International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Material Handling Trolley

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ABSTRACT - *This paper describes the "Design and Fabrication of Material Handling Trolley". We need to reduce manual efforts of workers for material handling effortlessly. The main purpose of material handling trolley is to ensure that the right amount of material is carefully delivered to the desired destination at the right time and at minimum cost. The main objective was to build a electric vehicle of capable of transporting weight of a material up to 150 kg and capable of travelling to some distance with varying speed. In present work, the focus is given on the time period, comfort, advancement, low cost, and mainly manual work is aimed to be reduced as much as possible. This paper also take into consideration the material used with minimum possible cost.*

Key Words: Trolley, handling cost, Electric Vehicle, manual handling.

1. INTRODUCTION

Fig-1 Raw material 25kg bag

A material handling system can be defined as movement, handling, storage and controlling of materials throughout the manufacturing process. The main purpose of using a material handling system is to ensure that the material in the right amount is carefully delivered to the desired destination at the right time at minimum cost. Material handling such as is not a production process and hence does not add to the value of the product but it costs 30-75% of the total product cost. An efficiently designed material handling system ensures the reduction in operation cost, manufacturing cycle time, MH cost, delay and damage. It promotes productivity, flexibility, better utilization of manpower, increases material flow in handling. The constraints and challenges in designing material handling system, solutions are identified and discussed.

1.1 Industry layout

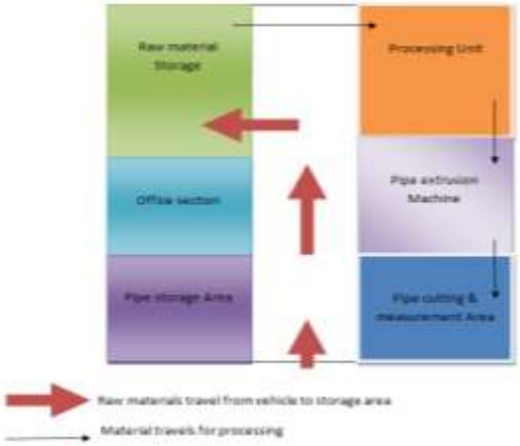

Fig-2 Industry Layout

1.2 Present practice

Annual requirement of raw material industry per year = 500 tonne
Wt of bag=25kg
No. of labours = 5
Total wages = 500* 100 = 50000 Rs.
Total time required for 500 tonne = 291.60 hrs

2. LITERATURE REVIEW

From the paper of Mr. Amol Kharge we studied the different applications of conveyor in industrial workplace and the necessary information regarding with the conveyor. This data provides useful information regarding to design of trolley dimensions, moving length of trolley carrying load, according to layout of the industry and also helps to reducing the complexity in the workplace. So the area should be available for the other work purpose. The problem regarding with physical pain of the workers at the time of loading and unloading due to less height of conveyor at ground. [1]

Mr. Sandeep Jadhav describes the design and fabrication of material handling transporter in this paper. In this paper the design of transporter which can 150 kg load is done.

From this paper we get the information of torque calculations, cost analysis etc. [2]

After selection of electrical trolley for the purpose of material handling the first step is to find out schematic layout of the trolley in order to move forward in the detailed design work of actual model. By using this paper we are able to get the following points:

1. Needed area for the placing the electric equipments such as electric motors.
2. Speed reducer required to reduce speed at time of loading and unloading condition.
3. Mechanical components for engagement of different components for transfer of torque from motor to wheel such as chain drive. [3]

The next step of design of our electric trolley is the designing each part of trolley separately. The selection of proper dimensions in order to keep design in safe criteria. we prefer the design data book, various catalogues and tables provided taken in to consideration of trolley dimensions, calculations and selection of motor for particular purpose. [4]

Khurami Gupta and Bhandari these reference books are also helpful for us while designing the various parameters of trolley. Design of trolley parts on which basis selection required?, which parameter should consider ?, what should be assumptions? These all questions are get clarified from these books. [5]

3. PARTS AND FABRICATION OF MATERIAL HANDLING TROLLEY

3.1 Power calculation & selection of electric motor

- Data : Distance= 45 feet= 13.716m

Expected time= 60sec
Velocity= 13.716/60=0.2286m/s
Bag's weight= 25kg Quantity of bags=5
Weight of trolley=50kg
GVW = 5 * 25 + 50 = 175kg = 1716.75 N

- Total tractive effort requirement for trolley

Total tractive effort = RR+FA+Fd
Where, RR= Force required to overcome rolling resistance
FA= Force required to accelerate to final velocity
Fd= Force required to drag
1 .Calculating rolling resistance (RR):
RR=GVW*Crr
Crr = coefficient of friction between rubber and concrete= 0.6 – 0.85
RR= 31716.75* 0.85 = 1459.23 N
. Calculating the drag force (FD):
A= 0.8*1= 0.8m^2
Fd= 1/2*(Cd*1.1613 *A*V^2)
=1/2*2.1*1.1613*0.8*0.2286^2
= 0.0509N
3. Calculating the acceleration force (FA):
FA= m * a
= 200*13.716/60^2
= 1.524N
Total tractive effort= RR+FA+Fd
= 1459.23+0.0509+1.524
= 1460.4N
Wheel motor torque = Tw= TTE*Rw*Rf
Rw= 0.1 m
Rf = Resistance factor= 1
Tw= 1460.4*0.1*1 = 146.04Nm
Now,
V= r*w
0.2286 = r* N*0.10472
0.2286= 0.1*N*0.10472
N = 21.82 rpm

- Power Calculations

P = (2*π*N*T)/60
= (2*π*21.82*146.04)/60
= 333.79W
Choosing 0.5 hp (373 w) electric motor.

❖ Motor
Type – 3 Phase AC Motor
Output speed = 20 rpm
Ratio = 50
❖ Reducer
Type- bevel gear
High Torque
High efficiency
Reversible
1000 : 1

Fig-3. 0.5HP AC motor used in trolley

3.2 Base frame

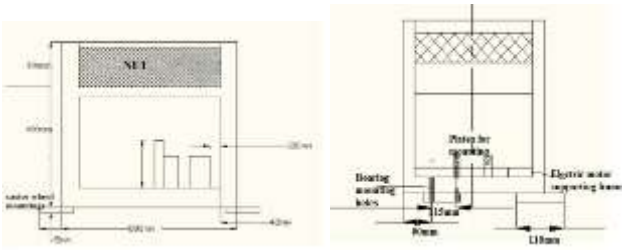

Fig-4 Frame

Base frame is the main buildings block. It carries all the weight of the crane hand and load which is lifted by the device. The frame is like the Truss structure.

3.3 Chain drive unit

N1 = 20 rpm
N2 = 22 rpm
Speed ratio (i) = 0.90
Z1 = 25
Z2 = 25*i=25*0.90=22.5
22 Selected
a = 36 cm=360mm
a = (30 to 50) P
P = 360/30 & P = 360/50
P = 12mm & P = 7.2mm
Select max. Pitch (P)= 12 mm
Calculate no of chains in terms of no of links
lp=2ap+[(Z1+Z2)]/2+[(Z2 -Z1)^2/2*3.14]/ap
= 2*30+(25+22)/2+ [(25-22)^2/2*3.14]/30
= 83.50
Actual length of chain= 83.50*12
= 1002mm
Exact center distance
a =[e+√(e^2- 8m)]/4*p
e= lp-(Z1+Z2/2)=84- (20 + 22)/2=63
m= [(Z2-Z1)/2*3.14]^2
= [(22-20)/2*3.14]^2
= 0.1013
a = {[63+√(63^2-880.1013)]/4}*15.875
= 377.98mm

❖ PCD Of Sprocket

Diameter of large sprocket
d1 = p/Sin (180/25)
= 12/Sin (180/25)
= 95.74mm
Diameter of large sprocket
d2 = p /Sin(180/22)
= 12/ Sin(180/22)
= 84.32mm
Length of chain = 100.5 cm
Center distance = 36 cm
Inclination = 45 degree

3.4 Assembling

Finally the whole body structure which consist of base frame, , AC motor, chain drive unit, wheels , net are assembled together.

Fig-5. Assembly of trolley

Fig-6 Actual Views of trolley operated by electric motor

4. RESULTS

- Calculations For 1000 kg
- Present Practice
- No. of labour = 5
- Labour for loading purpose
- Labour for transportation purpose
- Wage / Labour = 100Rs ……. For 1 tonne
- No. of bags = 1000/ 25= 40bags …… weight of one bag is 25kg
- Total time required for 1 tonne = 35 to 40 min
- Total wages of labour = 500 Rs
- Electric motor operated trolley
- Transportation time of trolley = 2 min
- Loading and unloading time = 3 min
- Capacity = 10 bags
- No. of trolley travel trip = 4

Total time required = 20 min

- Energy calculation of motor
- 0.5 hp motor is used
- 1 hp = 746 watt
- 0.5 hp = 373 watt
- Time = 30 / 60 = 0.5 hrs
- O.5* 373 = 186.5 W. hrs = 0.186 k W. hr = 0.186 unit
- For 3 phase = 3*0.186 =0.558unit
- Assuming cost for 1 Unit = 7 Rs.

Then, total cost = 3.906 Rs.

- Calculation for 500 tonne
- Present practice
- Annual requirement of industry per year = 500 tonne
- No. of labours = 5
- Total wages = 500* 100 = 50000 Rs.
- Total time required for 500 tonne = 291.60 hrs
- By electric motor operated trolley
- Total time required = 500* 30 min = 15000min = 250 hrs
- Total unit required = (250* 373) / 1000 = 93.26 kw.hr

Cost = 652.75 Rs.

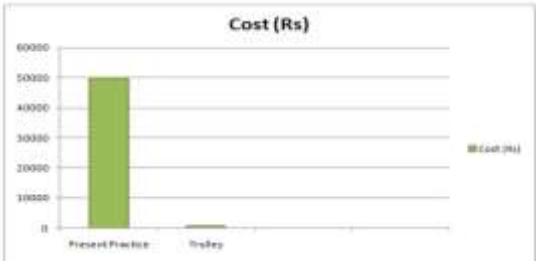

Chart -1: Cost Vs Method

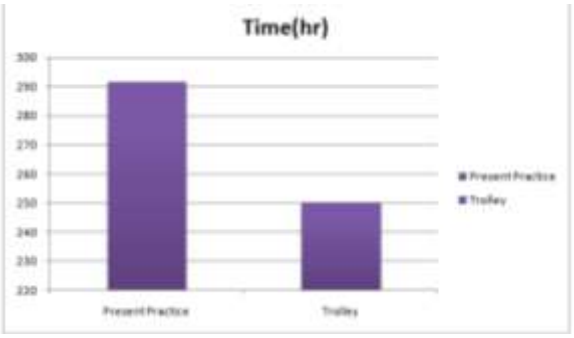

Chart -2: Time Vs Method

5. CONCLUSION

The aim of our project is to reduce the cost of manual material handling by use of trolley which is power by electrical motor and capable of handling 150-175kg weight.

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