Journal of Engineering and Applied Sciences 1 (4): 538-541, 2006

Bands's Rupture Prediction of the Conveyors by Reliability Analysis

A. Belhamra, A. Yousfi and E. Hadjadj-Aoul
Département Electromécanique, Faculté des Sciences de L'Ingénieur
Laboratoire des Systèmes Electromécanique, Université Badji Mokhtar Annaba, Algeria

Abstract: The total absence of the scientific techniques facilitating the rational use of the means of pickling on the one hand and the lack of a policy of maintenance on the other hand, have an impact direct and harmful on the production and the productivity of the company consequently us summons itself proposed has to solve one of the major problems frequently encountered in the various careers, that of the tear of the band of the conveyors. The innovation of this study consists has the contribution of a scientific methodology, modern and universal which enables us to determine the tensions relative causing the rupture of the band to the requirements of exploitation due mainly to tiredness. The objective will be thus to deal with this problem, having expensive consequences by introducing the modern techniques of analysis with a methodology which will be elaborate in order to evaluate the tensions in each point of the band under the conditions imposed on the level of the company and careers Algerian.

Key words: Conveyor, reliability, weibull, maintenance, diagnostic

INTRODUCTION

The installations, the equipment end up worsening in time, the causes are multiple. Most known are:

Various wears and deformations due to operation such as the action of corrosive agents (chemical agents, atmospheric, etc.)[1,2]. These deformations cause stops, breakdowns, can decrease the outputs, the quality of the product, increase the costs of operation (increase in the consumption of energy etc.), to endanger the safety of the people.

Thus to produce or ensure a service requires equipment, machines increasingly sophisticated. The mission of maintenance with respect to these investments is in priority:

- to keep them in good condition of walk at lower cost and in the slowest possible time;
- to ensure a maximum production, therefore the availability alone is not sufficient; currently one requires the output;
- to control all the factors of costs by controlling their assignment (labor, spare parts) a follow-up of the cumulated costs must exist for each material;
- to take care of the aspects of maintainability of the equipment;
- the cost of maintenance contributes to that of the end product by the means of the unit cost of production;

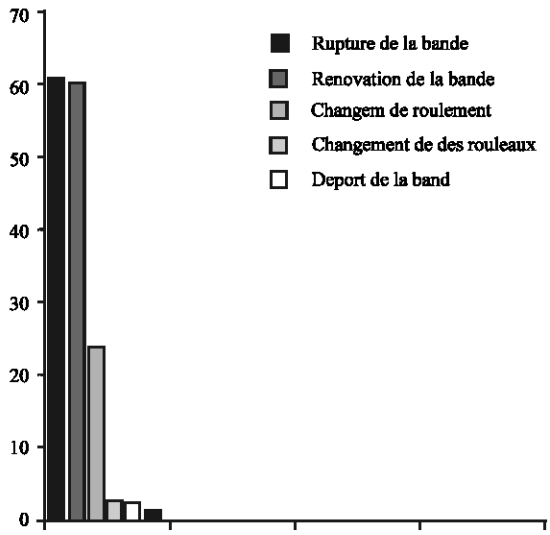

Fig. 1: Analyze failures of a conveyor in a mine

- a good maintenance prolongs the service life of the equipment.

As already to announce, the absence of the scientific techniques facilitating the rational use of the equipment on the one hand and the lack of policy of maintenance on the other hand, have an impact direct and harmful on the production and the productivity of the company in our

Corresponding Author: Belhamra, A., Département Electromécanique, Faculté des Sciences de L'Ingénieur, Laboratoire des Systèmes Electromécanique, Université Badji Mokhtar Annaba, Algeria

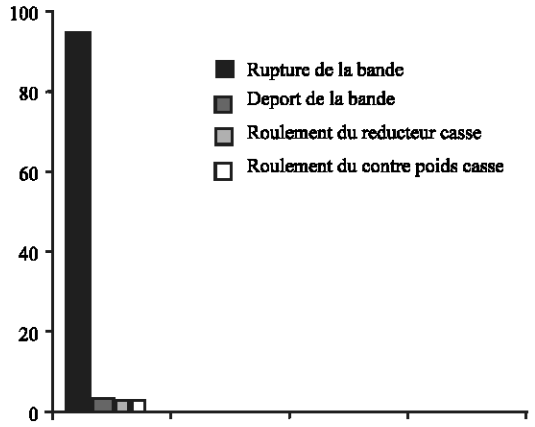

Fig. 2: Analyze failures of a conveyor in a company

study one proposes to solve one of the major problems frequently encountered in the careers, that of the tear of the band of the conveyors mining means of transport).

This work arises in two stages:

- the first consists with a complete census, comprising the breakdowns, the causes, the number of h of stops, the rate cumulated Fig. 1 and 2
- the second consists with the treatment and analyzes information collected, thus the determination of the failure rate which characterizes the reliability of the systems.

MATERIALS AND METHODS

In the present study, we carried out a current evaluation of the belt conveyors installed in various careers and industrial companies. Most significant consists with the census of the conditions of use of the technical parameters concerning the belt conveyors in order to know with precision the various causes of the frequent stops and to define with precision a service of maintenance in the determination of a state according to residual durability.

To arrive at these objectives, one allowed oneself to carry out an analysis in the various companies quoted above in order to determine:

- causes of stops and to fix the points to be improved;
- to study and define the adaptations necessary of the principles, methods and of the means to cure these problems.

RESULTS AND DISCUSSION

Considering the results of the research carried out on grounds in the various companies, one notes the various breakdowns whose origin is due to the effect of several causes. One of the most frequent breakdowns and which has a harmful effect on the correct operation of the conveyors and consequently on the production of the company is not other than the rupture of the band. It is evaluated at an average failure rate of 63.68%.

It is concluded that this rate is raised the most compared to the other failures detected during the censuses carried out. That does not prevent that one should not neglect the other causes which are rather considerable such as: the electric defect on the level of the engine estimated at (20.13 %), the detachment of against estimated weight (6.43%) offset of the band estimated at (2.18%) and the mechanical breakdown.

The high rate of failure of the mechanism of the belt conveyor which is summarized in the tear of the band is the subject of our study. It is noted that the rupture of the band causes the most damage for much undertaken using this kind of material. This at summer proven by the present study.

Considering the extent of the problem from the economic and technical points of view one proposed to make a study attentive concerning to the maximum the causes of failure and to try to find a solution adequate.

Several causes were highlighted in our research causing the rupture of the band at knowing:

- the quality of the band, the device of loading, the bad adjustment of expander, the misuse of the conveyor, the recommended granulometry of the load;
- developed non in conformity: material design of the equipment is incorrect. It is known that the conveyor is an indivisible unit being given a frame badly calculated or realized with subsets of bad quality can influence in a considerable way at the point to leave an oscillation of the band in the horizontal direction what results in a bad alignment of the rollers as it can be in the vertical direction what causes vibrations on the level of the engine, or shocks on the rollers of supports which can involve thereafter the very fast wear of the band.

By examining the conditions of use attentively, one realizes that a part of good quality but misused or badly treated with the assembly results in frequent failures and their correction one of the prime objectives sought in is very undertaken.

Political of maintenance: It is admitted that maintenance is one of the principal causes of the wear of the band by leaving one cumulates matter between the drum and the band and on the rollers .In this study the cause is manageable, it is enough to maintain the elements

touched by this index, such as the rollers and the drums, by cleaning them and by controlling the devices of cleaning and their replacements by other types if it is necessary.

Granulometry: The absence of homogeneity of granulometry accelerates the vibrations due to the shocks of large blocks which run up against in the passing the rollers of support of the tape.

Moreover if the granulometry of the transported product is significant and provided with stop sharp, it can directly cause tears on the tape installed.

The nature of the product: Gilles[3] the nature of the product especially has an effect direct on the tape when it is abrasive to cure this problem one calls upon the coating known as: of wear.

The faulty operation of the rollers of guidance: It is likely to damage the edges of the band by the action of the friction of the latter with the framework of the conveyor and who could be at the origin of serious damage.

Excessive tensions (causes principal): One of the principal causes causing the tear of the band noted on the level of the careers is the bad adjustment of the tension of the latter it is very significant to know the maximum tension necessary that can support the tape. One knows q' a reliable operation of the conveyor is directly related to the output engine installed the latter given according to the tension is carried out (TE) which makes it possible the drum of order to turn and to make function the conveyor at a given speed (V).

These tensions have an influence on the majority of the mechanical parts of the conveyor such as the carrying rollers or the spacing varies according to the tension of the band. In this study plus this tension is raised more the authorized variation increases, plus the bending of the band becomes significant what imposes on the band bending stress useless, that increases the wear of the higher coating between the band and the side walls causing of the problems of sealing. The power increases in a considerable way. In order to rectify such a situation and to avoid any useless expenditure one must control the tension of the band before the loading, this element who is most significant and who could take part in the creation of a possible inflection.

Probabilistic model of weibull: The interpretation of Weibull[3,4] on the phenomenon of rupture is summarized in the effect of size and of volume, its resonnement is based on the principle which a structure has the resistance of the weakest part, or in other term the theory of the link weakest W L T (Weak link theory). Knowing that the probability of rupture related to a unit is given by the relation:

$$P_f = 1 - \exp\left[-v\left(\frac{\sigma - \sigma_u}{\sigma_0}\right)\right]$$

The technique most used to measure the parameter of Weibull consists of the linearization of the equation of the probability of rupture, thus we obtain:

$$\ln\left[\ln\left(\frac{1}{1-P_f}\right)\right] = m.\ln(\sigma - \sigma_u) + \ln v - m.\ln\sigma_0$$

The chart of $\ln\left[\ln\left(\frac{1}{1-P_f}\right)\right]$

function of In ($\sigma - \sigma_u$) is a line of slope (m).

It is thus a question of assigning a probability of rupture to each level of constraint classified according to an ascending order 1m2. The latter is a function of the row (I), analytically, the probability calculus is made starting from the expressions of the median row Median rank following

$$P_f = \frac{i}{N+1}, \text{ or } P_f = \frac{i-0,3}{i+0,4}$$

The most used expression is the first; the points obtained are then represented on the diagram

$$\ln\left[\ln\left(\frac{1}{1-P_f}\right)\right]$$

function of ($\sigma - \sigma_u$),

By applying the theory of Weibull to the results obtained we can supplement the analysis of the rupture quantitatively.

In any obviousness the evolution of the probability of the rupture is proportional to the constraint. The results are represented on Fig. 3. The measurement of the parameter of Weibull (m) is shown on Fig. 4.

The module of calculated Weibull is about m = 6.854. This order of magnitude falls under the beach of the values of the module of Weibull relating to the composites.

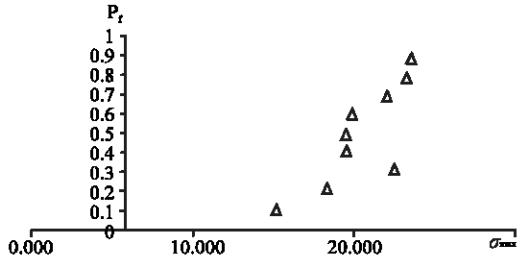

Fig. 3: Variation of the probability of rupture in function evolution of the constraint

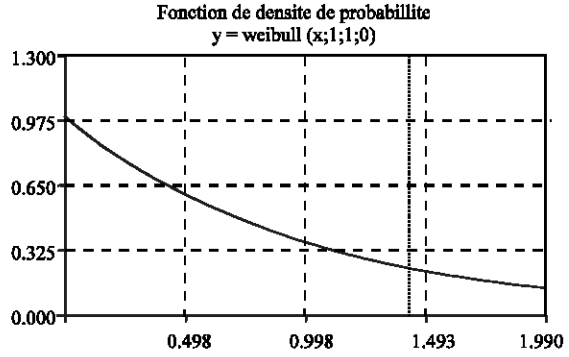

Fig. 4: Weibull's model

Calculation of desirable time for a systematic intervention: We fix reliability at 75% and we deduce systematic time.

$$R(t) = 75\% \Rightarrow t\ ?$$

$$R(t) = e^{-(t/\eta)} \qquad \ln R(t) = -(t/\eta)^{\beta} = \ln 0.75$$

$$0.3566 = (t/517.53)^{\beta} \Rightarrow t = \sqrt[\beta]{0.3566}\,(517.53)$$

$$tsys = 459.3\ h$$

With each T sys = 459.3 h, intervening us on the conveyor to keep one Reliability of 75% for that it will be necessary to apply a range of preventive maintenance systematic.

CONCLUSION

This study shows that the weibull's law is very significant interest for the preventive maintenance. It allows a determination of systematic time for intervention in order to improve the early reliability of wear occurring on machines. It is indeed imperative to intervene on the tape even if this one does not present any defect because the tear is abrupt and to use Draconian procedures, to ensure itself of the cleanliness of the analysis and sampling systems.

REFERENCES

1. Gary R. Sharlow, 2001. The high cost of over designing your belt conveyor. Powder and bulk engineering.
2. Wensrich, C., 2001. Load sharing models for steel cable reinforced conveyor belting. Transactions of mechanic. ME25 N°1.
3. Gilles Zwingelstein, 1996. La maintenance basée sur la fiabilité, Hermes.
4. Bernard Goldfarb and Catherine Pardoux, 1999. Introduction à la méthode statistique Dunod.