A Review: Identify Reasons of Timing Belt Failure Analysis with Corrective & Preventive Measures

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Abstract: This paper refers the mosteasiest & pretty common case of damages in timing belt drives which occurred due to hammer down with some sharpen materials. Belt's wear, Pulley's teeth damages failure frequently occurs. Including also wear, Belt tension on an improper ways, some hardware issues & effects of environment. This paper also refers to identifying various basic reviews behind these premature failure and performing recommendations on both preventive and very truly measures or say corrective ones.

Keywords: Belt Wear,Crimp Failure,Improper belt tension,Environment effects,Hardware problems, Tribology, Tribomechanical Systems.

1. INTRODUCTION

In a power transferring various conceptions timing belt drive acceptance in various areas of industry is relatively new in modern era. If suppose in your timing belt drive after used a lot you are still going to replacing your belt more than one time in a single year, clearly shows that you needed to analyze whole drive. This paper based on review to both clarifying & identifying common culprits of timing belt failure while using. Also reviewing frequently occurs damages on pulleys of belt & belt itself. Also reviewing causes of various common culprits of timing belt drive failure likes of crimping damage of belt, high amount belt tension while installation, Misalignment of sprocket & condition of adverse environment effects.

This paper will give you the identifying ways of premature belt failure after considered various advantages of belt and also clarifying both preventive & truly measures.

Replacing of belt drive and performance of this belt drive decreasing and expensive respectively. In automotive arena it demanded a lot & even more after its usages also in other fields as well. After detecting underlying various issues eventually you saved both your valuable time of maintenance and lots of money **[6]**.

2. COMMON CULPRITS OF TIMING BELT FAILURE

There are also high amount of factors have influence on the working life of this belt drives:

- Friction & Wear,
- Tension,
- Hardware problems,
- Environmental effects& other **[1].**

2.1 INFLUENCE OF NORMAL BELT WEAR & FAILURE

If we considering tribomechanical system in this belt drive it's basically required (1) Face of belt (2) Some gaping's between belt pulley's tooth &Apex of belt as shown in fig 3. This system required the direct influence on working life and power in motion transmission of this drive while analyzing things. If this belt drive running for longer period of time we can call

this failure as ideal one. Considerations in general for running 2 or 3 years. When belt drive reaches its apex or the tensile cords in life of fatigue then failure occurs.

As shown in fig 1. It illustrates 45 degrees fracture of belt on a cord of typical tensile at the end of drive's fatigue life.Also considered this belt drive under as a Non-ideal type failure. It will give you the fuzzy appearance as shown in fig 2.

For longer running period considerations action significantly has been taken out & will applied on a various factors likes of transmission of power on an alignment of shaft& belt tension in installation **[1].**

Figure 1. Normal fatigue failure **[2]**

Figure 2. Fuzzy tooth appearance from wear **[2]**

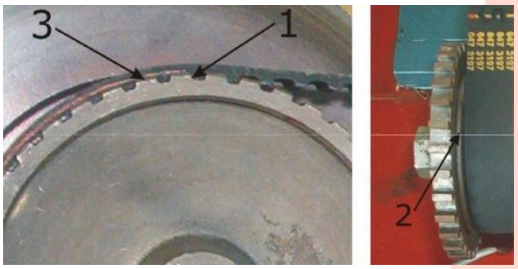

Figure 3. Timing belt drive and basic tribomechanical systems **[1]**

2.2 INFLUENCE OF BELT CRIMP FAILURE

It's an obvious thing that if the tension on a belt will slight higher up, cords of the belt simply just can't resist & not supporting enough load on it. Bending of localized cords caused debonding within them, which resulting as huge reduction on its tensile strength so as abrasion of interfilament of loading those cords as shown in fig 4.

It damages mishandling of belt drive in adequation of drive while installation higher tension & minimal diameters of sprockets. Belt drive mishandling can happened from improper sort off packaging & on a storing. Some foreign objects located in between sprocket & belt resulted as crimping. Belt drive riding out of sprockets while working under some tension, which is an acceptable belt drive tension named as "Self-tensioning".

Also riding out grooves of those sprockets helped to increasing in tension of span on approachable at tighter side in grooves. Those minimal diameters also ended with resulting in crimping and bending belt drives. If tighter side not forced enough then it will working as a ratchet & teeth's will back down which also resulted in tooth damage in fig 5 **[2].**

Figure 4. Cord Elimination **[6]**

Figure 5. Crimp Failure **[2]**

2.3 INFLUENCE OF SHOCK LOAD FAILURE

When in any of the driven equipment, regular cyclic loads and higher than a normal intermitting of belt drives are generated shock loading or shocking load has occurred. Also ended with higher than normal stresses of belt this failure of belt will act as a catalyst. Sometimes it will ended up with some unwanted appearances & belt breaking under a ragged in fig 6. & also in V-belt conventional belt drives slips under some higher amount of loading torque condition where synchronized belts must have transmitting their peak loads & Magnitudes.

Contained multiple cracks at everywhere as shown in fig 7. Or jamming caused shock loading. If elimination of this shock loading can't be possible then it's good to be increasing or replacing with some capacitive system on it **[5].**

Figure 6. Typical Shock load Failure **[2]**

Figure 7. Tooth Crack by Shock load **[6]**

3. IMPROPER BELT INSTALLATION TENSION

In this, it will reflect &illustrate some of the most common culprits on belt installation tension challenges.

3.1 INFLUENCE OF HIGH BELT INSTALLATION TENSION

Some additive tension of belt drive installation caused shearing or breakages of belt tooth. For signing as worn of sprocket under those belt land areas as shown in fig 8. It illustrates crushing portion formed at tooth in a region of belt land with fig 9. Illustrates larger sprockets consideration in belt. Certain phases we have to done on an accurate & on a determined way so that we can preventing our issue, also it will eventually revealed each & every cords in tensile individually **[2].**

Figure 8. Crushed Land areas [2]

Figure 9. Excessive land area wear [2]

3.2 INFLUENCE OF LOW BELT INSTALLATION TENSION

While rotation of tooth & insufficient installation on a heavily loaded drive system ended up in failure of premature.Tearing of rubber with a tensile member separate tooth from the body strips line as shown in fig 10. Some in accurate adhesion of rubber to the cords of tensile. Also ratcheting and resulting tearing and jumping on a belt tooth. Breaking load under meshing referred as a "Hook Wear" as shown in fig 11 **[2].**

Figure 10. Tooth Separation Failure [2]

Figure 11. Excessive tooth wear [1]

4. BELT DRIVE HARDWARE PROBLEMS

In this, we will examined the negative impact or say those effects that helping occurred these hardware issues in a belt drive, In their operation & in life of the belt.

4.1 INFLUENCE OF SPROCKET MISALIGNMENT

Tearing or root crack at the tooth occurring failures in the side of the belt. It operated on drives misalignment of the shaft which wear of unwanted pattern across tooth of the belt and compacting of flanks in the areas of belt land drives. Right at the edge of belt drive there's some significant tracking force & wear down at one side and rolled up for sprocket flanges as shown in fig 12. With some parallel misalignment on sprockets flanged region which is operated by belt have some additive edged wear and pinched on an opposite side of flanges. There's also full operating load developed as shown in concentrated region of fig 13. Carried by Non-flanged sprockets where tooth unworn on it **[5].**

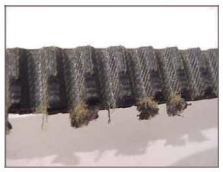

Figure 12. Extreme belt edge wear **[2]**

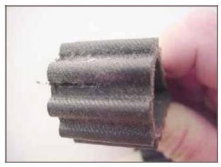

Figure 13. Uneven belt wear **[2]**

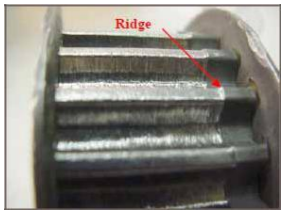

Figure 16. Excessive Sprocket wear**[2]**

4.2 INFLUENCE OF SPROCKET OUT OF SPECIFICATION

Selecting appropriate belt & materials of cords in for designing toothed belt as main methods. Arc of contact examined by arc angle over the deformed teeth on the bases of the extension value. Between toothed belt and pulleys a qualitative geometric couplings been developed. Which considered different phenomena occurred in a driving & in a driven wheel model. Deformation of tooth depending on wear of energetic tooth **[3].**

As shown in fig 14. The fuzzy appearance exhibiting and also curvilinear operating on a minimal diameters landed on disintegrated region of the belt drives shown in fig 15. Sprocket teeth eventually get visible as shown in fig 16. Another sprocket indicating wear down which is noticeably in action when reduced the previous belt life **[4].**

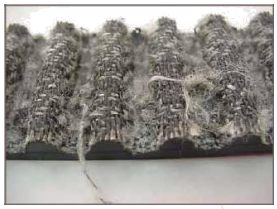

Figure 14. Extreme tooth wear from worn sprockets**[2]**

Figure 15. Land disintegration **[1]**

4.3 INFLUENCE OF EXCESSIVE SPROCKET RUN-OUT

It's subjected to cyclic rise and fall of belt operation of rotations on a radial run out of sprockets as shown in fig 17. While crushing has happened it will crushed shear of belt tooth and those land regions as shown in fig 18. Some moderate sizing of sprockets excess under a high amount of tension. Generally when bushings are improperly mounted on a sprockets it often examined. As shown in fig 17. When tensioning of belt fails from shearing and breaking pretty often **[5].**

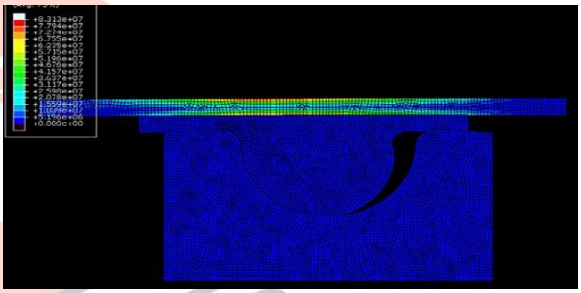

Figure 17. Total deformation under radial force**[5]**

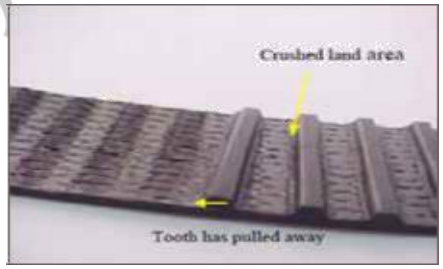

Figure 18. Extreme land crushing and wear from excessive sprocket run-out**[2]**

5 INFLUENCE OF NEGATIVE EFFECTS OF ENVIRONMENTAL CONDITIONS

In this, we'll define zero environmental conditions and also some common culprits of environmental issues.

5.1 INFLUENCE OF ABRASIVE ATMOSPHERE

On a various applications of mining of phosphate belt conveyors, equipment of taconite processing and foundry shakers high degrees of belt drive & flank wear operating in an abrasive atmosphere. As shown in fig 19. Chemical compound of polyurethane moved on a very higher abrasive environment. Usually those quick sprockets movement along with belts pressurized installing clean air from seal guard to keeping dust & various contaminates away **[2].**

Figure 19. Extreme wear from abrasion**[2]**

5.2 INFLUENCE OF HEAT DEGRADATION

For prolonged period of time higher grade than 185°F rubber belts operates. As shown in fig 20. These compound interest in gradually back cracking things. The construction of this belts are available in higher environment temperature to improve their provided services. Polyurethane compound of carbons at the excessive temperature of 185°F subjected to an environmental system. As shown in fig 21. High operation been performed on a chemical compound of polyurethane at a given melting point which occurring some loses of integrity inside **[6].**

Figure 20. Back Cracking from high temperature**[6]**

Figure 21 Melting from high temperature operation **[1]**

5.3 INFLUENCE OF CHEMICAL DEGRADATION

Vapors of organic solvent or ozone resembling to subject highering of a belt temperature which harden and exhibiting back cracking. Allowing surface region cracks and differing them on both longitudinal and on a lateral path **[1].**

5.4 INFLUENCE OF FOREIGN OBJECTS

Between sprockets and a belt often damaging cords tensile and teeth's of belt in fig 22.Ended up effecting internal fracture. As shown in fig 23. Crimping "lateral belt failure" occurred due to debris once fractured part reducingtensile strength of belt in consideration values. If noticeable debris damages belt drives it will be examined and replaced **[2].**

Figure 22. Tensile cord failure from debris [2]

Figure 23. Crimp failure due to debris [2]

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6 CONCLUSIONS

From above all the common culprits of failure in timing belt analysis deeply focused on the variable effects performed under all the common culprits. Also with this paper it can be defined the lifetime dependency and influenced factors of timing belt drives, which helped us to provide guidance while occurring on those damages of belts. Study of various effects on failure analysis steps of common study resulting on a decreasing performance that further lead to help for saving our money & valuable time of maintenance.

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