ASPECTS RELATED TO THE USE OF HIGH CAPACITY FACE CONVEYORS

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Abstract: Production increase in the long faces is generally based on the creation of adequate machineries especially high capacity conveyors. The degree of use of face conveyors depends mainly on the reliability of their sub-ensembles and also on the completion of maintenance activities according to a maintenance schedule while respecting the quality characteristics of materials and spare parts necessary for maintenance.

Key-words: wear, trough, chains, scraper, cog rack

1. INTRODUCTION

Haulage represents one of the main links of the mining process; the proportion of haulage costs within the total production cost of one ton of useful extracted mineral substance from the mine reaches 50%. Armoured Face conveyors represent the main haulage machinery used in coal long faces. The National Coal Company Petroşani uses two types of high capacity armoured face conveyor, i.e. TR-7A and TAGOR-260/750, the later one being used in Lupeni Coal Mine.

2. TR-7A AND TAGOR-260/750 CHARACTERISTICS

The TR-7A double chain conveyor (Figure 1, Table 1) is used for the haulage of coal from long faces operating within mechanised complexes for medium and thick layer faces. The conveyor may operate together with the longwall powered complex with weights up to 400 kN. It may also be used in longwalls with individual supports.

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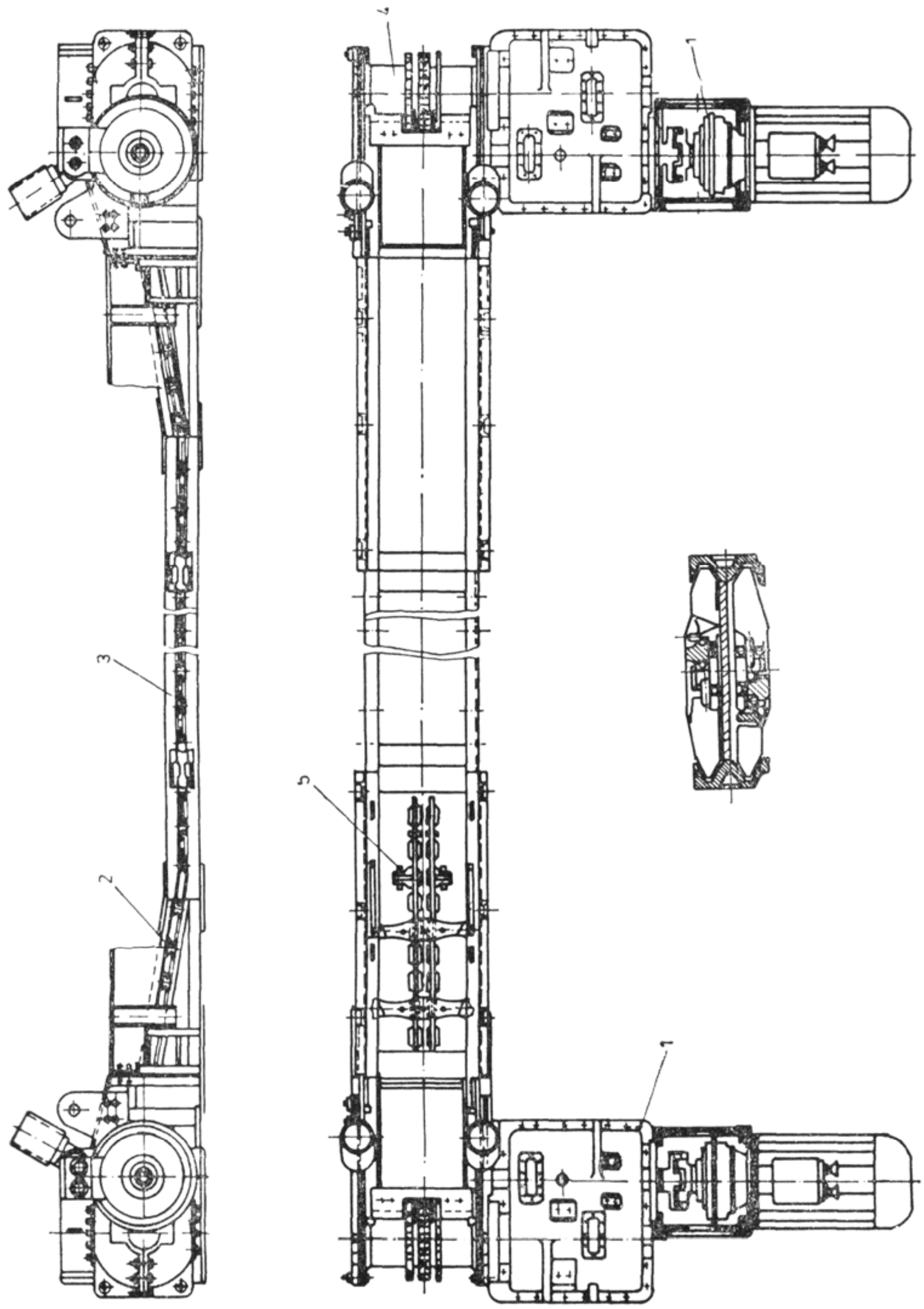

Fig. 1. TR-7A type push conveyor

Table 1. **Main characteristics of TR-7A type push conveyor**

Characteristic	Unit	Value
Technical – functional characteristics		
Haulage capacity		
- for V = 0.7 m/s	t/h	450
- for V=0.9 m/s	t/h	600
Chain speed	m/s	0.7/0.9
Angle of turning	Degrees	
- vertically		±6
- horizontally		±3
Haulage length	m	120
Constructive characteristics		
Installed power	kW	2×125 (110)
Electric motor speed	Rpm	1470
Supply tension	V	660
Electric installation construction		Fire proof
Haulage mechanism		chain 26×92
- breaking point	kN	min. 850
-scrapper pace	mm	920
- number of branches	pcs.	2 central
Trough dimensions :		
- length	mm	1500; 1000; 700; 500
- width	mm	736
- height	mm	220
Conveyor dimensions:		
- length	m	120 (informativ)
- width	mm	3914
- height	mm	1210
Weight	t	66

It operates in longwalls with slopes between +35° and -35°, on a minimum accepted specific resistance to compression bottom of 50 N/cm^2. For slopes over 10° the conveyor will be secured against sliding.

The TR-7 face conveyor is composed of the following main sub-ensembles:

- The main operation station (1) composed of a metallic frame, operation cylinder and powered drive (composed of electric engine, hydraulic coupling, guriflex coupling and reducer);
- The role of the intermediate trough (2) is to ensure a smooth passage from the main operation station to the trough column. It is a welded construction formed of sigma E 74 expanded feather form outriggers, bound together through a centre plate.
- The trough column (3) is composed of troughs made of sigma E 74 profiles bound together through a centre plate resistant to wear. The trough binding system is a “dog bone” type system resistant to forces

appeared during the production process;

- The return point (4) is composed of a metallic frame, return cylinder and and stretching system;
- The hauling system (5) is composed of a double layer conveyor chain on which the troughs are mounted.

The TAGOR-260/750 type face conveyer (Figure 2, Table 2), installed for the first time in our country in Lupeni Mine, operates together with the KSW-460NE type powered complex (Figure 3). The conveyor is fitted with elements ensuring the movement of the powered complex through an Eicotrack type advance mechanism.

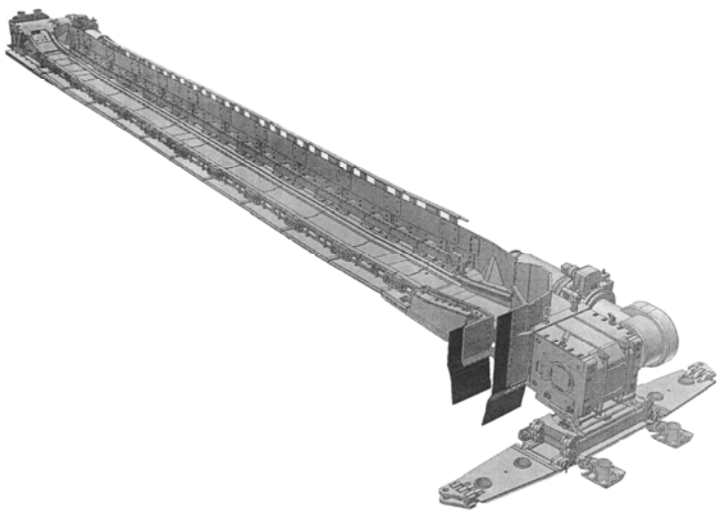

Fig. 2. TAGOR-260/750 type face conveyor with lateral dumping version

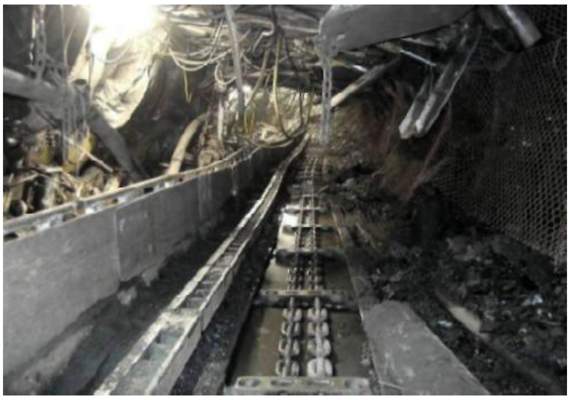

Fig. 3. Tagor powered complex Lupeni Mine

The Tagor type face conveyer is an iron-cased conveyer with 1×65/200 kW installed power at the dump point and 1×65/200 kW at the return point, the supply voltage is 1000 V, with lateral (right, left) or front dumping version, ± 35° maximum longitudinal inclination, ± 25° maximum transversal work inclination, forged-welded troughs, 1000 t/h conveyer discharge.

Table 2. **Main characteristics of the TAGOR-260/750 type face conveyor**

Characteristic	Unit	Value
Installed power at the dump point	kW	1×65/200
Installed power at the return point	kW	1×65/200
Power supply	V	1000
Dump option	-	lateral (right, left) or frontal
Combination advance system	-	No Eicotrack chain with a 125 mm division
Haulage length	m	112
Maximum longitudinal slope	Degrees	±35
Maximum transversal slope	degrees	±25
Reducer	-	conic-gear
- size	-	15, conf. RAGN 335 000
- transmission ratio	-	33, conf. RAGN 335 000
Coupling type	-	elastic
Trough raceway	-	Based on moulded – welded troughs
- profile height	mm	260
- profile roughness	HB	min. 300
- trough length	mm	1500
- external width of the chute	mm	755
- the maximum inflexion angle of the troughs	Degrees	Horizontally 1.3
	Degrees	Vertically 2.5
- width of the sliding plate	Mm	35 (min. roughness 400 HB)
- width of the bottom plate	Mm	20
- trough connection resistance	kN	min. 2500/o connection
Scrapper chain	-	-
- type	-	2×30×108 class PW9 or chain 2×30×108 with smaller breaking force 1280 kN
- gauge	Mm	130
- scrapper interval	Mm	1080 (every 10 link)
- linear speed	m/s	1.12
Anchorage system	-	Hydraulic ensemble HZN-600
Fast connection thimble	-	30×108 class PW9 or other thimble 30×108 with a smaller breaking force of 1150 kN
Conveyor flow	t/h	1000

Four hydraulic units with T-125/32 type pump situated in PTS Cpx transformation post provide hydraulic agent (high pressure) for powered support.

The powered unit is equipped with a monitoring dispatching system providing monitoring and displaying the position of the face machine and its working parameters, monitoring and displaying operating parameters for the sections, the hydraulic agent's pressure, the water spraying pressure, the state of the tools.

The TAGOR-260/750 type face conveyor is composed of three main sub-ensembles:

- The dump drive mechanism (lateral or frontal) composed of:
  - A drive unit;
  - The dump drive mechanism, together with the drive sprocket (adapted to lateral or frontal dump);
  - Lateral dump segment (with the possibility to pass to frontal dump) (Figure 4);
  - The segment attachable to the secondary drive;
  - The support base for gliding and anchorage of the dump drive (adapted for a lateral or frontal dump);

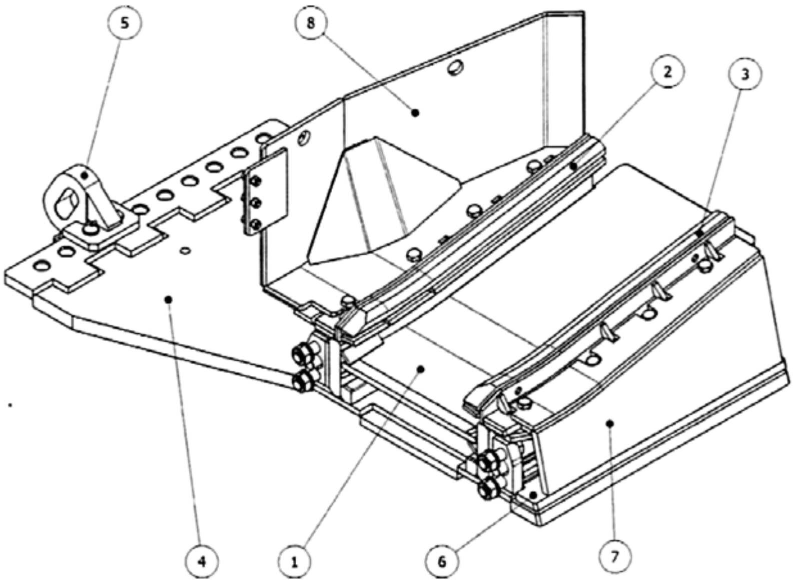

Fig. 4. The connection segment with lateral dumb of the TAGOR-260/750 type face conveyor: 1 – connection trough; 2 – left slider; 3 – right slider; 4 – secondary operation plate; 5 – attachment handle; 6 - spur

- The drive mechanism from the return station is composed of:
  - A drive unit;
  - Return drive mechanism (Figure 5), together with the drive sprocket and the secondary drive plate.
- The trough ensemble is composed of:
  - The main raceway segments (Figure 6);
  - Raceway controllable segments;
  - Passage segments next to the drive from the return station;
  - dump connection segment;
  - return station connection segment;
  - scrapper chain.

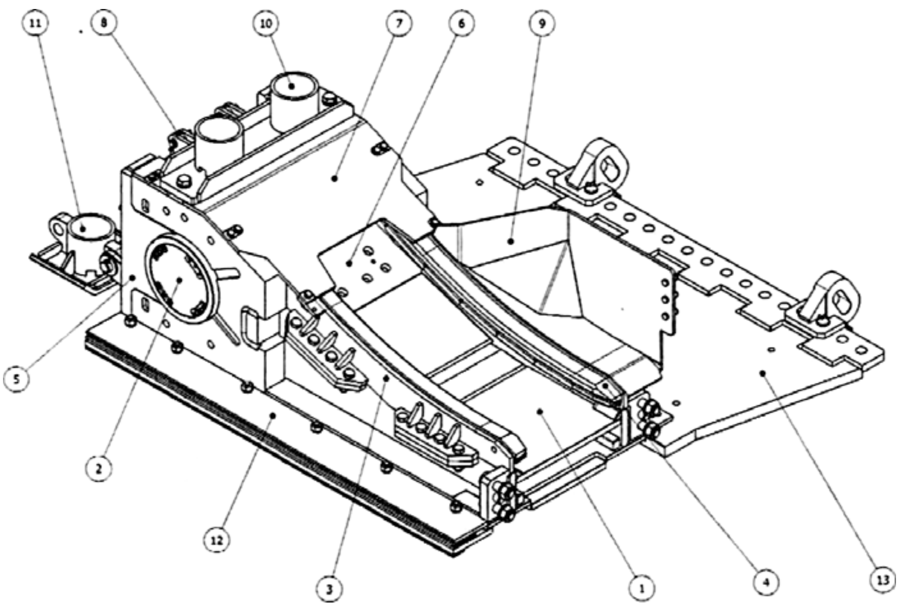

Fig. 5. Return station body of the TAGOR-260/750 type face conveyor:
1 – drive case; 2 – drive sprocket ensemble; 3 – left slider; 4 – right slider;
5 - lock; 6 –ejectors and ejector plate; 7 – superior lid; 8 – frontal lid; 9 - shield;
10 – anchorage beam; 11 – anchorage bottom; 12 - spur; 13 – secondary drive plate

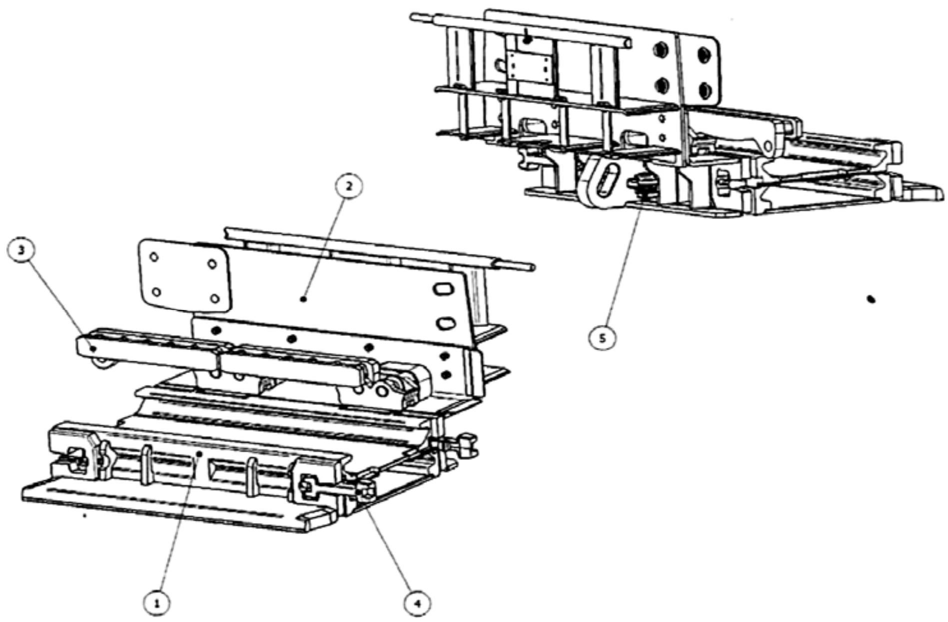

Fig. 6. Main raceway segment of TAGOR-260/750 type face conveyor:
1 – trough 1500; 2 – cable routing device; 3 – Eicotrack cog rack;
4 – connection element TI; 5 – safety connection device

3. FAIL AND WEAR ANALYSIS OF THE COMPONENTS OF THE TR-7A AND TAGOR-260/750 TYPE FACE CONVEYORS

Comparative appreciations of operational behaviour of TR-7A and TAGOR-260/750 type face conveyors suppose the physic analysis of most frequent failures. In the case of the TR-7A face conveyer, the reliability study is based on the determination of failures and the period of time needed for remediation (Table 3, Figure 7).

It may be observed that most of the failures are chain breaks leading to important production lose, with unwanted implications on economic earning performance of the units.

Table 3. **Flaws of the TR-7A face conveyor**

No.	**Name of the flaw**	**No. of failures, n_i**	**Failure frequency, f_i**	***MTR***	**Proportion of repair time, p_i**
1	Chain break	13	0.2708	2.878	0.1170
2	Broken motor	10	0.2083	4.591	0.1865
3	Electric flaws	7	0.1458	2.178	0.0885
4	Other minor electrical defects	6	0.1251	6.160	0.2502
5	Replaced reduction sprocket	5	0.1042	3.083	0.1252
6	Replaced hydraulic coupling	5	0.1042	2.599	[illegible]056
7	Seized up bearing	2	0.0417	3.124	0.1270

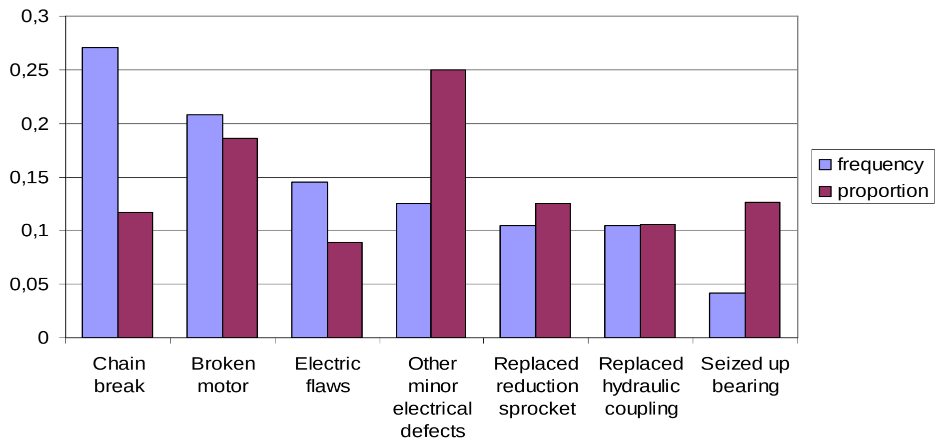

Fig. 7. Pareto diagram of TR-7A type conveyor failures

Together with the previously mentioned failures, the wear of troughs and their replacement create a special problem. The Tagor260/750 type face conveyor, recently imported in Romania, operates as a Tagor powered complex together with he KSW-460NE type combination machinery, installed at Lupeni mine. The limited size of the wear of the sliding plate of the trough, for a hauled coal quantity (in million of tons) is determined as follows:

$$W_g = G - (A + 0{,}1 \cdot A) \cdot P, \quad \text{mm} \tag{1}$$

where: A = 5 mm/*l*m*l*nt - the wear for *l*m*l*n tons of hauled coal; G - width of the sliding plate, mm; P - hauled coal production in millions of tons, m*l*nt.

Considering a sliding slope of a width G = 35 mm, the value of the limited dimension W_g in its median part (point B) (Fig. 8, Fig. 9), which practically eliminated the trough from the exploitation is 16 mm.

Therefore, the limited width of connections (points A, C or D) which eliminate the trough from exploitation is 4 mm.

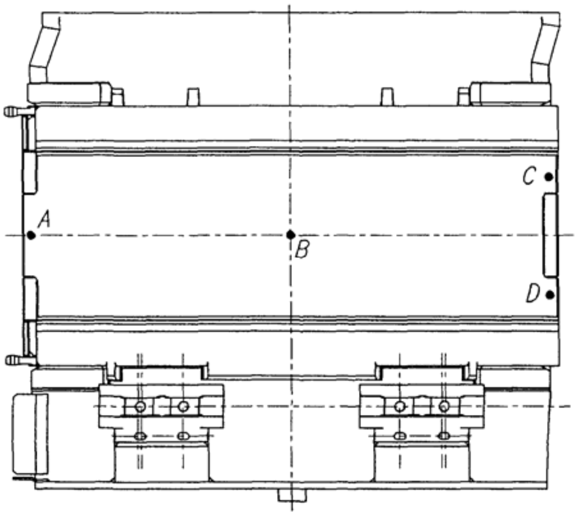

Fig. 8. Measurement points of the slipping plate thickness of Tagor conveyer

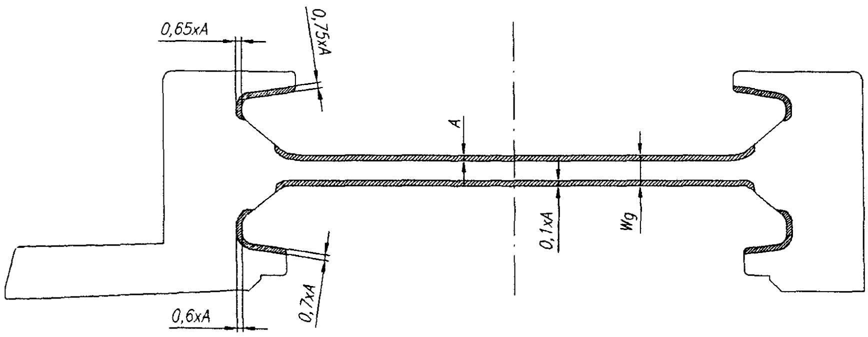

Fig. 9. Limits values of the slipping plate weare

The Tagor powered complex of Lupeni mine allowed the observation of operational behaviour of all the machineries composing it, therefore a series of wear have been noticed on several sub-ensembles: i.e. troughs, chains and scrappers of the Tagor face conveyor as well as the Eicotrack cog rack (Fig. 10).

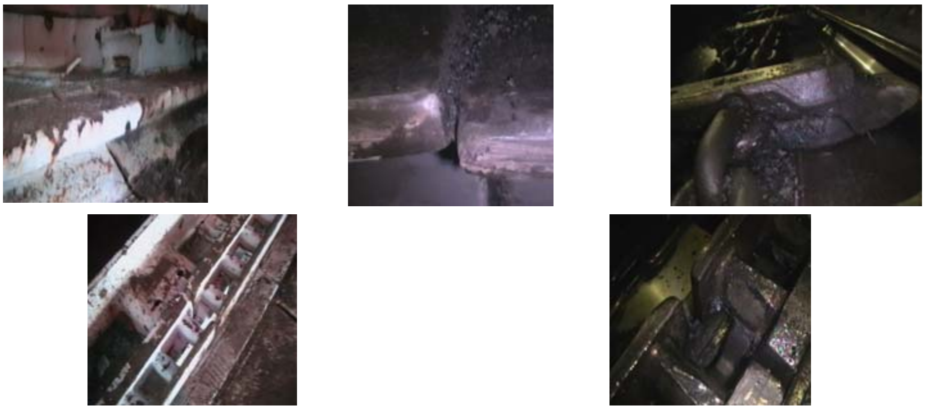

Fig. 10. Worn sub-ensembles of the Tagor powered complex: the 1500 mm trough, connection elements, chains, flights, scrappers and Eicotrack cog rack in the base segment of the raceway.

Giving examples of the wear of troughs and Eicotrack cog rack from the basic segment of the raceway and other components proves the need to observe the operation of these machineries in order to establish the causes and measures to be taken for the increase of their reliability.

4. CONCLUSIONS

The observation of operational behaviour of face machineries needs to be made depending on the causes leading to failure: constructive or technologic design, installation errors, working environment and the human factor. Considering the high capacity push conveyors (TR-7A, Tagor) it is observed that the same sub-ensembles frequently wear off, i.e. troughs, chains and scrappers, due to the same causes or depending on the constructive solution and respecting the maintenance activity. The worn off troughs which need to be replaced imply important break-offs of the operational cycle, as well as extra costs, therefore reliability being a problem for mining equipment manufacturers.

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