

Refurbishing of Hardinge 600-L1 Vertical Machining Center

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Abstract- This project aims at improving the overall equipment effectiveness of a Hardinge 600 II series VMC machine by using a specified problem solving process and to reduce the power consumption and increase the units produced per hour of working time which in turn increases the range of productivity of the machine in a few possible ways like implementing accumulator in the hydraulic system of work holding setup and simplifying the chip removal mechanism in an effective and reliable way by removing the conveyer belt and implementing tray disposal method.

PROBLEM STATEMENT

Problem identified	Root cause
Increase in power consumption	Use of Conveyer belt
Increase in power consumption	Continuous running of motor to hold and clamp
Reduction in productivity	Due to delay cleaning of filter mesh
Increase in cost(electric bill)	Due to usage of electric motor for conveyer belt and continous running of clamp and jack motor to produce sufficient pressure

PROBLEM ANALYSE

Increase in power consumption: Due to use of separate conveyer belt to transmit chips to filter tank, a motor has to be kept for conveyer operations. Hence more power is consumed eventually leading to high electric bill

Increase in power consumption :(Continuous running of hydraulic motor)To give enough pressure to work holding devices a pressure of 50 bar is required, it is achieved by a motor which creates sufficient pressure. Due to this current consumed is high and leading to increase in power utility bill.

Reduction in productivity:Due to delay in cleaning of burr from filter tank there is a reduction in productivity because the operator has to clean the burr from the filter tank which is tedious and time consuming.

Increase in cost: Due to usage of separate motor for conveyer belt and continuous running of hydraulic pump motor the power consumption cost is increased.

ALTERNATIVE SOLUTIONS

Alternate solution for conveyer: Remove conveyer setup and install pneumatic cleaning of burr. Cleaning burr using push and flush coolant methods. Running the conveyer belt motor by using other sources like solar power, etc.,

Alternate solution for hydraulic motor pump: Use of accumulator as a pressure storage device. Use of solar power to run electric motor.

Alternative solution for productivity: Usage of vacuum cleaner to clean. Usage of single mesh tray and enlarge the size of the tank.

Alternate solution for power consumption bill: Use of solar power to run electric motors.

CALCULATION

CONVEYER REPLACEMENT

EXISTING SETUP POWER CONSUMPTION:

Drive motor capacity = 400VAC, 5 Amps

Power = 4KW

Working hours per shift =7 hrs

No of shifts per day = 3

Total working hours per day= Working hours per shift * No of shifts per day

Total working hours per day = $7 \times 3 = 21$
 Total working hours per month = Total working hours per day * 30
 Total working hours per month = $21 \times 30 = 630$ hrs
 Power consumed for a month = 4×630
 Power consumed for a month = 2520 kW hr
 Cost Saved per month = RS. 24,642
 Note: cost of electricity bill is found by using TNEB Power Calculator from the official website <http://tnebnet.org/tariff.new.html>

EXTRA COOLANT PUMP SPECIFICATION

Volt: 415 V
 Current: 4.5A
 Power: 2.25 kW
 Rpm: 3000
 Total working hours per month = 630 hrs
 Power consumed per month = Total working hours per month * power
 Power consumed per month = 2.25×630
 Power consumed per month = 1417.5 kW hr
 The monthly cost due to usage of coolant pump = RS. 17288
 Note: cost of electricity bill is found by using TNEB Power Calculator from the official website <http://tnebnet.org/tariff.new.html>
 Cost saved per month due to replacement of Conveyer belt = 24642 – 17288
 Cost saved per month due to replacement of Conveyer belt = Rs. 7354
 No of coolant motors used = 2
 • Push coolant
 • Flush coolant
 Type of coolant used: WS 5050
 Previous capacity of coolant tank = 100 lit
 Modified coolant capacity = 2×100
 Modified coolant capacity = 200 lit.
 Tray of 300 micron and 800 micron are used in filtering the chips formed during the operation. This is chosen based on the chip size.
 Tank size chosen based on the opening of the work table.
 Size chosen = 80*55 cm

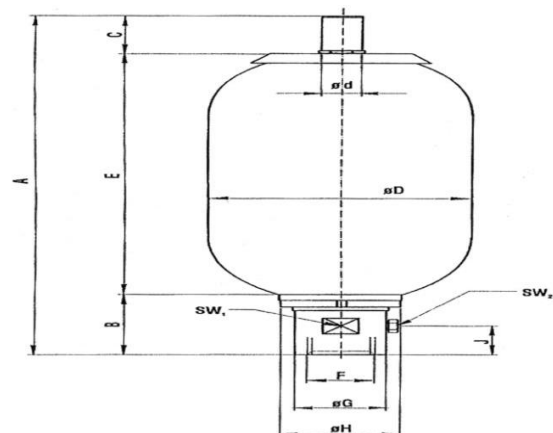
MAINTENANCE IMPROVEMENT BY MEANS OF TIME

Previous time taken for cleaning = 3 mins
 Current time taken for cleaning = 1 min

Time saved per cleaning = $3 - 1 = 2$ mins
 No of cleaning cycles per shift = 4
 No of cleaning shifts per day = $4 \times \text{number of shift} = 4 \times 3$
 No of cleaning shifts per day = 12
 Time saved per day = Time saved per cleaning * No of cleaning shifts per day
 Time saved per day = $2 \times 12 = 24$ mins
 Time saved per day = 24 mins
 Parts produced per shift = 70 parts
 Number of working hours per shift = 7 hrs
 Parts produced per hour = Parts produced per shift / working hours per shift
 Parts produced per hour = $70 / 7$
 Parts produced per hour = 10 parts
 Parts produced per 24 mins = Parts produced per hour * $24 / 60$
 Parts produced per 24 mins = $10 \times (24 / 60)$
 Parts produced per 24 mins = 4 parts.
 So in average for every day the time is saved for the production of extra 4 parts. It doesn't mean that for every day extra 4 parts can be produced excess, it means that in case of defects in parts machined this will compensate the target to be achieved by the production. It may also be helpful to increase overall productivity.

DIMENSIONS

The symbols mentioned below can be identified from the image of the accumulator shown in the figure
 Maximum height, A = 245 mm
 B = 52 mm
 C = 28 mm
 ØD = 90 mm
 Ød = 16 mm
 Øe = 68 mm



Previous running time of motor = 21hrs
Current running time of motor= Parts per day *
running time
Parts per day * running time= 210*10
Parts per day * running time= 2100 sec
Current running time of motor in minutes= 2100sec
/60
Current running time of motor= 35 minutes
Take 1 hr approximately considering other allowance
Current running time = 1 hr
Difference in time = 21 - 1 hr
Difference in time = 20 hr
Power saved by using accumulator
= 2.3 kW * 20 hr
Power saved by using accumulator= 46 kW hr
Power saved per month = 46*30
Power saved per month = 1380 kW hr/month
We save Rs 16,822 a month by using accumulator.
Note: cost of electricity bill is found by using TNEB
Power Calculator from the official website
<http://tnebnet.org/tariff.new.html>

RESULTS AND DISCUSSIONS

Increased Mean Time Between Failure(MTBF) and
decrease Mean Time To Repair(MTTR).Reduction in
power consumption. Increase in productivity of the
machine(saves 4 parts a day).Reduction in power bill.
Reduced cleaning cycle time. Reduce reduction rate.

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