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Design Procedure and Impact of Fixed Type Automation for Billet Loading

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Abstract – *Present forging industries having certain issues. Continuous demand and various challenges forced industrialist and forgers to replace their current forging method with automation. As forging industry is having high temperature operation. It is having high risk operation at various stages now automation is taking place. Automated loading enables manufacture of forging with enriched thermal accuracy with large quantity with reasonable cost. Mechanism of loading of billet in forging industry increases the possession of this technology and offers many benefits to forger through various ways such as economical technological and ecological as manufacturing trends and technologies are changing as per demand supply management. Every industry tries to working with automation problems like cycle time reduction deficiency of efficient and skilled work labour. Even if country like India cheap labour is available many problems occurs due to human operation. So, automation is necessary in rapid and continuous manufacturing. The project we have to work with is having similar kind of continuous operation of loading so we decided to make fixed type of automation.*

Key Words: (Size 10

1. INTRODUCTION

Billet loading is very prime necessity of every forging industry. In conventional loading machine there are human operators to load the billets. This includes small industries also large industry of forging. Also, some different purpose like Inspection lines, Sorting lines. Conventional loading process involves gravitational slider to which efficient manual loading is required. Who can manage proper timing of loading billet for initial heating stages, so it is better to go with automation otherwise problems regarding thermal stresses, improper heating of billet is observed. Instead of billet, small rods, bars can be loaded to elevated platform.

2. PROBLEM STATEMENT

Local industry selected to work on, was facing some issues regarding billet loading for furnace. Lack of efficient labor is found labor charges getting higher relative to work, maintaining cycle time was difficult to maintain by gravitational slider mechanism & also it affects line efficiency. Thermal stresses created due to overheating which not supposed to exist.

2.1 Billet Specification

Billet is prime product of machine, so it is necessary to understand its dimensions.

Maximum Billet sizes taken for reference.

1. Diameter: up to 26mm
2. Length: 150mm
3. Material: Stainless Steel
4. Temperature required to heat: Up to 1500°F
5. Time for heating billet: 6-7 sec.

Fig -1: Billet

2.2 Working Condition and Requirements

For selection of mechanism for billet loading in furnace it is necessary to understand current system.

1. Furnace height 800mm from ground.
2. Hooper size demanded: 1000 Billets per loading.
3. Working hours: 6 24 (Days Hours)
4. Single billet per loading is necessary.
5. Total stroke length: 700mm.

Fig -2: Conventional loading

3. TYPES OF LOADING

In current designed system within all the loading types certain loading methods are appropriate they listed as below

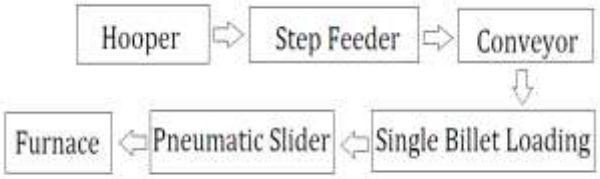
1. Bucket conveyor
2. Pocket elevator
3. Vertical conveyor system
4. Step feeder

4. DESIGN SYSTEM

For above mentioned billet specification & working conditions, bucket conveyor step feeder was suitable. Automated billet loader should work for continuous cycles (6□24) bucket conveyor found with many issues regarding maintenance for continuous operation, so step feeder is best mechanism for carrying billet. Total elevation (height of end of Hooper to furnace is 685mm) is substituted in little portions of (114.5mm) that mean it divided into 6 steps. Further process is described in given flow chart

5. WORKING PRINCIPLE

Hooper is container that store processing component required. Hooper should be capable to handle 1000 billet per loading. Further as above-mentioned billets gets load singularly by step feeder billet loaded on conveyor. If accidently more billet gets loaded goes to conveyor it provided with two provision guide plates & side way. Conveyor carries single billets in one direction. Conveyor is with 50 rpm & having length 2205 mm. Single billet loader is a mechanism with pneumatic pushing programmed for time 7 sec time. Tilted base load it on angle which is go through furnace. Total length of this angle is 700 mm.



Flow Chart -1: Process

6. TORQUE CALCULATION OF STEP FEEDER FOR MOTAR SELECTION

1. Mass of moving plate & attaching plates creates major normal force (M)

   Total mass (M) =97.35 kg

2. Total weight (W = F) = M □g

   = 955.0035 N

3. System is tilted by 15° so its cosine angle is need to be taken,

   = F sin θ

   = 955 sin (15)

   = 922.45 N

4. Maximum moment occurs at force to center of gravity.

   Assumed point of center of gravity occurs at middle plate center because of its self-weight & position.

   Length of center plate (L) = 805mm

   C.G at plate (L) = 805/2

   = 402.5mm

5. Max. Torque(T) = F □L

   =922.4591 □402.5

   = 371289.78 N-mm

   = 371.289 N-m.

   From Catalogue nearby value,

   T= 407 N-m.

7. CALCULATION OF PNEUMATIC CYLINDER

To push billet into furnace or to remove it, is necessary to happen within fixed time and without manual intervention should not occur so appropriate cylinder have to select.

In current mechanism steady load of billet is only load for pneumatic cylinder to push. So there is no major thrust force.

P = F / A

As,

P = Pressure

F = Force (weight of billet)

A = Cylinder area.

F = 0.632 ×9.81

= 6.2 N

P = 6 bar

By considering safety factor 1

So A = 10.34 square mm

Diameter (d) = 3.6mm

This size is so small commercially not effective so 80mm cylinder is used, excess force produce by it control by flow control valve.

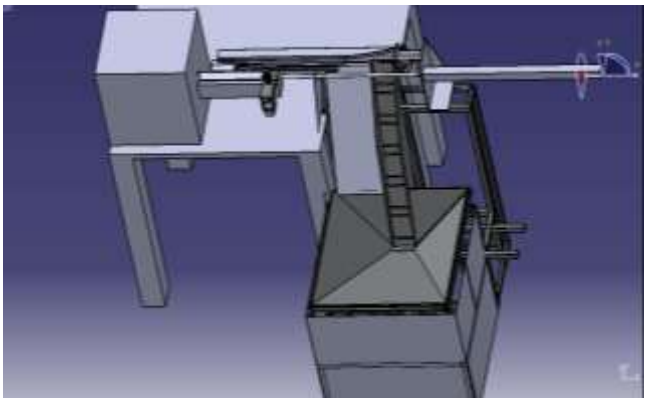


Fig – 3

8. NECESSITY OF MATERIAL SELECTION

As mentioned above current mechanism having large area in continuous contact if material like steel is used maintenance will be higher due to wear so material should with stand high wear and abbreviation.

9. SELECTED MATERIAL AND REASONS

1. EN 31 is a good quality steel used for high frictional surface like press tool machine
2. Ball and Roller bearing spinning tools bending rolls, punches and dies by its character this type of steel has high resisting nature against wear

Table -1: Chemical composition of EN31

Carbon	1.05
Silicon	0.335
Manganese	0.54
Sulfur	0.0339
Potassium	0.028
Chromium	1.4
Molybdenum	0.0132
Nickel	0.0705
Aluminum	0.0267
Cobalt	0.0124
Copper	0.12

Table -2: Mechanical composition of EN31

Bulk modulus (GPa)	140
Poisson's ratio	0.30
Shear modulus (GPa)	80
Elastic modulus (GPa)	190
Density (kg/m³)	7.8

10. RESULTS

1. Manual intervention neglected. Three person's works for single operation at different shifts working with human efficiency observed around 80%. Also this efficiency changes with respect to shift duration. Some injuries occurs while loading it neglected totally.

2. Cycle time maintained. Study showed very good results by automating system which is of 6-7 sec maintained by PLC program.

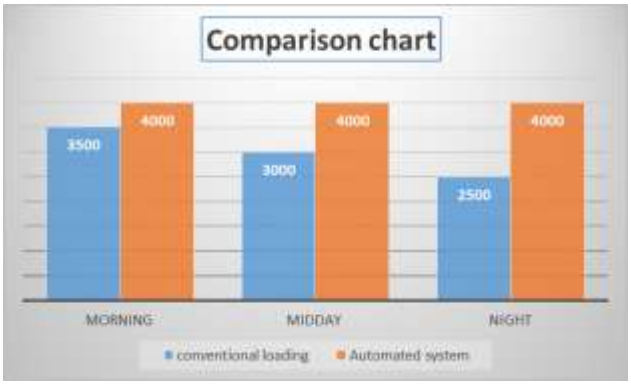
3. Thermal stresses induces due to uneven heating it maintained.

4. Productivity increased & constant throughout all the day.

Table -3: Per shift no of billets completed

Shifts	conventional loading	Automated system
Morning	3500	4000
Midday	3000	4000
Night	2500	4000

Chart -1: Comparison chart



11. CONCLUSION

Automation in billet loading is fixed type automation. Designed mechanism (Plate Step Feeding) is appropriate for continuous loading. With these mechanism Manual errors, efficiency losses & economical losses are avoided. Following goals achieved by automation like cycle time maintained labour cost saved. Due to continue operation EN31 is selected for high frictional surface in mechanism. Motor is selected by calculating torque as mechanism runs at high load condition (self weight).

REFERENCES

[1] Ghazi Abu Taher' (March 3, 2014) Automation of Material Handling with Bucket Elevator and belt conveyor. ISSN 2250-3153

[2] VemuriLaksminarayana (July 13, 2015) Influence of Varying Load on wear rate and Frictional resistance of EN-8 Steel Sliding against EN-31 Steel. ISSN.1819-6608

[3] Kunal Chopra (December 18, 2018) Detailed Experimental Investigations on Machinability of EN-31 Steel by WEDM.

[4] Spartak Ljasenko (November 04, 2016) A Comparison of the Manufacturing Resilience between Fixed Automation Systems and Mobile Robots in Large Structure Assembly. Procedia CIRP 57 (2016) 235 – 240

[5] D. Chakradhar (June 2, 2011) Multi-Objective Optimization of Electrochemical Machining of EN-31 Steel by Grey Relational Analysis.

[6] C.LITTLEFIELD (February 2, 1932) CONVEYER MECHANISM FOR WRAPPING MACHINES.

[7] Jung-Eui LEE (August 17, 1998) A Fully Coupled Analysis of Fluid Flow, Heat Transfer and Stress in Continuous Round Billet casting. ISIJ International, Vol. 39 (1999).

[8] A. M. Cramb and E. S. Szekers: Mold Operation for Quality and Productivity, The Iron and Steel Society of AMIE, Warrendale, U.S.A. (1992), 37.

[9] J K. Brimacombe.I V. SamarasekeraandJ. E. Late: Contimious Casli,7g, 2, The lron and Steel Society of AIME. Warrendale, U.S.A., (1984), 29.

[10] Zhang S, Xia X. Optimal control of operation efficiency of belt conveyor systems. Appl Energy [Internet]. Elsevier Ltd; 2010;87(6):1929–37. Available from: http://dx.doi.org/10.1016/j.apenergy.2010.01.006

[11] Ho YC, Liu HC. The performance of load selection rules and pickup-dispatching rules for multiple-load AGVs. J Manuf Syst [Internet]. Elsevier Ltd;2009;28(1):1–10. Available from: http://dx.doi.org/10.1016/j.jmsy.2009.06.001

[12] H Schrewe. H. Nilsson and H. Jacobi: Proc, of Continuous Casting Conference. Vol. II. MannesmannAG. Dtisseldorf. Germany,(1986), 147.

[13] A. Spivakovshy and V.Dyachkov, "Conveyors and related Equipment", Chapter-IV, VII & XI, Peach Publishers, MOSCOW

[14] Wong, M. M., C. H. Tan, J. B. Zhang, L. Q. Zhuang, Y. Z. Zhao and M. Luo,. 2006;On-line reconfiguration to enhance the routing flexibility of complex automated material handling operations, Robotics and Computer-Integrated Manufacturing, March 2006.

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