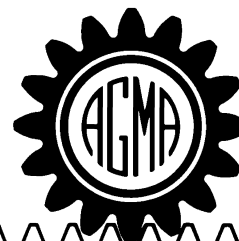


Dual Drive Conveyor Speed Reducer Failure Analysis

by: M. Konruff, Rexnord Geared Products

American Gear Manufacturers Association



TECHNICAL PAPER

Dual Drive Conveyor Speed Reducer Failure Analysis

Mike Konruff, Rexnord Geared Products

[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

With increasing requirements, many conveyor systems utilize dual drive arrangements to increase output. Dual drives can provide an economical solution by utilizing smaller, more efficient, system designs. However, multiple drive conveyors must proportion the load between drives and load sharing without some type of control is difficult to achieve. This paper presents a case study on a failure analysis of a coal mine dual drive conveyor system that experienced gear reducer failures between 2 to 18 months. Physical and metallurgical inspection of failed gearing did not indicate material or workmanship defects, but indicated overload. In order to determine the cause of the failures, strain gage load testing was performed. The testing of the conveyor drives revealed load sharing problems which that will be reviewed.

Copyright © 2005

American Gear Manufacturers Association
500 Montgomery Street, Suite 350
Alexandria, Virginia, 22314

October, 2005

ISBN: 1-55589-868-8

Dual Drive Conveyor Speed Reducer Failure Analysis

Mike Konruff, P.E., Rexnord Geared Products

Introduction

With today's ever increasing requirements for bigger and faster equipment, many conveyor systems utilize dual drive arrangements to increase mine output. Dual drives can provide an economical solution by utilizing smaller components and more efficient system designs.

A downside to multiple drive conveyors is that the conveyor load must be proportioned between drives. Load sharing without some type of control is difficult to achieve. This paper presents a case study on a failure analysis of a dual drive conveyor system.

A coal mine was experiencing speed reducer failures on the dual drive main line conveyors coming out of the mine. The reducers operated from 2 to 18 months before mechanical failure. All failures were on primary pulley drives. Three of the four failures occurred on the same primary pulley. Physical and metallurgical inspection of failed speed reducers showed no signs of material or workmanship defects, but indicated that loading was higher than the reducer rating. In order to aid in determining the root cause of the failures, strain gage load testing was performed. Load testing on the conveyor drives revealed a load sharing problem which contributed to the failures.

The Conveyor System

The subject mine had recently replaced its main line

conveyors. Components of the new conveyor system consisted of both used and new equipment. All main line conveyors were dual drive arrangements. Figures 1 and 2 show the conveyor layout of the main line dual drives before the slope belt. The speed reducers were coupling connected to the pulley shaft with grid type couplings. Prime movers were connected to the reducers with elastomeric couplings. The drive base was fabricated from steel plate and structural steel members. The base was welded to the pulley support structure. Information on the speed reducers and prime movers is provided below.

Speed Reducers

Triple reduction bevel helical models
22.84 Ratio
RPM 1750
Service Power 250 HP
Service Factor 1.36

Prime Movers

449T Frame TEFC
Crusher Duty Design B
250 Hp
1790 rpm
575 Volt, 3 ph / 60 Hz
Nameplate Amps 225
Locked Rotor Torque 210%
Breakdown Torque 320%
Class F insulation

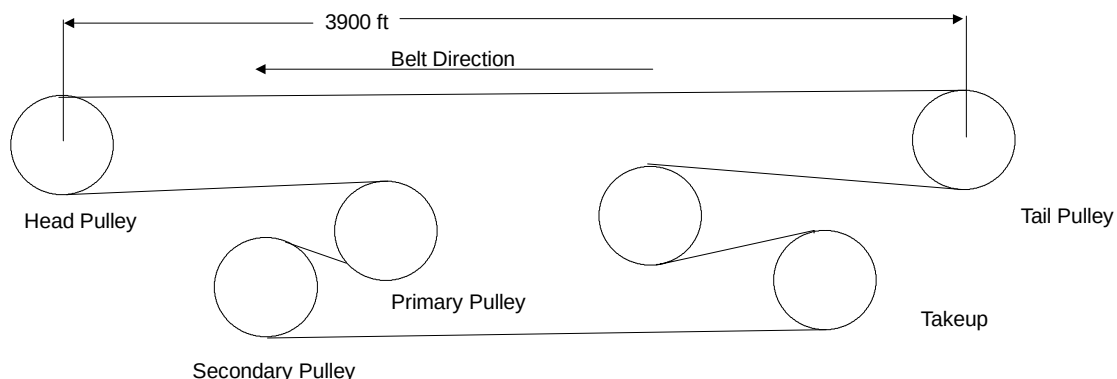


Figure 1. Conveyor Layout

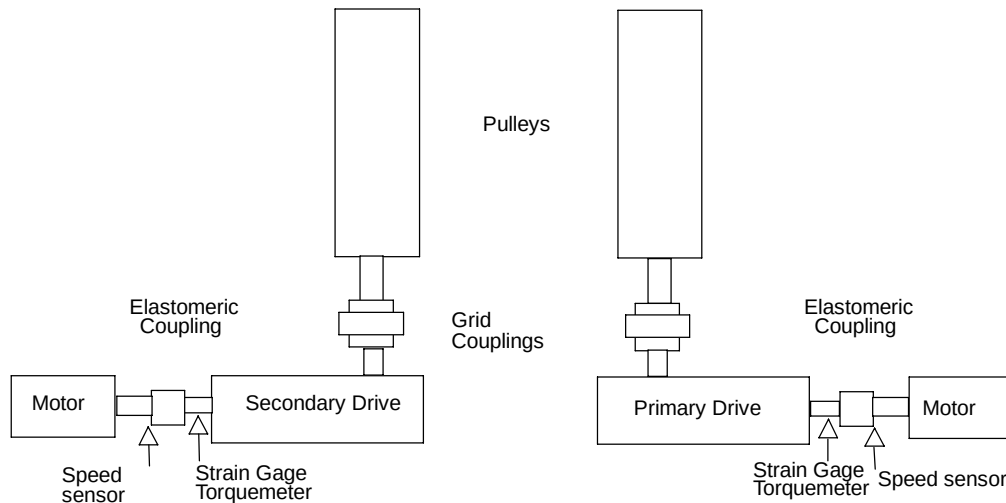


Figure 2. Drive Arrangement

To start the conveyor, both motors are energized at the same time with a single solid state starter. The conveyor is brought up to speed, which takes 4 seconds with an unloaded belt. A vacuum bypass contactor engages after the drives are at full speed which puts the motors across the same line and shuts off the solid state circuit.

Mine personnel stated peak mine design capacity on the main line was 1000 ton/hr. Coal travels from the mine sections to the slope belt via the main line belts. All coal exiting the mine is transported on the conveyor system under test. During the measurement program, observed mine output levels (as measured by the slope scale) were between 200 to 500 tons/hr with occasional instances of 800 tons/hr. Therefore average observed output was less than half of the system capacity. Mine output for day two was 8800 tons/21 hours of operation, which is far less than the design capacity. Typical duty cycle for the conveyor system is about 18 hours. At the time of testing, one miner was being utilized to mine the section. It was anticipated that after the super-section was started, the mine would be operating closer to design capacity.

Failure Analysis

The failure investigator must be like a detective and gather as much evidence as possible to determine the root cause of the failures. Failed reducers were returned to the manufacturer for analysis. The reducers were photographed and bearing setting

measurements recorded before disassembly. Each component of the reducer was carefully inspected, removed and their appearance documented. Housings dimensions were checked on a CMM machine and verified against drawing specifications. Damage to the rotating elements was in varied degrees of distress. A common thread was the appearance of the low speed pinions. The pinions were severely spalled which can be attributed to either high loads or inadequate lubrication. Some of the low speed pinions also had broken teeth. Component ratings predict the low speed pinion as the limiting component in the reducer. Also, material removed from the pinions during operation caused debris damage to other components.

The OEM claimed that current readings were below nameplate full load rating and that the drives were lightly loaded. The OEM also claimed that the current between primary and secondary drives was balanced by normal standards. Since the information supplied by the OEM did not agree with the analysis of the failed drives, further investigation was required to help with determining the root cause. A site visit was scheduled and an independent testing service was hired to measure loads. While the cost of load testing may appear to be high, it will often result in a lower total cost by enabling the investigator to determine the failure's root cause faster than other analysis methods. The point at when to perform load testing is based on the experience of the investigator.