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Remediation of leakage of the hydraulic block presses MAC Master

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Abstract The best way to prevent unplanned downtime of production machines is certainly adherence to the principles of preventive maintenance. In case of extremely difficult working conditions and the contaminated working environment of the machine, a major maintenance intervention is required. This involves not only the replacement of worn parts, but also design changes, the use of other materials or shapes, such as hydraulic cylinder seals. Such a major intervention often also presents a major logistical and organizational challenge. As such an example, the paper presents the reconstruction of an older special press for the production of molds for casting and is still of key importance for the production of the company. The challenge was to renovate a special hydraulic block with 63 hydraulic rollers mounted in a 9 x 7 matrix, which, in addition to the appropriate force for sand compaction in all molds, must also ensure flawless compression parallelism.

Keywords: • hydraulic mold press • leakage • renovation • cylinder matrix block • MAC Master •

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1. Introduction

The MAC Master press for the production of casting molds is of key importance for the production of the company LIVAR, Production and processing of castings, d.d. - PE Črnomelj. Despite 20 years of operation in very difficult operating conditions, the MAC Master press is thanks to careful maintenance still above average productive. The heart of the press is a hydraulic block with hydraulic rollers mounted in a 9 x 7 matrix. The rollers must ensure flawless parallel operation while ensuring adequate sand pressing force in all molds. The appearance of the special hydraulic block of the press is shown in Figure 1.

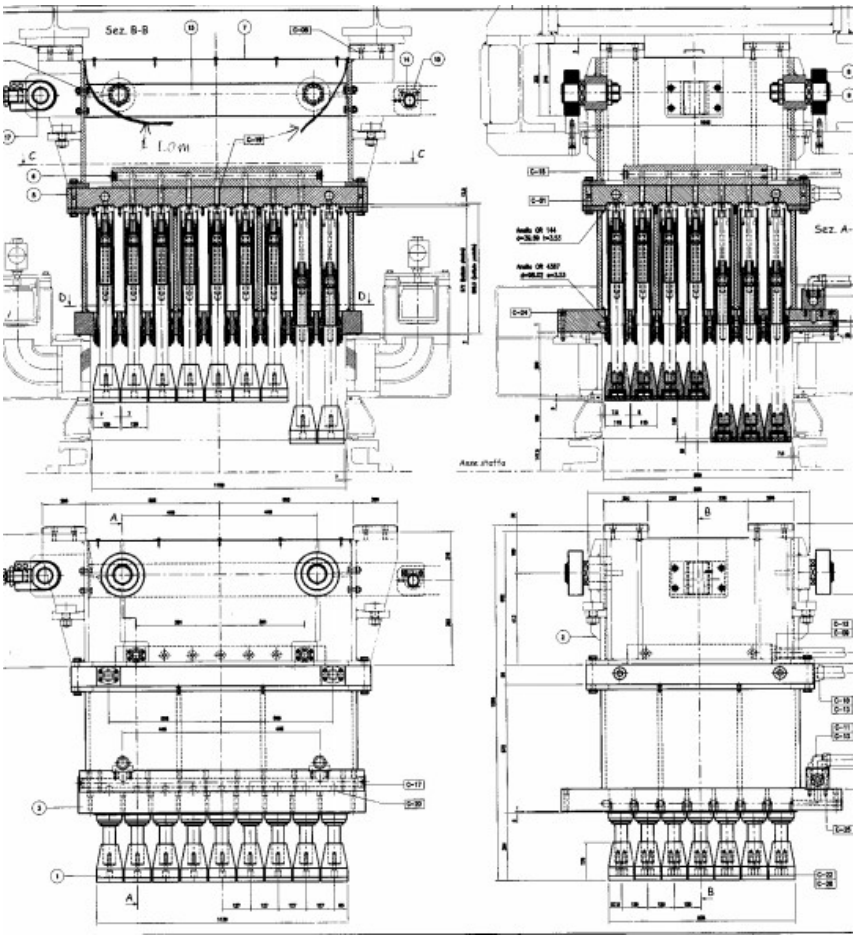

Figure 1: Hydraulic block with 63 rollers in 7 x 9 die.

Regarding the implementation of a possible remediation of the press and/or hydraulic block, there are two options:
a) Continuation of the continuous fight against leaks in the hydraulic block with 63 rollers, b) Replacement of the existing technology of the sand molds with a new one. The second option was the first to be disregarded due to the long delivery time (up to 2 years). On the other hand, there was a real possibility that the quality of the molds would become completely unsuiTable for the next phase of the production process. The limited remediation schedule (before the dismantling and defecation) was limited to a maximum of 2 weeks, and planned in the second half of December, which was an additional condition in the already demanding technical - maintenance mosaic.

The main cause of intensive wear of the hydraulic components of the block is operation in an environment with the presence of foundry sand, which accesses all the "pores" of the hydraulic components, which is practically impossible to prevent. The abrasiveness of the foundry sand causes rapid wear of the piston rods and seals of the hydraulic cylinders, which is reflected in the ever-increasing bearing capacity. This causes an uneven distribution of compressive force (simultaneously) operating 63 hydraulic cylinders located inside a two-part steel block - dimensions 1360 x 1020 x 700 mm. The presence of the foundry sand on all parts of the press is shown in Figure 2.

Figure 2: Presence of foundry sand on the press.

The mentioned presence of foundry sand and its intrusion into the interior of the hydraulic system was also reflected in the degree of purity of the hydraulic oil. The purity class of the hydraulic oil in the system, despite regular replacement of filter cartridges and occasional by-belt filtration, was 28/26/22 according to ISO 4406.

2. Operational approach to hydraulic block rehabilitation

The dismantling of the entire hydraulic block (total weight 5.7 t) was a particular challenge due to the very limited space and obstacles around the press, as it was not possible to use any lift or forklift assistance. All disassembly had to be done manually, with the maintainers 'own physical strength (Figure 3). In addition to the problem of dismantling, an economic condition was set regarding the price and scope of renovation. When preparing the offer, it was necessary to take into account an estimation that quarter of the existing 63 hydraulic cylinders will have to be replaced with new piston rods. In fact, more than half of the existing piston rods had to be replaced with new ones.

Figure 3: Physically released hydraulic block of the press.

A further obstacle was also the modest technical documentation of the Italian-made press, as it did not contain a more detailed description of the hydraulic components. The only indication of the quality of the roller block design was the small engraving inside the hydraulic block. The logo of the manufacturer HUNGER, which was detected only after the separation of the cover and guide plate, indicated the fact that the block was manufactured by the company in the appropriate quality and thoughtful construction, and that it is a particularly demanding hydraulics. Due to the absence of documentation, it was necessary to dismantle the block according to the principle of hydraulic forensics - with real - time documentation and marking of individual parts - Figure 4.

Figure 4: Disassembly of the hydraulic block into component subassemblies.

The holes of all 63 special rollers had to be welded first and then mechanically processed. It was also necessary to process the grooves of the piston seals to a

uniform installation dimension (Figure 5). In this way, uniform sets of seals could be used, for all 63 pistons, regardless of their position in the matrix of the 7 x 9 block. A more durable material is used to make the seals: HPU (hydrolytic polyurethane) hardness 63 Shore D, filled with graphite, which provides sealing even in the event of minor damage to the seal. The main rings are made of PTFE.

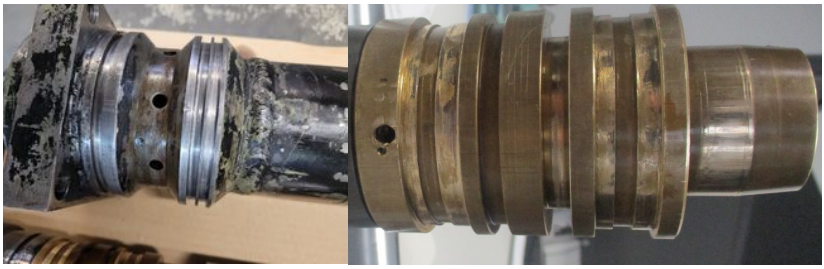

Figure 5: Cylinder hose with holes for hydraulic oil supply and cylinder piston.

A particular challenge has been the treatment of the roller's seats due to the frequency of the pressure load and the mechanical already slightly bent cover of the hydraulic block (Figure 6). The lower and upper matrix 7 x 9 must match in a tolerance of +/- 0.01 mm, otherwise the end roller would at best receive a hydraulic oil with a time gap, and at worst there would be a leakage on the hydraulic block immediately.

Figure 6: Cover and guide plate form roller housings

Ensuring the simultaneous and uninterrupted supply of oil through the block to all 63 cylinders provides an equal distribution of pressure force on the surface of the plate 1360 x 1020 mm, is a condition for optimal compression of sand models into molds.

3. Installation and operation test of the hydraulic block

Assembling individual cylinders and assembling a complex hydraulic block into a working whole, without prior sealing control, would be a rather risky act. Before transport from BOGADI Tesnila d.o.o. in LIVAR d.d. - PE Črnomelj, sealing control and simulation of simultaneous operation of all 63 hydraulic cylinders were performed.

Figure 7: Hydraulic block prepared for transport.

After installing the hydraulic block in the press, the by-pass filtration of the total amount of oil (8000 liters) to purity class 21/19/15 according to ISO 4406 was performed.

In the next phase of rehabilitation of the press, it will be necessary to rework and strengthen the method of mounting the main hydraulic cylinder and the supporting structure (Figure 8). Namely, the existing construction requires complete dismantling and thermal treatment after welding of the additional reinforcements, which was not possible in the time we had at our disposal.

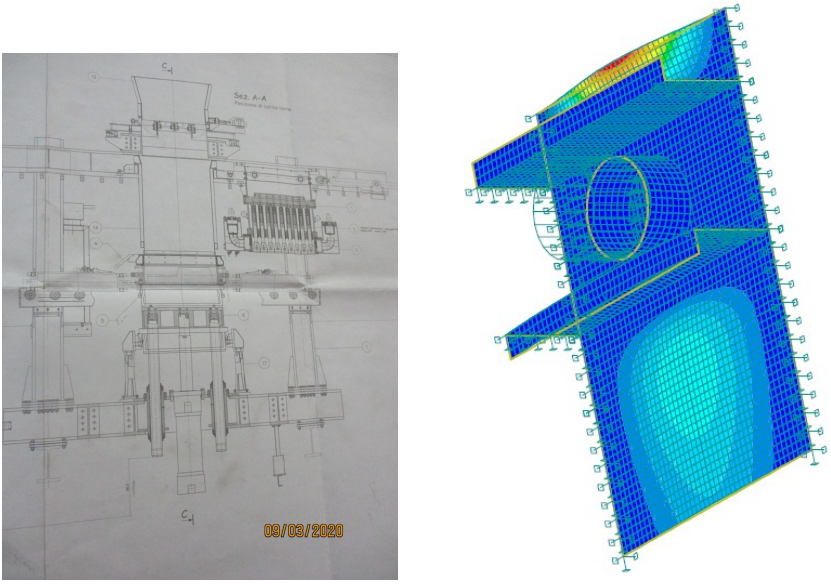

Figure 8: Press master hydraulic cylinder and stress simulation in the load-bearing structure of the clamp.

3. Conclusion

The entire operation to repair the hydraulic block leakage was carried out in an extremely short time. After a few days of regular operation of the press, when the ambient temperature and hydraulic oil reached the maximum operating values, it was necessary - at two intervals, to reseal 5 of the total 63 hydraulic cylinders.

References

[1] N.N.: Available Documentation for hydraulic presses MAC Master