Q			
Check all pneumatic pipe / connector condition	Visually	No leakage	Q			
Check pneumatic solenoid valve condition	By manually & Multimeter	Healthy	Q			
COOLANT AND CHIP DISPOSAL						
Clean the Y - stainer	Manually by brush	clean	Q			
Clean Drum mesh filter	Manually by brush	clean	Q			
Check conveyor sprocket / chain condition	Visual checking	Healthy	Q			
Check chip conveyor Gear box oil level	Visually on level indicator	up to mark	Q			
Check and clean coolant pipe / nozzle	Manually	no choke	Q			

Table 2: PM check list for ATC and Spindle

Activity	Checking Method	Standard Parameter	Freq.	Observation	Action Taken With Final Status	Remarks
ATC / MAGAZINE						
Check Magazine gear box oil level	Visually on level indicator	up to mark	Q			
Check ATC Arm gear box oil level	Visually on level indicator	up to mark	Q			
Check the condition of Arm gripper all springs	Manually	Healthy	Q			
Check the condition of sub arm movement	By manual operation	Healthy	Q			
Check tool pocket tenon condition	Manually	no damage	Q			
ATC door movement and flow setting	By manual operation	smooth	Q			
SPINDLE						
Clean spindle taper bore	Manually by soft cotton	clean	Q			
Check spindle tenon condition	Manually	no damage	Q			
Check spindle axial and radial play	Manually	5 mic	H			
Check tool clamp/declamp machanism	By manual operation	Healthy	Q			
Check the Air Blast while tool changing	Bymanual operation	Heavy air	Q			

Table 3: PM Check list for Hydraulic and Lubrication System

Activity	Checking Method	Standard Parameter	Freq.	Observation	Action Taken With Final Status	Remarks
HYDRAULIC						
Check the system pressure	Visually on gauge	50 bar	Q			
Clean the motor fan, cover, Raditor	Manually	clean	Q			
Check oil fillup filter and breather	Manually	clean	H			
Clean the suction filter	Manually	clean	H			
Check all solenoid valve / coil condition	By multimeter and manually	Healthy	Y			
Tank cleaning and oil replacement		clean				
LUBRICATION SYSTEM						
X axis L.M Guide (6 points)	Manually	Oil drops	Q			
X axis Ball screw (1 point)	Manually	Oil drops	Q			
Y axis LM Guide (4 points)	Manually	Oil drops	Q			
Y axis Ball screw (1 point)	Manually	Oil drops	Q			
Z axis LM Guide (4 points)	Manually	Oil drops	Q			
Z axis Ball screw (1 point)	Manually	Oil drops	Q			
Clean / Replace Lubrication line filter	Manually	Clean	Y			

Table 4: PM Check List for weekly maintenance

S.NO	MAINTENANCE WORK	TO BE CHECKED FOR	REMARKS
1.	Check fan of AC spindle motor	• Quiet run • Dust at the filter	Clean the filter
2.	Check axes drives	• Quiet run • Temperature rise	Do CAPA
3.	Check telescopic covers	• Smooth sliding	Do CAPA If not normal
4.	Check visible bright parts	• Oil films • stains	Do Why-Why Analysis
5.	Check oil level at all oil sights		Refill FRL lubricator unit if required
6.	Lubrication for counter balance chain	• Noisy operations	Apply the grease
7.	Check the air cooler filter	• Cabinet cooling	Clean the filter

Table 5: PM Check List for Half-Yearly Maintenance

S.NO	MAINTENANCE WORK	TO BE CHECKED FOR	REMARKS
1.	Check of oil level • Lubrication tank • Coolant tank, Gear box ATC Box	Loss of oil	Refill if necessary
2.	Check for Pressure and flow of: • Lubrication • Pneumatic, coolant		Adjust the Pressure switches and flow control valves if necessary
3.	Check LM Guide way	Damage wear, stains	Clean the Guide way
4.	Check the references points		To be adjusted by test mandrel
5.	Check Hydraulic power pack	Oil temperature, pump noise	
6.	Machine level	0.02/1000mm is permissible	

IV.CONCLUSION

This paper puts light on the importance of the Preventive Maintenance Plans According to the susceptibility of the failure inculcated in the component and the framework designed suggests the implementation of the strategic plans to maximize the usage of the asset in terms of working hours and the quality and required reliability obtained. The strategy is planned accordingly as daily tasks and weekly tasks to completely sanitize the cause of any breakdown if any may occur. The maintenance plans are such planned to maximize the usage and minimize the maintenance cost. The paper suggests that over maintenance and under maintenance both are not desired for an asset as it directly affects the economies associated with the asset. The paper Exemplifies the proper execution of the plan to reduce the breakdown of the machine and ensure availability.

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