Design of Compact Material Handling System inside the container

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Abstract — Conveyor equipment selection is a complex, and sometimes, difficult task since there are literally hundreds of equipment types and manufacturers to choose from. The expert system approach to conveyor selection provides advantages of unbiased decision making, greater availability, increase automation, faster response, and reduced cost as compared to human experts. Conveyor types are selected on the basis of a material handling system by the characteristics of the conveyor. This paper has the system in which conveyor is compact, material has to be drop at the minimum time, system has to be designed such that it will work in any conditions and center distance is less. This paper discusses the work done by the different researchers for the development of conveyor system for industrial purpose.

Key words: Conveyor selection, Design parameter.

INTRODUCTION

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. But there are very few numbers of researches on light material transportation. Belt conveyors are used as the principal components of some complex machines such as wheel excavator, conveyor bridges and much other type of hoisting and conveying machines. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Due to continuous flow, belt conveyor ensure steady and sufficient supply of material at the end of truck. Many kinds of conveying systems are available, and are used according to the various needs of different industries. Few numbers of conveyors are design for short center distance. In this paper conveyor is design for storage handling inside the truck.

In the industry, there is need that objects have to be removed from the truck at specific speed and make it palletization at the end. At that place also the conveyor system has to be needed. There is racks arrangement inside the truck. On which objects are placed which is to be conveyed at back side of the truck. A belt conveyor is a typical energy conversion system from electrical energy to mechanical energy. Its energy efficiency can generally be improved at four levels: performance operation, equipment and technology. However, the majority of the technical literature concerning the energy efficiency of belt conveyors focuses on the operational level and the equipment level. In practice, the improvement of equipment efficiency of belt conveyors is achieved mainly by introducing highly efficient equipment. The idler, belt and drive system are the main targets. There are objects placed in the rack in two sets. By help of griping mechanism the objects are going to be picking and placed on the conveyor. For that grippers are used. Which are going to pick objects and going to place it on the conveyor. After that motor will be start working and objects are taken at the end of truck. Components of conveyor system are:

1. Conveyor belt
2. Head pulley
3. Tail pulley
4. Snub pulley
5. Idlers
6. Belt take-up devices
7. Feeder unit
8. Discharge unit
9. Drive unit
10. Belt cleaner

Components of conveyor belt are:-

Car case:- Most belt carcasses are produced from fabrics that use polyester or nylon fibers, or a combination of the two. This fabric is completely resistant to the deteriorating effects of moisture, and resistant to most of the chemicals. The inherent strength of the fabrics give exceptional resistance to cutting and snagging by abrasive or gritty materials, and retain their strength indefinitely.

Rubber:- The rubber used in conveyor belting, whether natural or synthetic, is compounded to protect carcase from the material being conveyed and from any external conditions which could shorten the belt's useful life.

Conveyor systems are used widespread across a range of industries due to the numerous benefits they provide.

Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive. They can be installed almost anywhere, and are such safer than using a forklift or other machine to move materials.

They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.

There are a variety of options available for running conveying systems, including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs.

As the Center distance between drive and tail pulley is less, hence flat belt pulley is chosen and also the weight of object acting on the belt is low.

II. Design Parameter

Below are the design parameter for the conveyor system design which is going to be placed on the side of the truck. As the width of truck is short and maximum amount of object as to be stored in the rack system. Hence very less amount of space is given to the conveyor system. Also object has to be placed in the rack, hence the height given to the conveyor drive pulley and tail pulley diameter got

shorten. Belt conveyor can transfer the material at extremely high rate. Hence capacity of conveyor is much higher than the other conveyor. Belt conveyors are used where the manual loading and unloading is not possible.

Hence while on the travelling condition, belt conveyors are best to use. In the flat belt conveyor, when there is need of change in direction of martial is needed at that place snub pulley is used. As the material is needed to transfer at the back side of the truck. There is no need of snub pulley.

1. Center to center distance between head and tail pulley :- 5.2 meter
2. Width of conveyor belt :-0.18 meter
3. Strength of belt:-
   PN315/2 P stand for
   Polyester
   N stand for Nylon
   Ultimate full belt tensile strength:- 315 kN/m 2 plies of polyester and nylon.
4. Speed of belt:-
5. Diameter of pulley:-
6. Mass of material:- 11 kg
7. Density of material:- 861.57 kg/m^3
8. Dimensions of material:- 1.2*0.115*0.091 meter
9. Power:-

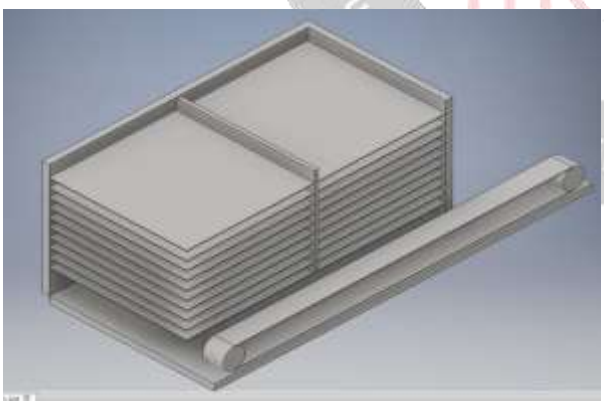

Fig No.1:- Belt conveyor inside the truck and rack arrangement.

In the above figure, conveyor belt is shown on the right side of truck. By help of gripping mechanism objects stored in the tray are pull down and placed on the conveyor and after that objects are taken at the end of truck.

III. CALCULATION

1) Capacity of belt conveyor

B= width of belt
c = surcharge factor
q = mass per unit length
=4.4307kg/m
b = width of material storage on belt

= (0.9*B-0.05),
meter b = 0.115 meter

0.115= (0.9*B-0.05)
Therefore
B=0.183 meter
v = speed of belt, meter/sec
= 0.9 meter/sec
Volume of material = 0.01558 m^3
Mass of material = 11 kg
Density of material = 875.94 kg/m^3
Volume flow rate, Q = c*b^2*v, m^3/s
Q = 7.933*10^{-4}, m^3/s
Capacity, C = density*Q
C = 0.695,
kg/s

= 2.5 ton/hr
Diameter of pulley = 0.15 meter

2) Belt power and tension Power required of belt conveyor

= {F_c*(L+ t_f)*(C+3.6*q*v)}/367,
Kw Or

= {F_e(L+ t_f)*3.6*q*v}/367+{F_l*(L+ t_f)*C}/367

F_e, F_l, F_c :- Equipment friction factor F_c = 0.0225, For horizontal
F_e, = 0.02, Empty Calculation
F_l = 0.025, loaded calculation
t_f = terminal friction constant
= 60 meter

Power =
{F_c*(L+t_f)*(C+3.6*q*v)}/367
= 64.785 W
Or

={F_e(L+t_f)*3.6*q*v}/367+{F_l*(L+t_f)*C}/367 = 59.808 W
Power = T_e*Speed of belt
T_e = effective tension
T_e = 71.983 N/m
Angle of contact: (between pulley and belt).
Angle =180^o
Coefficient of friction =0.20

Drive factor for the conveyor is find out by taking the value of friction coefficient and angle of contact.

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As per given friction coefficient and angle of contact, drive factor for the conveyor system in find out. Drive factor K=1.14

Slack side tension $T_2=T_e*K$
=82.06,
N/m
T_1/T_2= exp (0.2*3.141)
T_1 = exp (0.2*3.141)*T2
T_1 = 153.45, N/m

T_1 and T_2 are calculated by taking different parameter such as live load, dead load, belt pull etc.
Speed of Pulley:- N =(60*V)/(3.141*D)
N = 114.6 rpm
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III. CONCLUSION

Now a day, we are coming in contact with conveyors in all walks of life, specifically conveyors are making movement of raw material, heavy goods, assembly of ready products, truck loading etc. easy. The major components and its parameter like belt tension, power, and diameter of pulley were designed successfully by using standard practice such as CEMA standard, Fenner Dunlop Handbook. We are customizing the use of conveyor system according to our convenience, so we can say that this is the right time to avail this opportunity to benefit your business. Now, realize your business has one of the efficient resources you could take a good benefit of is found with investment into a conveyor system. These resources will enable you to expand business efficiently and also provide your associates with the greatest resources. Power = 64.785 W

Tight side tension = 153.45 N/m
Slack side tension = 82.06N/m
RPM = 114.6 rpm

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