FAILURE ANALYSIS ON CONVEYOR DRIVE GEARBOX

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ABSRACT

Our project titled as "FAILURE ANALYSIS ON CONVEYOR DRIVE GEARBOX". In this topic we discuss about the failure of gearbox. Gearbox is a device and it is a heart of conveyor system. It is used to transmit the coal by using conveyor belt system. This Gearbox has the capacity of 1250 KW has runned by the motor. Gearbox is used to run the conveyor belt system by using shaft. Gearbox is majorly failed due to the envinonmental conditions and pollutions. Surroundings of gearbox pollution must occur We never neglect them. So the gearbox should need an proper maintenance. If the gearbox not maintained properly, it cause the failure on component of gearbox. If any component of gearbox is damaged, it will affect the whole gearbox system. By cost wise it was big lose. So we need to protect the gearbox by proper maintenance.

KEYWORDS

Frosting, pitting, spalling, stress, gears, bearings.

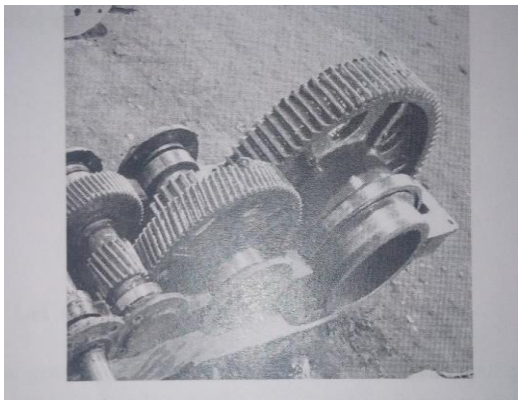
INTRODUCTION

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt coneyor system is one of many types of conveyor system. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium-the conveyor belt that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. Belt conveyor is a commonly used equipment of continuous transport and it has a high efficiency and large conveying capacity, simpler construction, small amount of maintainance. It is widely used in coal handling system in thermal power plant and other products. Belt conveyor will often occur some typical problems in the course,

A gearbox is a transmission device which is used between engines output shaft and the final drive inorder to transfer required torque and power to the wheels of the vehicle, a gearbox consists of the set of gears. The basic principle of operation of a gearbox is that speed of rotation of two mating gears depends on their size. The larger gear always have a smaller rpm and the smaller gears always have a larger rpm. The gearbox is the second stage in transmission system, after the clutch.it is usually bolted to the rear of the engine, with the clutch between them. Modern cars with manual transmission have four or five forward speeds and one reverse, as well as a neutral position. The main parts of gearbox are driving gear, lay shaft, main shaft.

A gear is a kind of machine element in

which teeth are cut around cylindrical or cone shaped surfaces with equal spacing. By meshing a pair of these elements, they are used to transmit rotations and forces from the driving shaft to the driven shaft. Gesars can be classified by shape as involute, cycloidal and trochoidal gears. Also, they can be classified by shaft positions as parallel shaft gears, intersecting shaft gears, and non-parallel and non-intersecting shaft gears. the history of gears is old and the use of gears already in ancient Greece in B.C in the writing of Archimedes.



Types of gears

These are many types of gears such as spur gears, helical gears, bevel gears, worm gears, gear rack, screw gears, mitre gears, etc. These can be broadly classified by looking at the positions of axes such as parallel shafts, intersecting shafts and non-intersecting shafts.

COMMON FAILURES IN CONVEYOR DRIVE GEARBOX

FAILURE ON BEARING

Bearing can easy damage due to dust particles gets deposited inside the gearbox. When the dust particle settle inside the gearbox if affect the bearing. If the Bearing can fails the gearbox has been stopped. According to a recent study, up to 80 percent of bearing failures are caused by improper lubrication. This includes insufficient lubrication, use of improper lubricants or excessive temperatures that degrade the lubricant.

A] Lubrication Failure

According to a recent study, up to 80 percent of bearing failures are caused by improper lubrication. This includes insufficient lubrication, use of improper lubricants or excessive temperatures that degrade the lubricant.

Identify faults:

Look for discolored rolling elements (such as blue or brown) and rolling-element tracks as well as overheating or excessive wear in the bearing.

Prevention:

Use the appropriate type and correct amount of lubricant, avoid grease loss, and follow appropriate re-lubrication intervals.

B] Contamination

Contamination is caused by foreign substances getting into bearing lubricants or cleaning solutions. These include dirt, abrasive grit, dust, steel chips from contaminated work areas and dirty hands or tools.

Identify faults:

Watch for denting of rolling elements and raceways that cause vibration.

Prevention:

Filter the lubricant and clean work areas, tools, fixtures and hands to reduce the risk of contamination.

C] Improper Mounting

In most instances, bearings should be mounted with a press fit on the rotating ring.

Identify faults:

A number of conditions can cause denting, wear, cracked rings, high operating temperatures, early fatigue and premature failure of bearings. These include mounting bearings on shafts by applying pressure or blows to the outer race, mounting bearings into a housing by pressing on the inner ring, loose shaft fits, loose housing fits, excessively tight fits, out-of-round housings and a poor finish on the bearing seat.

Prevention:

Follow proper mounting instructions and provide training to ensure all employees understand the difference between a properly and improperly installed mounting.

D] Misalignment

Bent shafts, out-of-square shaft shoulders, out-of-

square spacers, out-of-square clamping nuts and improper installation due to loose fits can cause misalignment, which may result in overheating and separator failure.

Identify faults:

A wear path that is not parallel to the raceway edges of the non-rotating ring should be noted.

Prevention:

Inspect shafts and housings for runout of shoulders and bearing seats, and use precision-grade locknuts.

FAILURES ON GEARS

1. Excessive wear:

Excessive wear results from moderate damage that is never addressed and causes periodic problems. This wear results in putting in the surfaces of the gear. Putting cause vibration within the gearbox, which Increase noise and damage to the gear. Eventually, this issue could results in total equipment failure.

2. Frosting :

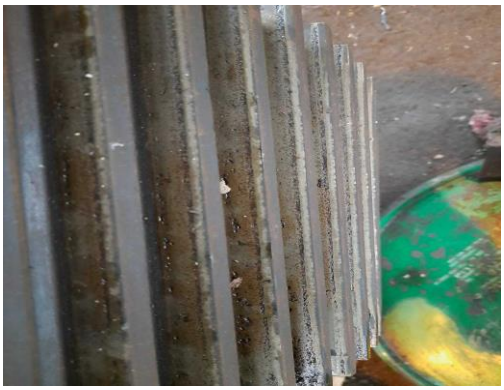
This issue usually shown up in the dedendum area of the driving gear. The wear pattern gives the frosted appearance, which are many micro pits on the surface. Frosting is common issue when the heat breaks down the lubrication film.

3. Spalling :

Spalling is the term used to describe a large or massive area where surface material has broken away from the tooth. With surface hardened gear teeth, surface or subsurface defects or excessive internal stresses from improper heat treatment alscan cause spalling.

4. Pitting and breaking :

Pitting is the surface fatigue failure of the gear tooth. It occur due to repeated loading of tooth surface and the contact stress exceeding the surface fatigue strength of the material. Material in the fatigue region gets removed and a pit is formed.



In this project the failures on conveyor drive gearbox are analysed

5. Lubrication failure

Viscosity:

Viscosity is another area that affects equipment life. Improper or changing viscosity can reduces the life of components by 30 percent. In hydraulic systems, viscosity cannot only shorten the component life but reduces the operational functions of the process.

Viscosity Failures:

Temperature Lube procedures Mixing, storage / receiving Oxidation • Contamination • Moisture / chemicals No / lack of additives.

6. Temperature:

Temperature of the lubricant determines the lubricant life. So, how do we control temperature in our process Temperature Failure Modes Overloading Over-greasing • Location (no air movement) High viscosity Poor lube circulation Improper cooling No lube cooling Multi-speed / load components (high-speed input, low-speed outlet) Thermal conditions Sunlight Ambient atmosphere.

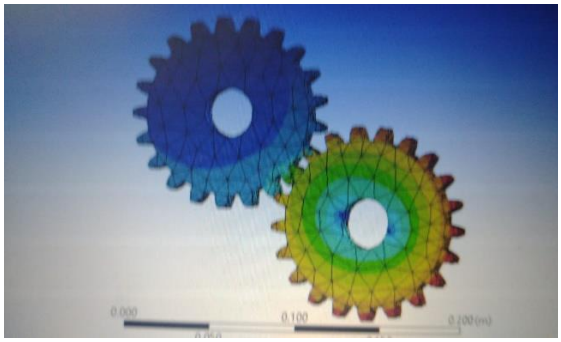
FAILURE ANALYSIS OF GEAR USING SOFTWARE

PROCEDURE

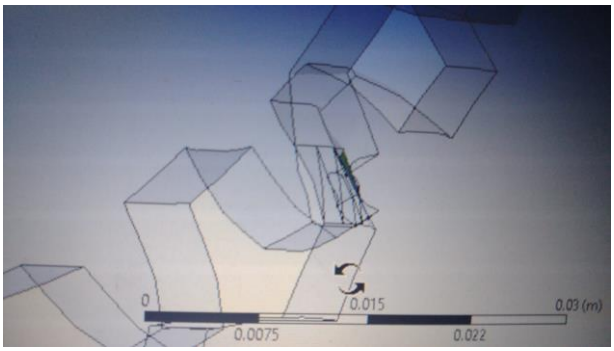
The conveyor drive gear boxes are very huge and having higher load carrying capacity. The gear should posses higher torque and speed to transfer the load from one place to another. During the transferring of such load the gear may cause some above failures.

The load carrying capacity of the broken gears are very less when compared to normal gears. The difference between the two gears can be analytically found out by using the software such as AUTOCAD, ANSYS.

The normal stress distribution of an unbroken gears are



The above analysis shows the stress variation in between the two meshing gears. If the gear is wealthier the high stress will be occurs on the teeth. The red colour denotes the higher stress, then the yellow colour of the gear will show the amount of stress occurs in the next stage. The stress occurs in this stage will be comparatively lesser than the previous stage. The amount of load over the gear surface goes on decreasing and finally blue colour having very less amount of stress carrying. But for the broken gears, the stress distribution will not be uniform, it will cause major failures on the gears.



The above analysis describes the breakage occurs in the gear tooth so the distribution of the stress over the surface is ununiform, which causes the major failures on the gears.

SPEED AMD TORQUE CALCULATION

SPEED REDUCTION CALCULATION

Motor speed input = 980rpm

Reduction ratio = 1375:1

Spiral bevel pinion & wheel

No. of teeth in pinion Z1 = 28, module = 3

No. of teeth in wheel Z2= 28, module = 3

N2/N1=Z1/Z2 So, N2= 980 rpm.

Speed reduction formula for planetary gear = (Zr /Zs)+1

STAGE 1:

N3=980rpm P=4KW

i=(152/19)+1

i=9 N=(980/9)

N4=106.67rpm

STAGE 2:

N5= 106.67 rpm

i=(125/22)+1

i=6.681 N6=106.67/6.681

N6=15.96 rpm

STAGE 3:

N7 = 15.96 rpm

i = (Zr /Zs) + 1

=(65/26)+1=3.5

N8= 15.966/3.5

N8 = 4.5617rpm.

STAGE 4:

N9= 4.56I rpm

i=(56/16)+1 = 6.401

N10 = 4.5617/6.401

N10 = 0.724 rpm.

Output pinion speed of slewing gear box = 0.724 rpm.

TORQUE CALCULATION

STAGE 1:

N=106.667 rpm P= 4KW

P=2πNT/60

T=4000x60/2xπx106.6

T= 358.087 N-m.

STAGE 2:

N= 15.966 rpm P= 4KW

P=2πNT/60

T= 4000x60/2xπx15.99

T= 2338.817 N-m.

STAGE 3:

N=4.5617 rpm P= 4KW

P= 2πNT/60

T= 4000x60/2xπx4.5617

T=8373.45 N-m.

STAGE4:

N=0.734 rpm P=4KW

P= 2πNT/60

T= 4000x60/2xπx0.734

T= 52,039.763 N-m.

The above calculation of the torque and speed is for the unbroken gears, where the failed gears should not posses an uniform torque and the speed, it may varies with respect to the input load.

RESULT AND DISCUSSION

In gearbox, breathe in and breathe out are placed in a single way itself. So breathe in and out are seperately fixed. The thick metal mesh is used for cleaning them. Breathe in valve are used only for pure air flows inside the gearbox and breathe out valve are fixed by the mechanism of only air comes out.

Sensor can be used for deducting the contamination of lubrication oil inside the gearbox, contaminating of oil inside the gearbox makes many problems. Supplying of oil inside the gearing mechanism can works the gearbox smoothly and keeps the components good.

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