NON-DESTRUCTIVE CONTROL ON QUARRY MACHINERY TYPE ERc 1400-30/7

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ABSTRACT: Non-destructive analysis, visual control and penetrating fluids methods as well as ultrasonic thickness control are easily applicable to machinery in lignite quarries and can reveal major defects on both the load-bearing structure and the main kinematic elements of the safety mechanisms.

KEY WORDS: visual control, penetrating fluid method, excavator with rotor type ERc 1400-30/7, ultrasonic thickness control

1. INTRODUCTION

The extraction of lignite in the coal basins of Oltenia is carried out using continuous-action operating systems consisting excavators of rotors.
The main equipment for the stripping of sterile material or the excavation of lignite is the excavator with rotor type ERc 1400-30/7, Figure 1, originating from the German variant SRs 1400 designed by KRUPP, assimilated in Romania [2, 6].

Figure 1 - The excavator with rotor type ERc 1400-30/7

Periodically, they shall be checked through technical expertise for the purpose of extending the functioning life.
Therefore, in order to assess the state of degradation of a machine and to estimate its potential period of operation, it is necessary to carry out, through maintenance work, non-destructive controls, in the main areas of load-bearing structures or on the main safety mechanisms, lifting/descending cables, pins within the lifting mechanism, etc. [4, 7].

2. The main methods used in non-destructive control in quarry machinery

Being a large machine with a working mass of 2100 tons, a height of 34.8 m and taking into account working conditions, the non-destructive methods that can be applied are:

- Visual control - It will be performed for the entire load-bearing metal construction or safety elements. Constructive elements: beams, crossbeams, pillars, diagonals, bolted cover plate, stiffeners, etc. must not be deformed, cracked, broken or accentuated corroded. Cables must not have broken wires. No pinches, cracks or breaks of the pinion teeth should occur in the pinions.

- Non-destructive examinations (NDT), PT(Liquid penetrant testing), UT (Ultrasonic Testing), VT (Visual Testing) shall be carried out on the welding cords and adjacent surfaces of the heavy-demanded load-bearing construction elements, as well as in the areas severely affected by corrosion.
- Dimensional control and geometric deviations – will be performed on the geometric system of the subassembly (or on load-bearing elements) and checked with the documentation of the execution of the machine.

3. Case study – Non-destructive analysis for ERc 1400-30/7

As part of the presented revision, non-destructive control was carried out on both the load-bearing structure as on the lifting mechanism – lowering the portcup wheel arm. The study on load-bearing metal construction shall be carried out by penetrating liquids or by US control for measuring material thicknesses or welded wheels [1, 3].

Although it does not have excessive load, the node pillar 8', figure 2, after visual control did not show microcracks, figure 3.

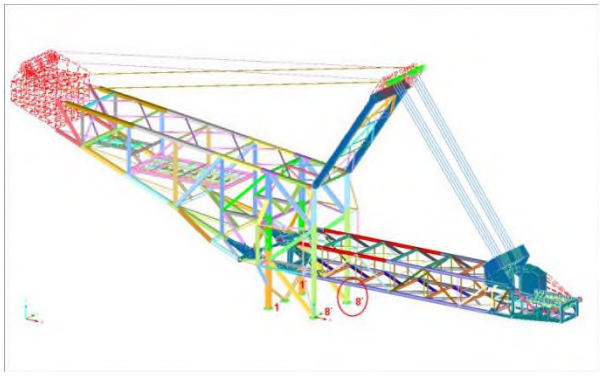

Figure 2 - The excavator with rotor type ERc 1400-30/7

Figure 3 - Lack of microcracks in visual verification

On a closer inspection with penetrating liquids, the microcracks were highlighted, figure 4, figure 5.

Figure 4 - Application of the developer to the micro-cracked area

Figure 5 - Microcracks in the area of ZIT and fatigue

Another situation is the working pinion within the lifting-descending mechanism, figure 6, position 7.

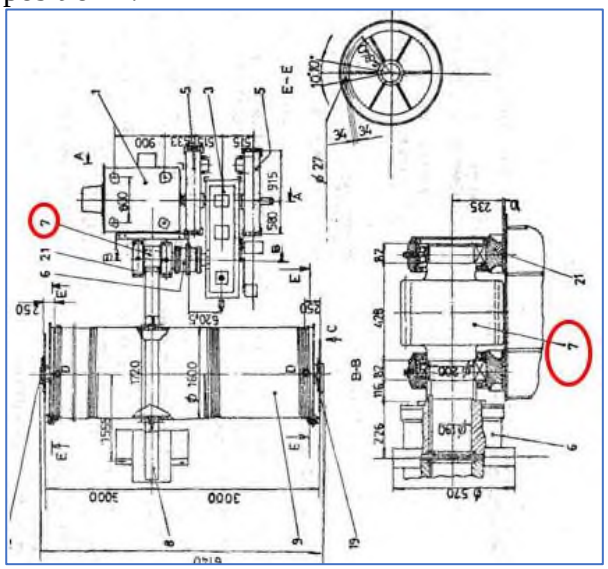

Figure 6 - Lifting–descending mechanism arm

Pinion-wheel gear defects were found in the visual control. After cleaning in several contact areas and applying the specific control procedure with penetrating liquids, both the pitting phenomenon, fig. 7.d and the micro longitudinal fissure on the flank of the tooth, fig. 7, b, c., were founded. Moreover, on the tip of the tooth appeared a rupture of the material, fig. 7.a.

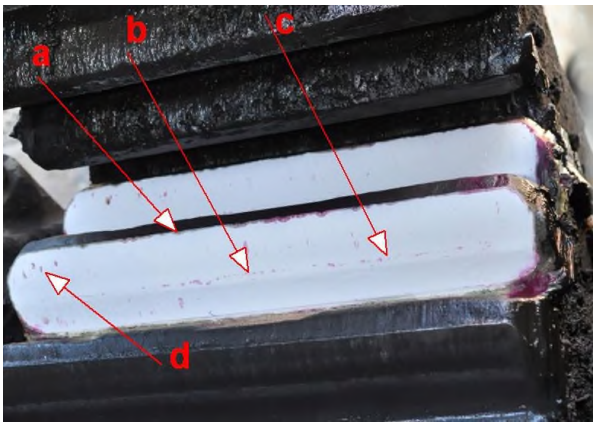

Figure 7 – Defects highlighted on the pinion that operates the lifting–descending mechanism arm

Another situation in which both the visual control and the one with penetrating liquids is used is the verification of the screws and of the possible cracks at the base plates of the pillars of the tower node 8` and 8.

Thus, after cleaning the area, applying the penetrating liquid, removing the excess liquid and applying the developer, the area was checked, figure 8.

Figure 8- Examination of the welded joint of the base plate - column node 8` and 8

If the visual cracks could not be observed during the visual inspection, figure 9 by applying the method with penetrating liquids was found both the crack area, figure 10.a and the damage of the fastening screws, figure 10.b.

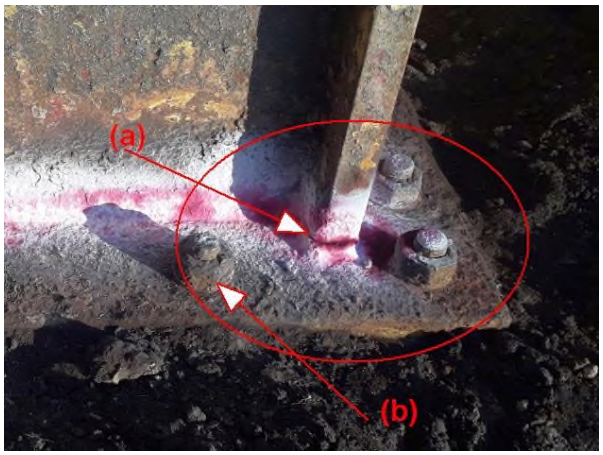

Figure 10 a. Crack on the base plate-pillar; b. Damaged screws

It is often applied the combination of the visual inspection method and the thickness measurement method is, Figure 11

Figure 11 a. Cleaning the area for ultrasonic control

The next step is to apply a contactor solution, figure 12.a, and effectively measure the thicknesses with the apparatus.

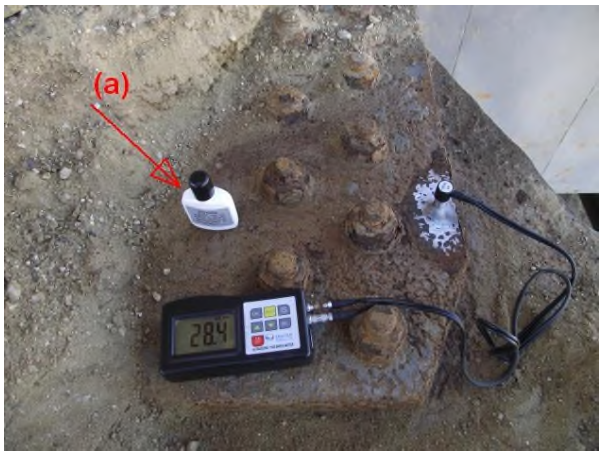

Figure 12 Measurement of the plate thicknesses by ultrasonic method; a - glycerin used to make the plate contact

After performing the in situ measurements, they are compared with those prescribed in the basic documentation of the machine [6].

CONCLUSIONS

From the experiments carried out it can be concluded that the three methods described, visual control, penetrating fluid și ultrasonic thickness control are easily applicable to such machines and may reveal major defects which may endanger the safety of the machine.

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