STUDY THE ADAPTATION AND FIXATION CHAIN ENDS ON ADVANCE MECHANISM OF 2K-52MU COMBINE TO THE STATIONS OF THE TR-5 SCRAPER CONVEYOR

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Abstract: The need for the mechanization of coal exploitation in the mines of Vale Jiului, under the conditions of the current economic crisis, required the adaptation of the existing machinery to the new conditions for the re-technology of some cutting sites.

Keywords: Advance mechanism, coal, CAD software

1. INTRODUCTION

The need for the mechanization of coal exploitation in the mines of Vale Jiului, under the conditions of the current economic crisis, required the adaptation of the existing machinery to the new conditions for the re-technology of some cutting sites. Thus, as part of the re-engineering program of a frontal slaughterhouse within E.M. Lonea, it was necessary to adapt the 2K-52MU slaughterhouse combine to the TR-5 scraper conveyor. The main problem of adapting the two machines consisted in the design and realization of systems for attaching the ends of the chain of the forward mechanism of the combine to the drive and return stations of the conveyor with scrapers TR-5. In solving this problem, it was ensured that all the elements of the attachment systems of the chain ends of the combine withstand the maximum pulling force of the combine of 250 kN, and that this request is not transmitted to the metal construction of the stations and is taken over by the hydraulic anchoring post of the the transporter's station.

The technical characteristics of the felling combine 2K-52MU were not correlated with those of the scraper conveyor TR-5, especially since it was not designed for felling, and they were designed and made by different companies in different countries. But the two machines are compatible, at least from the following points of view:

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- more than half of the theoretical cutting capacity of the combine, which is not reached in practice due to the correlation of the advance speed with the geological-mining conditions, can be supported by the scraper conveyor;
- dimensionally, the combine can be mounted on the conveyor by adopting appropriate modifications, adapting the TR-5 stations to TR-6 troughs with the use of TR-7A sides and modifying the combine shoes, without diminishing their resistance characteristics;
- the robust construction of the conveyor supports the mass of about 12 ... 14 tons of the combine;
- the construction of the conveyor with scrapers allows the coal to be loaded in good conditions by the worm drums.

The main mismatch between the two machines is that the drive and return stations of the TR-5 scraper conveyor are not equipped with plates/lugs for the attachment of the combine's drive chain end.

2. LINKING SYSTEM TO THE DRIVE STATION

Figure 1 shows the constructive solution for placing the end of the calibrated chain with 26x92 links of the advance mechanism of the 2K-52MU combine, reference 2, to the metal construction of the drive station, reference 1.

The constructive solution of the binding system is presented in figure 2, which consists of: 1 – ear fixed on the station; 2 – lateral connecting plate; 3 – lateral locking plate; 4 – locking bolt Φ50; 5 – locking bolt Φ60; 6 – joint pin Φ60; 7 – device ear; 8 – towing rod; 9 – wear ring; 10 – wear ring support; 11 – chain fixing clamp; 12 – centering pin; 13 – calibrated chain with links 26x92; 14 – screw M20x100; 15 – screw M10 for lubrication; 16 – spacer ring; 17 – low M42 nut; 18 – nut M42; 19 – screw M24x100.

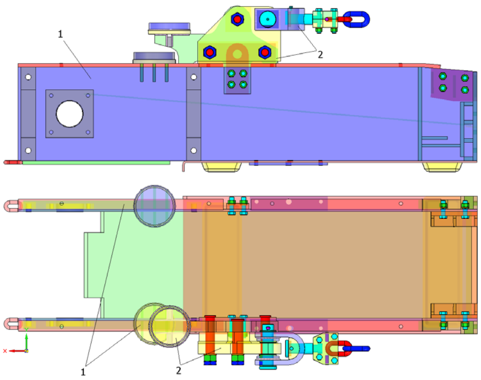

Figure 1. The location of the binding system on the drive station [7]

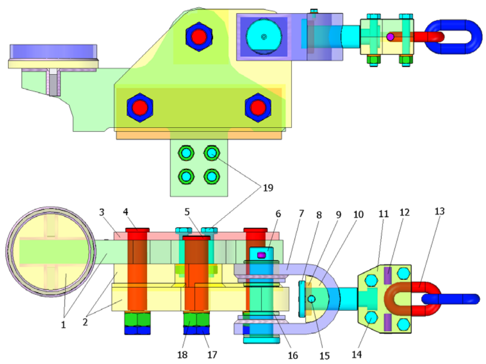

Figure 2. The constructive solution of the chain end binding system on the TR-5 drive station [7]

The chain end binding system on the TR-5 drive station has the following constructive improvements:

- the eye that is fixed on the station, instead of the lifting eye, rests on the frame of the station through two spaced feet and has its own support for the SVJ hydraulic post anchoring the station, which improves the stability of the eye and the way of transmitting forces to the station;
- by overlapping the supports for the pole, the wrong location of the anchor pole is avoided and allows the interchangeability of the actuation station;
- by the parallel positioning of the side connecting plate, reference 2 (fig. 2), and the rigid fixation on the lug by the three bolts Φ50, reference 4, and Φ60, reference 5, an outward movement of the chain axis was achieved with 120 mm which improved the movement of the combine on the conveyor in the area of the drive station;
- the distance between the wings of the device's ear was reduced, reference 7, by welding two additional plates with a thickness of 20 mm, which improved the way of stressing the joint bolt, reference 6;
- the axial ball bearing 51112 was replaced with a wear ring made of cast iron or bronze, reference 9, with the role of taking the twists in the chain, and a screw, reference 15, was provided to lubricate the contact surface between the wear ring and the ring support, reference 10;
- transverse pins, item 12, were provided for centering the two clamps in order to improve the transmission of the traction force between the towing rod, item 8, and the chain room, item 13;
- only sheets with a thickness of 20 mm and 60 mm were used, which were in stock at E.M. Lona.

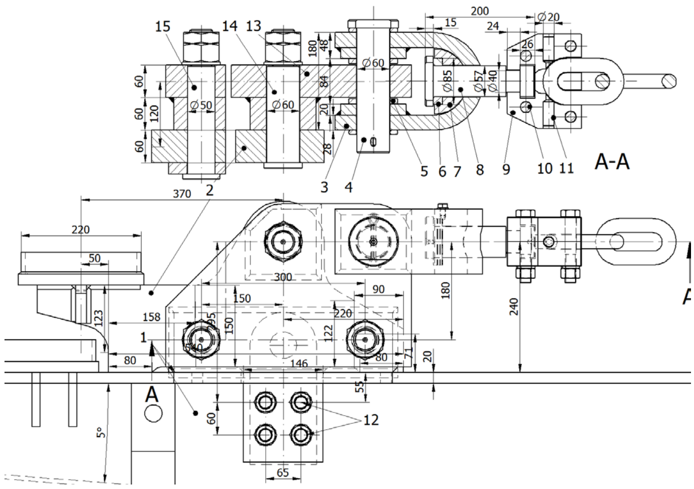

Figure 3. The calculation model for the system of connection to the actuation station [7]

Based on the constructive solution in figure 2, the calculation model with the constructive dimensions was drawn up in order to verify the dimensions of its elements, which is presented in figure 3, where the following were noted: 1 - the wall of the actuation station; 2 – ear fixed on the station; 3 - device ear; 4 – joint bolt Φ60x270; 5 - spacer ring; 6 – wear ring; 7 – wear ring support; 8 - towing rod

Φ57x200; 9 - clamp; 10 - screw M20x100; 11 – centering pin Φ20x45; 12 - screw M24x100; 13 – side connecting plate; 14 – locking bolt Φ60; 15 – locking pin Φ50.

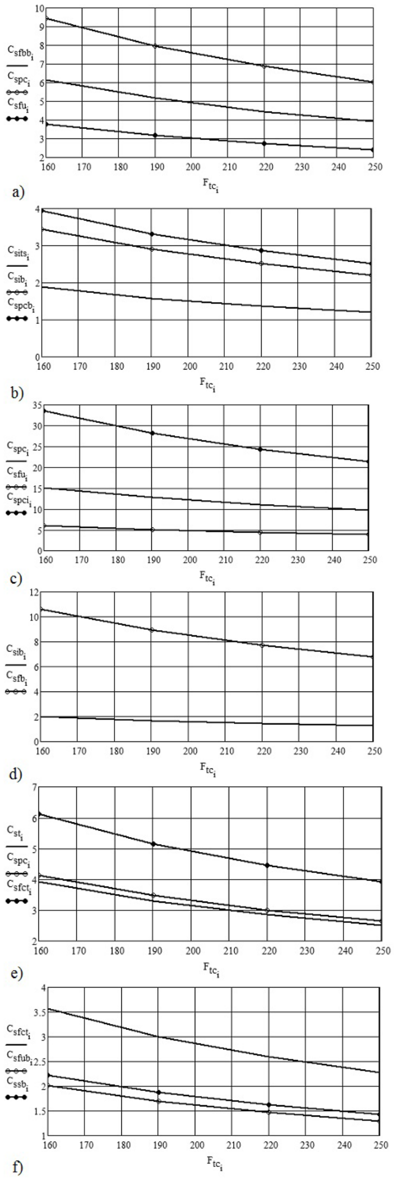

Figure 4. The variation of safety coefficients of the linkage system at the drive station

Based on the calculation model in figure 4, a calculation breviary was drawn up in MathCAD for the variation of the in figure 5 for the following constructive elements:

- side connecting plate, 13, (fig. 4a);
- the ear fixed on the station, 2, (fig. 4b);
- the ear of the connecting device, 3, (fig. 4c);
- joint bolt Φ60x245, 4, (fig. 4d);
- towing rod Φ57x200, 8, (fig. 4e);
- chain link clamps, 9, (fig. 4f).

Safety factors were obtained by referring to the mechanical characteristics of steel OL 37, yield strength of 210 N/mm^2, for plates and improved OLC 45, yield strength of 500 N/mm^2, for bolts. The lowest values are at bolt bending, reference 4, C_{sib}=1.28, and at the shearing of the chain fixing flange, reference 9, C_{sfub}=1.29, these values can be amplified 1.7 times if the reporting is does the breaking strength.

Based on the execution documentation, it was made at E.M. Lonea the chain link system of the combine to the drive station, figure 5.

traction force of the F_{tc} combine between 160 and 250 kN, and the values of the safety coefficients are shown graphically

Figure 5. Chain tying system at the station of action executed at E.M. Lone [7]

3. TIE-DOWN SYSTEM AT THE RETURN STATION

Figure 6 shows the constructive solution for placing the end of the calibrated chain with 26x92 links of the advance mechanism of the 2K-52MY combine, reference 2, to the metal construction of the turning station, reference 1.

The constructive solution of the binding system is shown in figure 7, which consists of: 1 – ear fixed on the station; 2 – joint pin Φ60; 3 – chain clamping device; 4 – screw M30x100; 5 – screw M30x200.

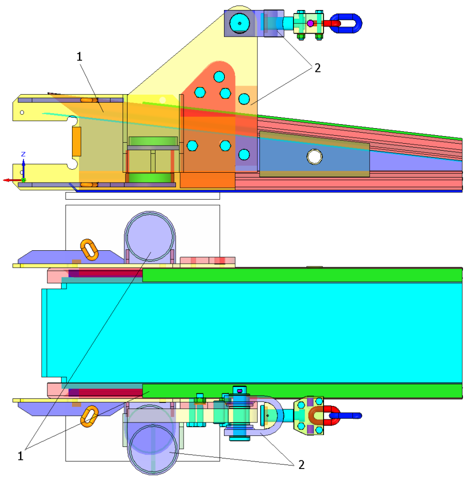

Figure 6 The location of the tying system on the return station [7]

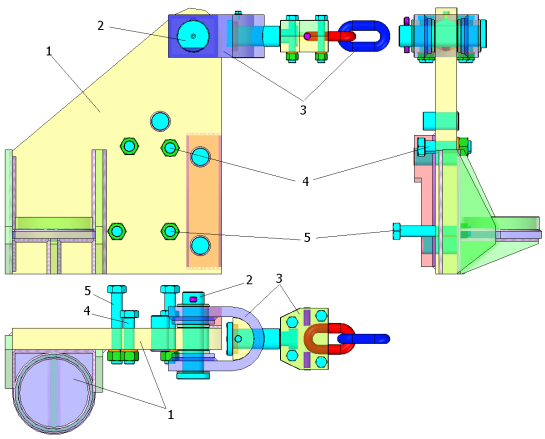

Figure 7. The constructive solution of the chain end binding system on the TR-5 return station [7]

The chain end binding system on the TR-5 return station has the following constructive improvements:

- the ear that is fixed on the station, on the lifting eye by means of a Φ50 bolt and four M30 screws, has on the front a threshold stiffened by two Φ50 bolts, which blocks the rotation of the ear against the wall of the station;

- on the outer side of the ear, the support for the SVJ hydraulic post anchoring the station was placed, in a more solid welded construction than the one on the return station;

- by overlapping the supports for the pole, the wrong location of the anchoring pole is avoided;

- in the case of changing the turning station, a part of the stiffening gussets of the pole support on the turning station, on the mounting side of the eye, must be cut with an oxyacetylene flame, and the two holes for the M30x100 screws must be made in the lifting eye.

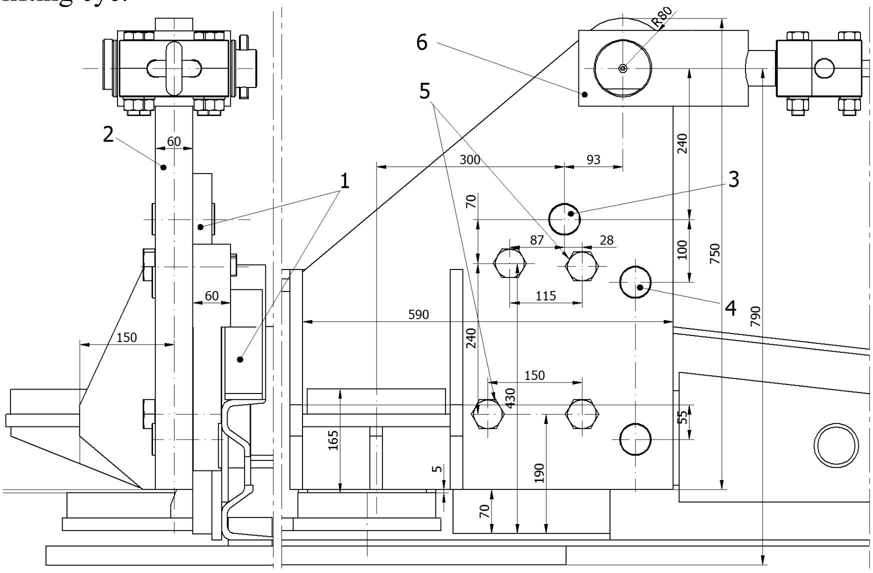

Figure 8. The calculation model for the tie system at the return station [7]

Based on the constructive solution in figure 6, the calculation model with the constructive dimensions was drawn up in order to verify the dimensions of its elements, which is presented in figure 8, where the following were noted: 1 - the station's lifting ear; 2 - ear of the binding system; 3 - bolt Φ50x100; 4 - bolt Φ50x120; 5 - screw M30x100; 6 - chain binding device.

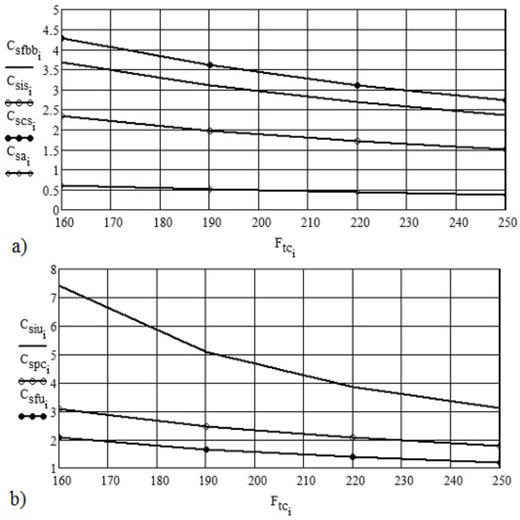

Figure 9. The variation of the safety coefficients of the tying system at the return

Based on the calculation model in figure 8, a calculation breviary was drawn up in MathCAD for the variation of the traction force of the F_{tc} combine between 160 and 250 kN, and the values of the safety coefficients are shown graphically in figure 9 for the following constructive elements:

- assembling the ear on the wall of the station with the bolt Φ50x80, 4, and the screws M30x100, 5, (fig. 9a);
- the lifting eye of the station, 1, (figure 9b).

Because the value of the sliding safety coefficient C_{sai} has low values, the additional blocking of the ear compared to the lifting eye of the return station was achieved with bolts

station	Φ50x120, reference 4, and a vertical ruler.

Based on the execution documentation, it was made at E.M. Lonea system for connecting the combine chain to the return station, figure 10.

In order to verify the placement and movement of the 2K-52MU combine on the conveyor made of TR-5 stations, TR-6 chutes and TR-7A sides, the assembly in figure 11 was made in the Mechanical Workshop of E.M. Lonea, having installed on the stations the new systems for tying the chain ends of the forward mechanism of the combine.

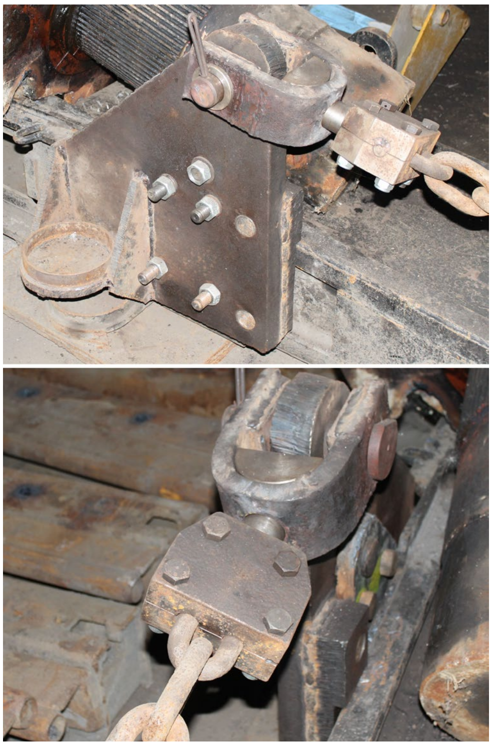

Figure 10. Chain tying system at the station of return executed at E.M. Lone [7]

Figure 11. Mounting the combine on the conveyor [7]

4. CONCLUSIONS

Even if the cutting height of the combine is not correlated with the felling height, it resulted in an increase in productivity with a minimal investment in the modernization of the felling.

By adapting the felling combine 2K-52MU to a conveyor with hybrid scrapers, TR-5 stations, TR-6 troughs and TR-7A sides, experience was gained in the use of these machines in the operation of frontal fellings with individual support and cutting with combine.

By attempting to move the combine on the conveyor, the systems for tying the chain ends of the advance mechanism at the conveyor stations were checked.

The information obtained following the re-engineering of the slaughterhouse from E.M. Lonea, with the advantages and disadvantages of applying the method, will allow in the future to optimize the correlation of machines in a short-front slaughterhouse.

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