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THE CONVEYOR ROLLERS INNOVATION AND VALIDATION
INOVACE A VALIDACE DOPRAVNÍKOVÝCH VÁLEČKŮ

Abstract

The article deals with cooperation between the VŠB-Technical University of Ostrava and Co. TRANZA, JSC, Břeclav. The goal is the conveyor roller analysis and its innovation and operation reliability testing.

Abstrakt

Příspěvek ze zabývá spoluprací pracovišť VŠB-TU Ostrava a firmy Tranza, a.s., Břeclav při analýze a inovacích dopravníkových válečků a ověřování jejich spolehlivosti při provozu.

1 INTRODUCTION

This cooperation arised on the basic of the EURO project IVTPUM č. 1/2007 between Co. TRANZA, JSC, Břeclav and VŠB-TU Ostrava. The aim of project is increasing roller quality both from view of mechanical properties and from view of influence on environment. Development must have a link to current world trend.

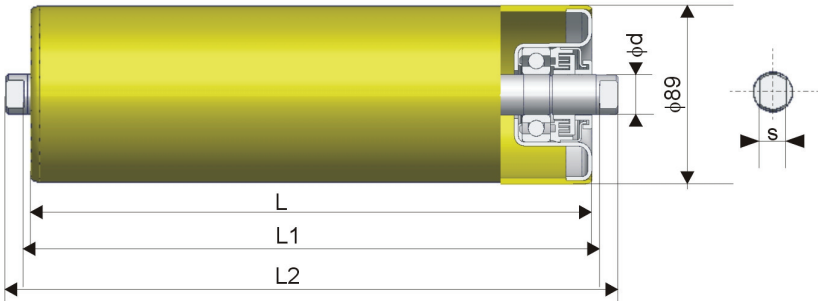

Fig. 1 Typical conveyor roll

The cooperation was made in two basic areas, design and testing.

Design area comprises:

- analysis of the stress condition by help of FEM and lifetime calculation of the roller body;
- analysis of a production deviation and a roller body deformation effected by the bearing loading and by the seal;
- choise of the manufacturing technique, especially in welding and material areas.
- Testing area comprises:
- determine the rollers lifetime and uncover the causes of failures;
- lifetime testing both in laboratory condition and in real operation;
- observing the condition of the rollers during real operation and failure analysis.

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Design area

This area was solved by department of mechanics. The goal of research is roller stress state caused by combination of loading from production and assembly inaccuracies as well as operation deformations. First problem is stress caused by press overlap of the roller heads. The results of FEM simulation show Fig. 3 – 4.

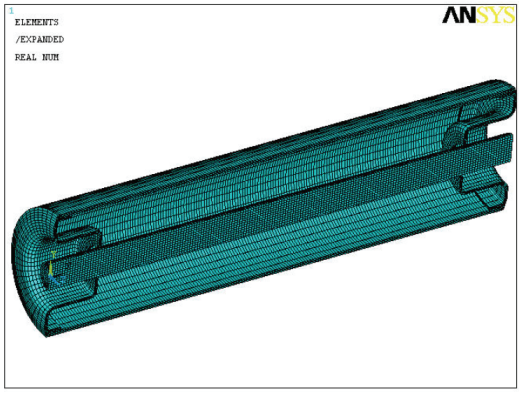

Fig. 2 FEM model of roller

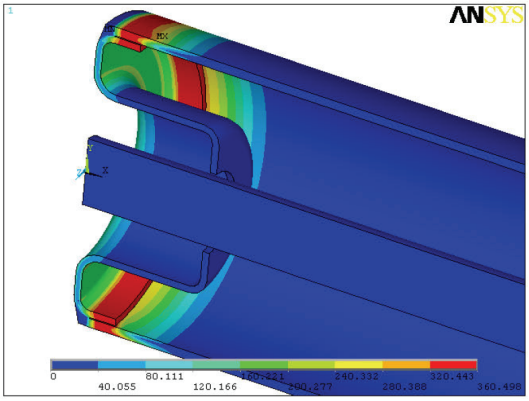

Fig. 3 Roller stress for pressed and welded head with overlap

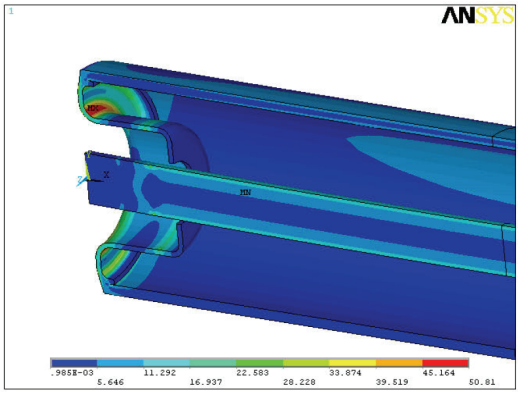

Fig. 4 Roller stress for welded head with clearance

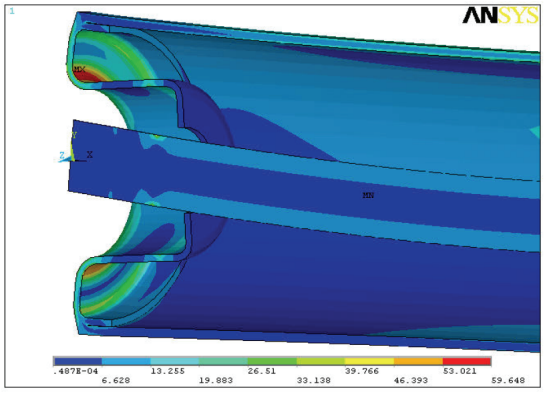

Fig. 5 Roller stress with operation loading for welded head with clearance

According to deformations from loading and product deviations possible turning in bearings is bigger than allowed bearing turning (14′ for used ball bearing with radial clearance C3). The goal of next research is to reach a suitable imperfections and deformations up to allowed bearing turning.

Besides both the static deformations and the deformation from operational loading, deformations from natural frequencies may affect as (Fig. 6). These influences have been intensively studied at present.

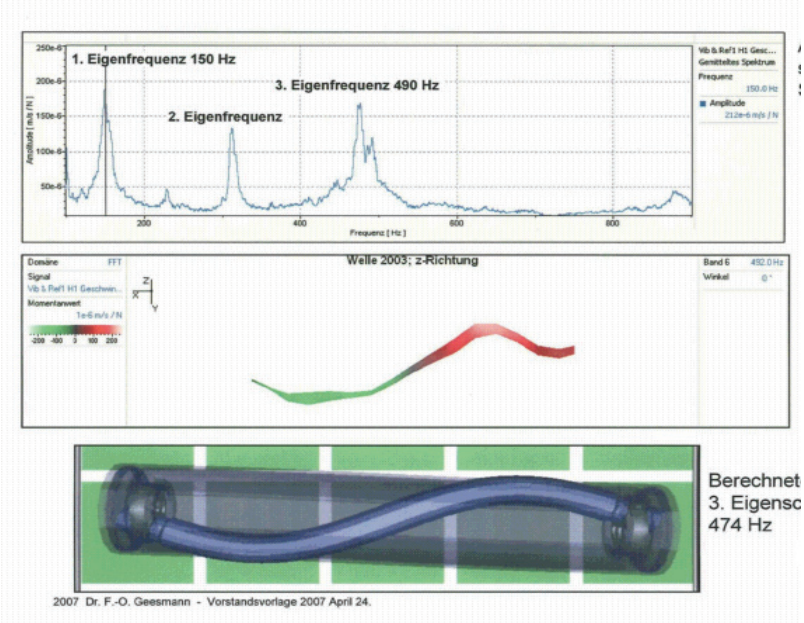

Fig. 6 Shaft deformation caused by natural frequencies

Dust and wet seal

The seal system is absolutely dominant factor for bearings lifetime. Whichever high quality and accuracy of the roller do not have a sense if a seal allows entering of dust or (and) wet. Concurrently the seal may determine rollers rotation resistance. It may be significant for energy consumption especially for long conveyors (Fig. 7).

Because a contact sealing have, due to friction, bigger rotation resistance and lower durableness, is for rollers used usually labyrinth seals (Fig. 8).

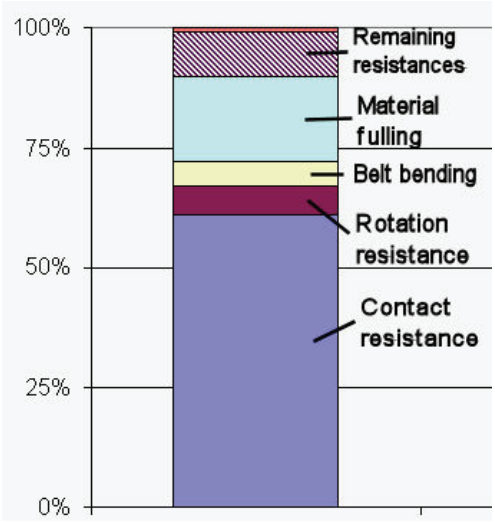

Fig. 7 The components of transport resistances

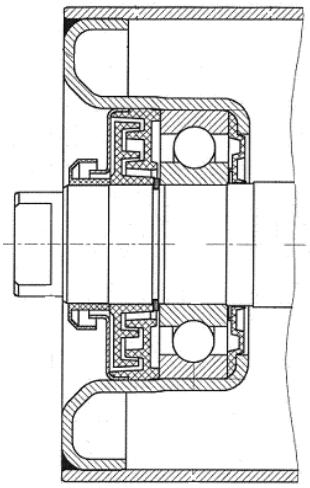

Fig. 8 The example of the rollers labyrinth seal

Theirs advantage is non-contact sealing and thus, theoretically, no limited lifetime. Under appropriate design there is resisting against dust and weather. Theirs disadvantage is low resistance

against air humidity, which infiltrates into a roller during its body temperature changing or changing of atmospheric pressure.

For verification of a labyrinth seal quality a testing stand is in design at present.

Manufacturing technique area

Generally rollers imperfections are impacted by:

- quality and deviations of semi products;
- deformations from assembling and pressing;
- thermal deformations from welding and fast temperature dropping;

One of technology innovation is a assembling and welding the body of roller and its head with clearance. The special machine, developed by Tranza, inserts head into body with about 0,5 mm clearance, then sets a perfect axle alignment and made weld (Fig. 9). That technique improves better axle alignment and minimizes radial turn-out.

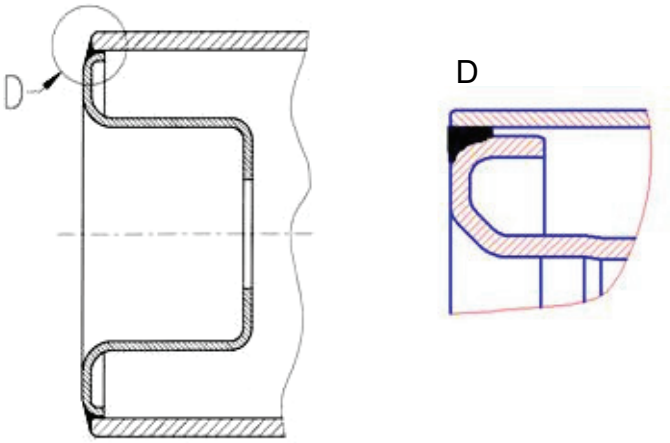

Fig. 9 The roll head and the body welding with a clearance

Area rolls durability and flaw detection

Because the main requirement is highest rollers durability, we start a monitoring roller state during real operation conditions. A testing segment on belt conveyer was selected in Tušimice surface mine, where new rollers were installed. First, theirs vibration and noise state were measured, and subsequently vibrations and noise are measured in periodic terms (Fig. 10 and 11). The goal is to detect beginning of noise or vibration growth. It gives a signal of defect formation, usually in bearing. In this moment it is possible to dismount this roller and to discover reason of vibration or noise growth.

Analysis of noise and vibration was made by frequency spectrum analysis. It gives us possibility to find a source of vibration. Fig. 12 shows an example of rollers vibration frequency analysis and Fig. 13 roller noise analysis. In charts there are market characteristics frequencies domain for bearing parts damage and its harmonics frequencies.

Fig. 10 Vibration measurement

Fig. 11 Noise measurement

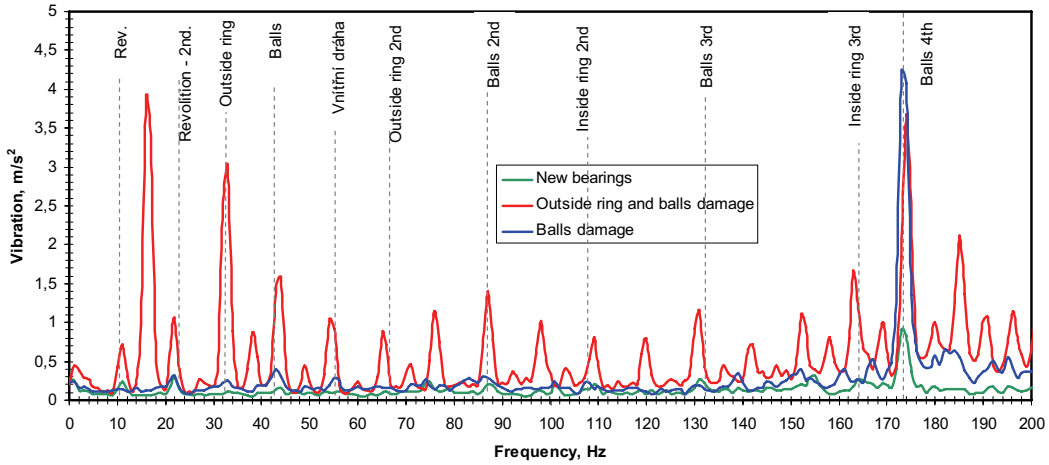

Fig. 12 Example of roller vibration frequency analysis

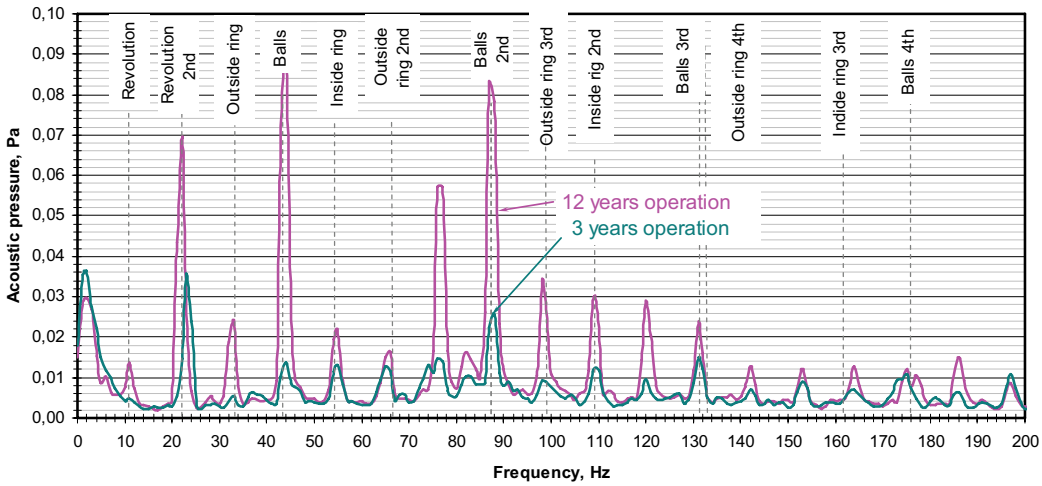

Fig 13 Example of the conveyor section noise frequency analysis

Further information and data dealing particularly with the applied technology and material can be found in the attached references.

2 CONCLUSIONS

Although the conveyor roller seems a simple device, the main requirement of customers is focused to a very long lifetime. The goal is minimum lifetime up to 8 years (55 thousand operation hours), increasing the transporting velocity up to 9 $m.s^{-1}$, and noise decreasing from 89 dB to 78 dB. Although rollers lifetime is up to 15 years, it is necessary to reduce a breakdowns arised in initial operating time. It signifies to improve especially bearing lifetime by redundant loading elimination and to safeguard bearings against dirt and water.

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