

# POSSIBILITIES TO REDUCE INTERRUPTION IN THE EXCAVATOR E<sub>s</sub>R<sub>C</sub>-1400 FUNCTIONING BY IMPROVING CENTRALIZED LUBRICATION SYSTEM OF BEARING PRESSURE

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## Abstract

The flawless and sustainable operation of an bucket-wheel excavator depends on the constructive solution of the lubrication system. The paper analysis the failures of the some component elements of pressure bearing lubrication installation of the E<sub>s</sub>R<sub>C</sub>-1400 type excavator slewing mechanism. In order to reduction the number of failures and the production loss, are proposed technical solution for the improvements of structure and lubrication installation circuit of this bearing.

**Keywords:** bucket-wheel excavator, lubrication system.

## 1. Introduction

Bucket wheel excavators are being used in Romania since 1969, in Rovinari, Gârla quarry. The excavator was initially imported from Germany (Krupp), it was assimilated during construction, in several steps and suffered several changes in order to be adapted to specific operational conditions of Romania's open-pit mining. For the same reason we can be analysed two different types of excavators: both old as well as modernized ones.

The swivelling superstructure of the E<sub>s</sub>R<sub>C</sub>-1400 type excavator its crown gear is solidarized to the chassis is laid on an 8650 mm ball bearing diameter. The swivelling of the superstructure is made by the swivelling mechanism through of two reducers foreseen with a break and safety couplings. The safety coupling breaks the operation in case of an overload, which may be provoked by lateral contact of the bucket-wheel with the slope wall, ensuring therefore the swivelling of the superior structure of the excavator to 360°.

The lubrication of the bearing of the crown gear is made by several oil electrical pumps supplies the lubricating points placed on the circumference of the bearing race. The oil pass through a closed circuit returning therefore in the pump's reservoir, passing first through a filter. The pump drive works through interlocking with a rotary mechanism, the

operation of which starts after the operation of the lubricating electric pump begins.

## 2. General aspects of lubricating system

However correct should be processed contact surfaces of the two parts moving relative to each other at their level of friction forces occur. According to existence or not a substance of lubrication between moving surface, this friction can be: dry, semifluid and fluid.

To the stationing of machine, because static load is removed lubricant between the two surfaces, making contact directly on top of that surface roughness, leaving only a small amount of lubricant in the gaps between the roughness; the lubrication will be incomplete start up, semifluid or even dry if the machine was stationed a long time.

Semifluid friction can occur as a result of a deficient or insufficient lubrication and to start and stop the machine when speed too low because you cannot enter the required oil layer between the two surfaces moving relative.

In the normal conditions working regime of the machine and equipment take place the fluid friction. This can maintain when between the surfaces is achieved displacements at high speed, presses the surfaces being subjected to medium and are supplied continuously with lubricants.

Lubricants are fluids, viscous or solid materials, which can spread between the contact surfaces of two solid so to replace dry friction between the two bodies through a fluid friction, diminishes friction and to prevent excessive heating.

The lubricant materials must perform several conditions, the main are:

- able to form layer of lubrication to reduce friction;
- to be adherent to the contact surfaces, not leak when the temperature increases and not harden it to a decrease;
- to provide transportation friction heat or produced from chemical reactions to the outside, so the bodies in contact and by itself flow of lubricant;
- transport ensure active chemical compounds mainly oxygen producing oxide layer;
- to provide protection against impurities penetration from outside.

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General progress of technology and operational conditions more severe imposed friction assemblies determined searching and finding new solutions in the field of lubrication systems and methods. Thus, in the field of fluid lubricants are great actuality semiautomatic and automatic centralized systems. This realizations allow solving some of the difficult problems evidenced by the current practice of lubrication [1].

By using such systems requires knowledge of calculation and obligatory principles of construction and operation for equipment which must to be lubricated.

### 3. Pressure bearing lubrication

The pressure bearing lubrication diagram of excavators imported from Germany foresaw a DII type lubricating pump, while the following local excavators have been foreseen with 2 types of pumps:

- lubricating electric pump code 6.651.000.600, realized by “Red Star” București;
- pump type G3-8”.

Both hydraulic diagrams have the same pipe trajectory, corresponding several pipes start from one pump to the lubricating points of the pressure bearing (figure 1).



**Fig. 1** Initial version of lubrication system to the pressure bearing

By reason of frequently defects due to pipe clogs and special pump complexity (table 1) is prefigured necessity to improvement of the lubrication system.



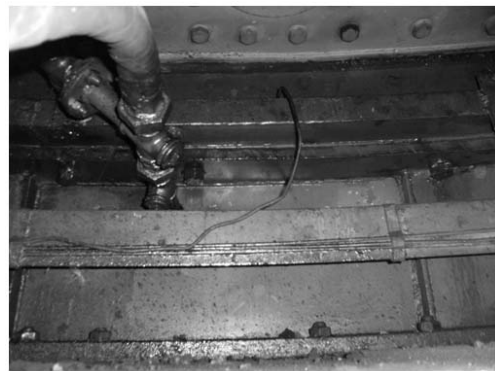
**Fig. 2** Modified pipe circuit to the pressure bearing

The new lubrication installation is supposed change of the pipes circuit structure: therefore an enlarged diameter pipe leaves from the pump, the ramifications of which reach the lubricating points of the pressure bearing.

Initial, in this version it was kept lubricating electric pump from excavator supply; after that at excavators subject to modernization process has been make following modifications (figure 2):

- modification of form of the pipe circuit;
- utilization of the AFuz0,1/20R pump produced in Germany.

Figure 3 presents a detailed image of one of the 20 points of lubrication bearing for swivelling superstructure.



**Fig. 3** Detail of the lubrication point to the pressure bearing

### 4. Defects of the centralized lubrication system of the pressure bearing

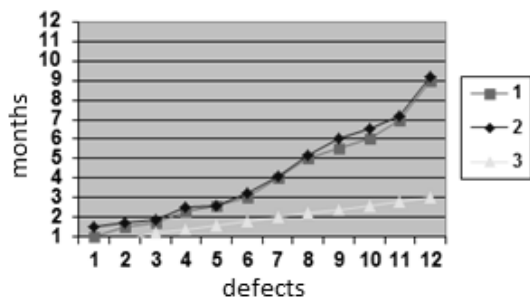
Pressure bearing centralized lubrication system defects monitoring during a year allowed the identification of frequent ones, such as:

- defects due to the lubricant quality (clogging of philtres, oil duct, etc.); the lubricant used is TIN 82 EP 90 24, but some defects were the causes improper oil viscosity considering environment temperature change;
- wear of the oil pump nuts due to inadequate materials and occur of bearing clearance;
- coupling defects of oil pump;
- defects of pipe circuit (obstructing and deforming of the pipes) as well as control impossibility of oil quantity and distribution from installation, respective the risk of uniform lubricate of the all bearing points;
- existence of many elements connected (elbows, couplings) and thus the risk of improper sealing-off;
- deteriorate of elastic elements of the rubber freewheeling clutch of pump AFuz0,1/20R;
- wear of toothing worm clutch at electric pump type 6.651.000.600.

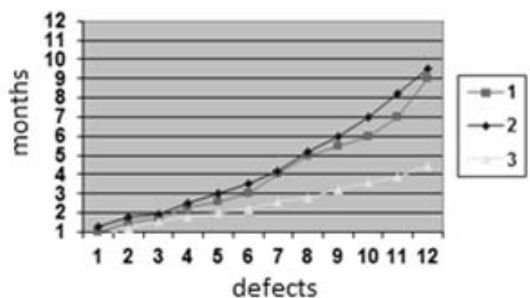
**Table 1** Analysis of defects found during operation the installation of bearing pressure at different excavators type  $E_3R_C-1400$

| Type pump  | Excavator   | Cause defect    |          |             |                |           | Data of defect | During repair (h) | During of mounting(h) |
|------------|-------------|-----------------|----------|-------------|----------------|-----------|----------------|-------------------|-----------------------|
|            |             | Pipe trajectory | Coupling | Own defects | Sealing system | Lubricant |                |                   |                       |
| Pump G3/8' | 03 Jilț Sud | 4               |          |             |                |           | 15.08.10       | 2.65              | 0.8                   |
|            |             |                 | 3        |             |                |           | 21.09.10       | 1.8               | 0.66                  |
|            |             |                 |          | 4           |                |           | 04.02.11       | 2.45              | 1.2                   |
|            |             |                 |          |             | 4              |           | 04.04.11       | 0.7               | 0.5                   |
|            |             |                 |          |             |                | 3         | 06.11.11       | 1.5               | 1.0                   |
|            |             |                 | 1        |             |                |           | 02.02.12       | 3.0               | 0.75                  |
|            |             |                 |          |             | 1              |           | 25.02.12       | 1.2               | 0.35                  |
|            | Total       |                 |          |             |                |           |                | 13.3              | 5.26                  |
|            | 04 Jilț Sud | 4               |          |             |                |           | 12.11.10       | 3.5               | 2.0                   |
|            |             |                 | 4        |             |                |           | 03.08.10       | 1.5               | 0.6                   |
|            |             |                 |          | 3           |                |           | 01.12.10       | 3.5               | 0.5                   |
|            |             |                 |          |             | 3              |           | 03.05.11       | 1.2               | 0.5                   |
|            |             |                 |          |             |                | 3         | 05.05.11       | 2.5               | 0.5                   |
|            |             |                 | 2        |             |                |           | 12.12.11       | 1.36              | 0.5                   |
|            |             |                 |          |             | 2              |           | 26.02.12       | 3.36              | 1.15                  |
|            | Total       |                 |          |             |                |           |                | 16.92             | 5.75                  |
|            | 12 Jilț Sud | 3               |          |             |                |           | 10.10.11       | 6.5               | 2.0                   |
|            |             |                 | 2        |             |                |           | 20.12.10       | 0.9               | 0.5                   |
|            |             |                 |          | 2           |                |           | 03.02.11       | 2.5               | 1.0                   |
|            |             |                 |          |             | 2              |           | 11.05.11       | 0.8               | 0.5                   |
|            |             |                 |          |             |                | 1         | 07.08.11       | 3.5               | 1.5                   |
|            |             |                 |          | 1           |                |           | 10.12.11       | 2.5               | 1.25                  |
|            |             |                 | 2        |             |                |           | 12.02.12       | 1.86              | 0.36                  |
|            | Total       |                 |          |             |                |           |                | 18.56             | 7.11                  |
| Pump AFuz  | 01 Rosiuța  | 1               |          |             |                |           | 16.09.10       | 2.5               | 1.45                  |
|            |             |                 | 2        |             |                |           | 10.10.10       | 1.25              | 0.8                   |
|            |             |                 |          | 4           |                |           | 12.11.10       | 3.25              | 1.2                   |
|            |             |                 |          |             | 2              |           | 14.12.10       | 1.5               | 0.25                  |
|            |             |                 |          |             |                | 2         | 12.06.11       | 2.5               | 1.56                  |
|            |             |                 |          | 2           |                |           | 18.11.11       | 2.8               | 1.15                  |
|            |             | 2               |          |             |                |           | 02.02.12       | 1.65              | 0.15                  |
|            | Total       |                 |          |             |                |           |                | 15.45             | 6.56                  |
|            | 02 Rosiuța  | 1               |          |             |                |           | 18.10.10       | 5.6               | 2.6                   |
|            |             |                 | 1        |             |                |           | 04.11.10       | 0.8               | 0.6                   |
|            |             |                 |          | 2           |                |           | 10.12.10       | 3.1               | 1.3                   |
|            |             |                 |          |             | 1              |           | 03.02.11       | 1.0               | 0.3                   |
|            |             |                 |          |             |                | 2         | 05.06.11       | 1.8               | 1.2                   |
|            |             |                 | 2        |             |                |           | 11.11.11       | 2.65              | 1.5                   |
|            |             |                 |          |             | 2              |           | 21.02.12       | 1.35              | 0.65                  |
|            | Total       |                 |          |             |                |           |                | 16.3              | 8.15                  |
|            | 04 Rosiuța  | 2               |          |             |                |           | 15.09.10       | 3.6               | 2.0                   |
|            |             |                 | 2        |             |                |           | 21.10.10       | 1.25              | 0.8                   |
|            |             |                 |          | 2           |                |           | 19.03.11       | 1.62              | 1.2                   |
|            |             |                 |          |             | 2              |           | 05.05.11       | 2.3               | 1.5                   |
|            |             |                 |          |             |                | 1         | 12.07.11       | 1.05              | 1.5                   |
|            |             | 1               |          |             |                |           | 23.11.11       | 1.85              | 0.89                  |
|            |             |                 |          | 1           |                |           | 26.02.12       | 2.12              | 1.78                  |
|            | Total       |                 |          |             |                |           |                | 13.79             | 9.67                  |

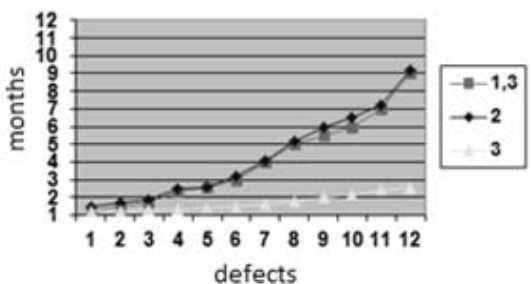
The defects frequency due to lubricants, some mechanical components and pipe trajectories is shown in diagrams in figures 4, 5 and 6. Parts significance from the diagrams is following: 1 – lubricating electric pump code 6.651.000.600; 2 - G3-8"-16l/min type pump, fitted with an AT71-148-4(2) electric motor; 3 – AFuz0,1/20R type pump.



**Fig. 4** Defects of the pump due to the lubricant



a.

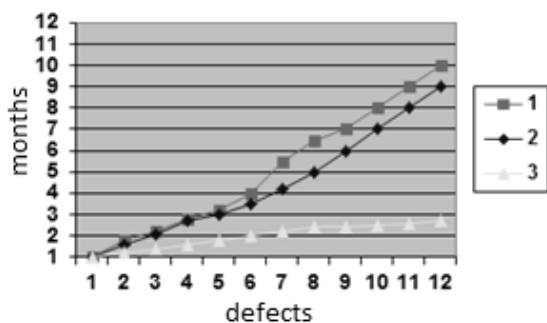


b.

**Fig. 5** Mechanical defects of the pumps

a. Coupling defects

b. Nuts and seals defects



**Fig. 6** Defects due to pipes trajectory

As shown in diagrams, solution using pump AFuz0,1/20R and the new distribution piping structure for the bearing pressure lubrication points that ensure the excavator superstructure rotation to ensure vital equipment operation lead to improvement in performance by reducing evident of defects.

## 5. Conclusions

The change of the trajectories of the pipes and used of AFuz0,1/20R type pump was implied by various defects due to pumping systems and pipe obstructions. This was due to the small pipes dimensions (diameter) as well as its numerous start points (obstructing possibilities).

In rebuilt version it was eliminate this possibility by using a main pipe with an increasing diameter, which determined reduction of total number of defects. In the same time, introducing the AFuz0,1/20R type pump with elastic elements of which are more reliable, it reduced considerable the frequency of operation interruption and less of the maintenance cost.

For the calculation of lubrication systems with fluid lubricants, according to the needs of the capacity and feed pressure of the fluid lubricant use places for correctly selection and regulation of the feed devices must be determined but pressure losses in the piping system.

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