NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 2, ISSUE 5, MAY-2015

DESIGN OF CANE CARRIER ROLLER CONVEYOR CHAIN OF 150MM PITCH AND TESTING UNDER UTM

Dattatraya Lawate
PG Student,
Mechanical Engineering Department,
SVERI's COE Pandharpur, Solapur University, Maharashtra, India

Bhaskar D.Gaikwad
Associate professor,
Mechanical Engineering Department, SVERI's COE Pandharpur,
Solapur University, Maharashtra, India

ABSTRACT

Chain is the most important element of the industrial processes required for transmitting power and conveying of materials. Roller conveyor chain performs efficient and economical in wide range of applications in manufacturing and agricultural industries. Chains are machine elements that are subjected to extreme service conditions, such as high tensile loads, compressive loads, friction, and sometimes aggressive operating environment. The present work focuses on the design calculations of cane carrier roller conveyor chain for calculating breaking load . Finally, experimentation is carried out on Computerized Universal testing Machine (UTM).

KEYWORDS- cane carrier roller conveyor chain, tensile loads breaking load

INTRODUCTION

Chains are used in a variety of applications in engineering practice. In general, there are three basic types of system; hoisting and securing chains, conveying and elevating chains and power transmission chains. Conveyor chains are used when material are to be moved frequently between specific points. Depending on the materials to be handled and the move to be performed, a variety of conveyors can be used. Conveyors can be categorized on the basis of the type of product being handled (bulk or unit) and the locations of the conveyor (overhead or floor). Bulk materials such as grain, dry chemicals, ores, minerals, coal saw dust can be conveyed using a chute, belt, and bucket or vibrating conveyors.

Based on its history and development, chain is a mechanical belt running over sprockets that can be used to transmit power or convey materials. Most of the time chain is under tension which causes elastic and plastic stresses which results into elongation of chain. Chain is the most important element of the industrial processes required for transmitting power and conveying of materials. As these chains operate under various forces, failure of chain assembly is the major problem. Causes of these failures are improper material selection, uncertainties in manufacturing,

faulty manufacturing processes. It is important to study the influence of these parameters on the strength of the chain which governs the failure modes of the chain.

BASIC STRUCTURE OF ROLLER CONVEYOR CHAIN

Figure shows the basic structure and components of roller conveyor chain and the different types of fits assembled under working conditions. All roller chains conveyors are constructed so that the rollers are evenly spaced throughout the chain. Several types of roller chains are used in conveyors, many of single-pitch or double-pitch conveyors chain.

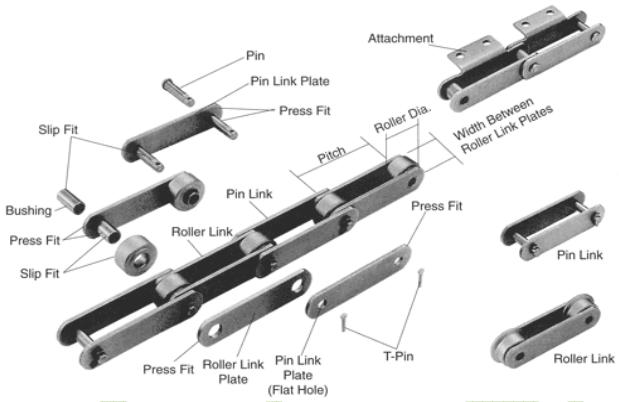

Fig. 1 Basic structure of roller conveyor chain

Parts of chain	Function	Criteria
Plate	Bears the tension placed on the chain	- must have great static tensile strength - must hold up to the dynamic forces of load and shock - must meet environmental resistance requirements
Pin	To shearing and bending forces transmitted by the plate	- needs high tensile and shear strength - resistance to bending - sufficient endurance against shock and wear
Bushing	To shearing and bending stresses transmitted by the plate and roller, and also gets shock loads when the chain engages the sprocket	- must have great tensile strength against shearing - resistant to dynamic shock and wear
Roller	To impact load as it strikes the sprocket teeth during the chain engagement with the sprocket	- resistant to wear - have strength against shock, fatigue, and compression
Split pin	Prevent the outer plate from falling off the pin at the point of connection	- may wear out during high-speed operation, therefore, for this application, these parts require heat treatment

DESIGN OF REQUIRED BREAKING LOAD AS PER CONVEYING CAPACITY OF ROLLER CONVEYOR CHAIN

A. **Weight Calculation of Present Chain:** Procedure for weight calculation of each part of chain:

- **a.** Calculate surface area(A) of each part
- **b.** Calculate volume(V) Volume= surface area × thickness = A × t
- **c.** Weight(W) Weight= volume × density =V × ρ
- **d.** Formulae used:
  - Area of sector= $\pi r^2 \Theta \div 360$
  - Area of triangle = (b × h) ÷ 2
  - Area of circle = πr^2
  - Volume of cylinder = $\pi r^2 l$
- **e.** Density for each material(ρ) ,ρ = 7850 kg/m^3

Sr. No.	Name of part	Number of parts present in one feet chain(N)	Weight of in one feet chain(N×W) (kg)
1.	Strip 1	2	1.867 ×2=3.734
2.	Strip 2	2	1.667 ×2 = 3.334
3.	Roller	2	1.013×2=2.026
4.	Pin	2	0.376×2=0.752
5.	Bush	2	0.29 ×2= 0.58

Total weight of present chain of one feet = 10.426 kg

B. Design of required breaking load as per conveying capacity of roller conveyor chain

For the survey of sugar industry I have visited Shree Sant. Damaji Sahakari Sakhar Kharkhana Ltd. Mangalwedha. The conveyor capacity is 40tonne/hour and speed of material conveyed 10m/min, from this data the breaking load is calculated by using below formulae.

Conveyor capacity W_c

$$W_c = 60 \times W \times S$$

W_c − Conveyor capacity in lb/hr

W − Amount of material carried in lb/ft

S − Conveyor speed ft/min

Chain pull - P

$$P = C \times f_m \times (2.1 \times M + W)$$

P −Preliminary chains pull in lb

C – Length of the conveyor in ft

f_m –Co-efficient of friction for chain

M – Weight of the chain, attachments and carriers in lb/ft

W- Amount of material carried in lb/ft

Breaking load

$$\text{Breaking Load} = \frac{P \times 8}{2}$$

Given

W_c – Conveyor capacity in lb/hr

W_c =40tn/hr

=88184lb/hr

S – Conveyor speed ft/min

S =10m/min

=33.3ft/min

C – Length of the conveyor in ft i.e. Conveyor total span

Length of conveyor C = 1080ft

Conveyor capacity W_c =

$$W_c = 60 \times W \times S$$

$$88184 = 60 \times W \times 33.3$$

$$W = \frac{88184}{60 \times 33.3}$$

$$W_c = 73.61 \text{ lb/ft}$$

W = 73.61 lb/ft is the Amount of material carried

Chain pull P

$$P = C \times f_m \times (2.1 \times M + W)$$

One link plate of 150mm pitch = 0.5ft

Therefore to cover span i.e. 1080ft

$$\text{Required no. of links} = \frac{1080}{0.5}$$

$$\text{Required no. of links} = 2160\text{links}$$

$$\text{Therefore no of links/ft} = \frac{2160}{11080}$$

$$= 2 \text{ links/ft of chain}$$

$$\text{Weight of links/ft} = 10.426\text{kg/ft}$$

For three strands conveyor $= 3 \times 10.426 = 31.278\text{kg/ft}$

$$\text{Weight of the chain, attachments} = \text{kg/ft}$$

Therefore Weight of the chain, attachments and carriers in lb/ft $= 36.27 \times 2$

$= 72.54$ lb/ft

$$P = C \times f_m \times (2.1 \times M + W)$$

$$P = 1080 \times 0.1 \times (2.1 \times 72.54 + 73.61)$$

$$P = 21218.11\text{lb}$$

$$P = 9627.09\text{Kg}$$

$$P = 94441.78\text{N}$$

$$P = 9.44\text{TN}$$

Breaking load

$$\text{Breaking load} = \frac{P \times 8}{2}$$

$$\text{Breaking load} = \frac{94441.78 \times 8}{2}$$

$$\text{Breaking load} = 377767.112\text{N}$$

$$\text{Breaking load} = 37.77\text{TN} \approx 40\text{TN}$$

By using the survey data I have been found the breaking load of 40TN. This breaking load has been calculated at the joint of conveyor in this joint there is need to find out minimum cross-sectional area for inner link plate and diameter of pin subjected to shear and bending stresses.

C. Power required to drive the conveyor would be:

K = Chain pull x Chain speed = (Px N)/1000 kW

= 94441.78 x0.1667= 15740.61 N-m/s= 15740.61W

= 15.74 kW

EXPERIMENTAL WORK

Universal Testing Machine (UTM) test widely used to determine strength, ductility, resistance, toughness and several other material properties. The component is held by suitable means between testing machine and subjected to a progressively increasing tensile load till it fractures. A record of load acting on the component obtained. The test carried out on the fixed length called gauge length. The typical set up for tensile testing of 1000KN capacity computerized UTM machine is as shown below.

Fig.2 testing of specimen under computerized UTM

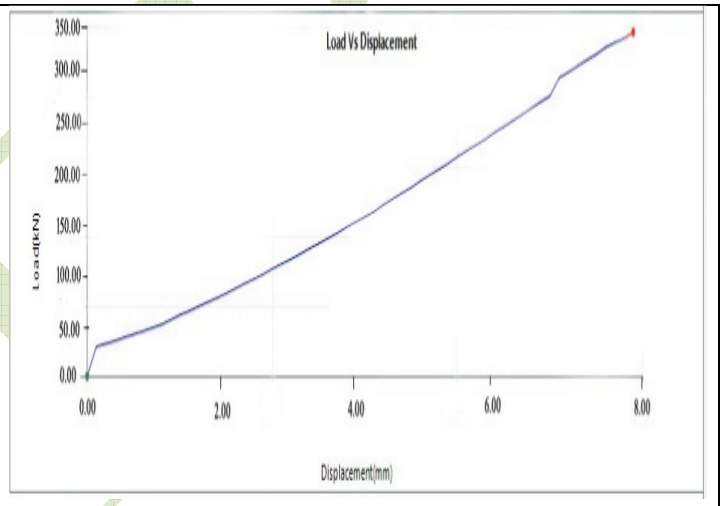

Fig. 3 graph showing load Vs displacement

CONCLUSION

We studied the analytical and experimental study of cane carrier roller conveyor chain of 150mm pitch. Selected specimen for study from sugar factory under tensile loading. We observed that specimen having breaking load 37,776 Kg theoretically and experimentally 35677Kg.This capacity of specimen is observed less than actual breaking load because of we carried experimentation on a specimen which was used at factory and was collected from scrap.

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