

Design Modification on a Chain Conveyor System in Sugar Factory

Tafes, Eshet Tesfaye

(BSc. In Electromechanical Engineering)

Assistant Researcher at Space Engineering Department.

Ethiopian Space Science and Technology Institute (ESSTI)

Email: eshettesfaye377@gmail.com/

eshett@essti.gov.et

ABSTRACT

This paper studies the economic effect of the conveyor system on the sugar industry sector and solutions in order to solve this critical problem at the sector and other process industry which uses different material handling equipment in the Ethiopia. Particularly it is done on the problem which has seen by the researcher at ‘wonji-shoa’ sugar factory; one of the pioneer sugar factories found in Ethiopia. The journal discusses about the problem which has been created there and also the cause of that problem. Which is the critical case that has been seen there. Following the problem, it is given for the literature review. By using different methodologies, the researcher wants to suggest his own recommendation on his perspective in order to be done a design modification on the system. And lastly, the researcher states his future work on the design problem of the chain conveyor which is found there in the factory.

Keywords: chain conveyor, roller bearing, TEFLON, WONJI-SHOA,

1. INTRODUCTION

Conveyors are durable and reliable components used in automated distribution and warehousing, as well as manufacturing and production facilities. They are considered as a labor-saving system that allows large volumes of materials to move rapidly through a process, and also allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense.[9]. A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. A Conveyors are mechanical apparatus for moving articles or bulk material from place to place (as by an endless moving belt or a chain of receptacles).[7] They are useful in applications like transporting of heavy or bulky materials. Many kinds of conveying systems are available and are used according to the various needs of different industries.[1]. Now a days they are quick and efficient transportation mechanisms for a wide variety of materials, which make them very popular in the material handling and packaging industries, food processing industries like: brewery industries, sugar industries and in many processing industries in the world.

Those conveyors which are used in those industries are varied depends on their particular missions. These conveyors may be a belt conveyor system that uses especially for transporting large materials that have no sharp edges. It also not used for hot products. Chain conveyors for sharp edges and hot products for short distance. Screw conveyors, chute conveyors, walking beam conveyors and so on with different orientations of horizontal, vertical, or inclined to move materials in different directions which powered by either different motors that have different capacity or work manually like baggage transport conveyors, especially at the airport. Most industrial conveyors usually consist of frames that support rollers, wheels, or belts.



Fig 1. Bagasse carrier Chain conveyor at sugar factory
(google image)

2. HISTORICAL OVERVIEW

The first conveyor was developed in the late 18th century it was a belts conveyor. It was about 1795 [8]. It was a leather belt which is running over wooden beds and were powered with hand cranks and a series of pullies. At that time the main use this conveyor was to transport goods of farmers

onto ships at port area. In 20th century during industrial revolution in Europe, the first steel belt conveyor was invented in Sweden in 1901 which was used to transport bulk materials such as gravel and charcoal. In 1905 in Ireland the first underground belt conveyor started its work in mining activities. The first patent for roller conveyors was awarded in 1908 allowing for smooth transport of goods by means of internal ball bearings.[8]. In 1913, Henry Ford introduced conveyor-belt assembly lines at Ford Motor Company's Highland Park, Michigan factory [9]. Which mainly used to reduce the time laps of the processed parts of the car. In 1972, the French society REI created a 13.8km straight-belt conveyor which is the longest conveyor in the world. Hyacynthe Marcel Bocchetti was the concept designer. [9]. In 1957, the B. F. Goodrich Company patented a Möbius strip conveyor belt, that it went on to produce as the "Turnover Conveyor Belt System". Incorporating a half-twist, it had the advantage over conventional belts of a longer life because it could expose all of its surface area to wear and tear. Such Möbius strip belts are no longer manufactured because untwisted modern belts can be made more durable by constructing them from several layers of different materials.[4] In 1970, Intralox, a Louisiana-based company, registered the first patent for all plastic, modular belting. [9]. According to Wikipedia of July 3,2019 edited report; The longest belt conveyor system in the world is in Western Sahara. Which was built in 1972 by Friedrich Krupp GmbH (now ThyssenKrupp) and about 98 km (61 mi) long, from the phosphate mines of Bu Craa to the coast south of El-Aaiun.

3. LITERATURE REVIEW

The researcher covers many research papers, journals, books videos that were written before. These research papers have their own missions. Some of these research papers are Conveyor project design by - Alibek Faiznur, Muhammad Almakhan Miras Mengdibayev:[1]. Material Handling Equipment by Michael G. Kay Fitts Dept. of Industrial and Systems Engineering; North Carolina State University. (January 12, 2012): states about general material handling and different types of material handling equipment with classification. It also deals with different conveyor systems and their characteristics in industry areas. DESIGN, ANALYSIS, AND OPTIMIZATION OF ROLLER CHAIN LINK FOR COAL TRANSPORTATION USING FEA [2]. The study deals with static structural analysis of the roller chain for a particular application, selection of the suitable material to enhance corrosion resistance, weight optimization by changing certain dimensions and experimental validation of the FEA results obtained. So, the objectives of the project are:

- i. Finding a problem on the industry conveyor system particularly at the milling section. And the serious cause of this problem.
- ii. Finding an optimized alternative solution for the problems.
- iii. Concluding for the project with a final and the last solution for this serious problem. And also,

the researcher suggests the future work of the research.

“Design Optimization of Roller Chain Link Plate used in Sugar Industry” [3]. Barge P.R.1, Gaikwad M.U.2The project was done on the design optimization of a roller chain link plate. Types of Conveyors - A Thomas Net Buying Guide [4]. These research journals have stated more about different conveyor systems types of conveyors use of conveyors and its working principles. And also, different lubrication systems and types of lubrication which different conveyors and material handling systems use in different industrial applications. After covering those research papers, the researcher tends to work the paper on the solutions for the problems for the first time which is not done yet.

4. STATEMENT OF THE PROBLEM

There are about thirteen sugar industries throughout the country, Ethiopia. These include the newly three sugar projects and the seven oldest industries which are producing sugar for domestic consumption and also for export standards in order to increase foreign currency for the county. Even if they are on the right condition for producing that much sugar, they are facing problems in the industry throughout their lives. Because of this, the factory is facing in a huge expense for frequent maintenance cost and also this influence on the production capacity of the factory. This is because of the different problems that are faced in the sugar industry. By the time of four-month internship in 2015 G.C. at one of huge and leading Ethiopian sugar factory called ‘WONJI SHOA sugar factory’, some problems have been seen which are created there frequently but the system is working with its problems without any measurement taken there. So, in order to make the factory economical, the problems which have seen there should be solved today. From those challenges, the research focused on the critical one which is found at the milling house section. It is a serious problem which tends the company for huge expenses in order to make a lubricant and continuous man supervision for the problem. It also has a noise which disturbs the people who work there. All these problems are because of the chain conveyor which is found between the mills.

By nature, chain conveyor has the advantage of high transmission efficiency for short distance transportation of materials over belt conveyors.[1]. Even though the conveyor is capable of heavy loads it is affected by the wear of materials due to frictions that are created by this load. So, in order to minimize the wear of materials in the industry, they are some mechanisms that are used there. From these ones is using lubrication through the entire contact surface of the conveyor. This is what the researcher focused on his research problem which is serious practice in wonji shoa sugar factory. The conveyor by itself is heavy and also carry heavy wet crushed or partially crushed cane and slides on the beam bed throughout its length which consumes a huge amount of lubricants in order to minimize the friction and noise. These and others are the reference the researcher to conduct this paper during his internship period at the industry.

5. SCOPE

Even though there are about ten sugar industries throughout the country the researcher focused his work on one of the pioneers which is called ‘WONJI SHOA’ sugar factory. The factory is found at Oromia Regional State near Adama/Nazareth City at 110 Kilometers from Addis Ababa. It is the oldest and the pioneer in the history of Ethiopia’s sugar industry which starts production since 1954. And newly expansion have been taken in July 2013. This modern sugar factory which is called ‘Wonji/Shoa’ Sugar Factory has currently had a capacity of crushing 6,250 tons of cane a day and producing over 174,000 tons of sugar per annum. So, the researcher focused his work on this factory because the problem has been seen there during his 4th year internship period in 2015 G.C.

6. CONCLUSION AND RECOMMENDATION

It is known that if some materials slide over each other there will be a great frictional force with a high level of heat in between; here heat causes high loss of energy. Though, during operation, all the length of the chain has an actual contact on the beam bed. And the operator has supervised actively and feed a lubricant in order to minimize the problem there, but the lubricant which used here is a special type of lubricant and should have a characteristic of its own heat resistance. However, this characteristic of the lubricant is essential, it consumes high cost and needs tentative supervision of manpower. Here in the factory, they used a special type of lubricant called ‘Teflon polymer’ Polytetrafluoroethylene (PTFE) solid lubricant which is expensive. But the problem here is that it easily rushed out by a high heat which is created by a dynamic movement of the conveyor with a huge load. By seeing the problem, the researcher recommended that in order to minimize the huge economic expense, manpower supervision and other serious problems that are found in the company for its operation there should be taken a design modification. This design modification which recommended by the researcher is substituting roller bearing instead of the lubrication system for one and last which is easy to design and highly reduces the cost of lubrication for the conveyor. It also easily maintainable, takes less space and installed with small contact area throughout the length of the chain, and once it installed it performs its operation for a long time without wear and tear of materials. Also, by using roller bearing there will be a reduction of a huge amount of Teflon polymer lubricant cost; or can use other lubricants that have less cost with low heat resistance because in the rolling body there will be a less frictional force at the same time the heat created during operation decreases. Since it takes less space, the loss of energy by the friction of the contact area becomes very less, and it reduces the frequent supervision of manpower for lubrication in the area.

6.1. Further work

The researcher attempts to design an appropriate specification of a roller bearing for the industry in order to overcome the huge amount of expenses in the factory.



Fig.2. chain conveyor at the sugar industry

7. REFERENCE

1. Material Handling Equipment Michael G. Kay Fitts Dept. of Industrial and Systems Engineering North Carolina State University January 12, 2012.
2. DESIGN, ANALYSIS, AND OPTIMIZATION OF ROLLER CHAIN LINK FOR COAL TRANSPORTATION USING FEA Prashant S. Mulmule¹, Prof. T. Y. Badgajar² and Prof. A. D. More³ ¹Department of Mechanical Engineering, Late. G. N. Sapkal College of Engineering, ²Department of Mechanical Engineering, Late. G. N. Sapkal College of Engineering, ³Department of Mechanical Engineering, Sandip Polytechnic
3. Material Handling Equipment by Michael G. Kay Fitts Dept. of Industrial and Systems Engineering; North Carolina State University. (January 12, 2012):
4. Types of Conveyors - A ThomasNet Buying Guide
5. http://www.substech.com/DokuWiki/doku.php?id=polytetrafluoroethylene_ptfe_as_solid_lubricant
6. http://www.substech.com/dokuwiki/doku.php?id=polytetrafluoroethylene_ptfe_as_solid_lubricant
7. <https://www.merriam-webster.com/dictionary/conveyor>
8. <https://www.phcfirst.com/words-in-motion/2014/6/30/the-history-of-conveyors>
9. https://en.wikipedia.org/wiki/Conveyor_belt From Wikipedia, the free encyclopedia