BETTER POLLUTION CONTROL AND REDUCED ENERGY CONSUMPTION THROUGH IMPROVEMENTS ON THE HYDRAULIC DRIVE SYSTEM OF A 55 MN OPEN DIE FORGING PRESS

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SUMMARY

Environmental protection issues required the revamping of the large tank system of the oil hydraulic drive for the 55 MN open die forging press at Buderus Edelstahl. The more than 40 m³ of hydraulic oil in the tanks were a potential pollution threat to the surrounding soil and the nearby creak.

Just solving that problem would have caused a substantial investment resulting in an ecological improvement but without any return on the investment. This led to the idea to spend a little more money to simultaneously solve the environmental problem, increase the productivity of the press and reduce the specific energy consumption.

The total investment was relatively small since only the low pressure part of the hydraulic drive was renewed. The result was a faster, more reliable press system that at the same time required 30 % less power per ton of forging. This means a twofold effect on environmental protection.

1. INTRODUCTION

Edelstahl Buderus in Wetzlar has two open die presses in its forge shop, one with 20 MN force and one with 55 MN *(Fig. 1)*. Both of them have oil hydraulic drives, integrated rail bound manipulators and programmable process controls.

The larger press was built completely new in 1985 by Pahnke Engineering, Düsseldorf to replaced an old water driven 40 MN press at the same location in the plant. In other words the press had to fit on the existing foundation of the smaller old press, the operators desk and the electronic controls were put into the existing operators room, and finally the entire hydraulic drive and control system hat to fit into the relatively small hydraulics room that before housed the accumulators, the valve blocks and a prefill tank. This resulted for the press mechanics and even more so for the drive system in severe space restrictions which also limited the capacity of the drive.

This was fine in the first years as the desired production of over 4000 ton forged steel per month was soon reached. But the originally installed 12 main pumps could never be put into permanent service. The small tank and the week low pressure support system allowed only the use of 9 to 10 main pumps. Of course, even with only nine high pressure pumps the actual pressing speed was with 90 mm/s at 55 MN and 125 mm/s at 36 MN still quite high. However, over the years production was raised to 8000 tons per month through a process of continuous optimizations. Among other things the products became slightly larger and the crane capacity as well as the furnace capacity were increased plus the production runs around the clock with only a few breaks on the high holidays. With that, the capacity of the drive system became the limiting factor.

2. ENVIRONMENTAL ASPECTS

Increasingly stringent rules about environmental protection or pollution control also forced another view on the hydraulic drive station in the last years. The long and narrow tank with rectangular cross section was built to suit the foundation cavity previously occupied by the accumulator bottles. It was

Fig. 1 55 MN Pahnke Press at Edelstahl Buderus

installed underground and on two sides very close to the basement wall. Thus the tank was not accessible from all sides for repair or even for thorough inspection. This did not comply anymore with recently tightened rules by the environmental protection agency. In addition to that, there was increased con-

Fig. 2 The Buderus steel plant between creak and living area

cern that with the constant around the clock operation fatigue cracks would sooner or later develop. This in turn could not only shut down the operation but might also lead to intrusion of larger volumes of hydraulic oil into the soil below the plant, with the danger to pollute also the nearby creak *(Fig. 2)*.

Such a horrible perspective was no longer tolerable either by the authorities or by the management of the plant. The Buderus Company therefore approached Wepuko Hydraulik to suggest a remedy for this problem.

3. THE SOLUTION

Two solutions were worked out. The minimal solution involved the lifting of the main tank above ground. Together with a suitable repair and modification, this would have given a maximum security against unforeseen failure. The continued permit to operate the system would have been given by the authorities. Of course this solution required a substantial spending and offered no other benefit like a technical improvement or an advantageous commercial effect *(Fig. 3)*.

Therefore a second solution was worked out by Wepuko Hydraulik and fine-tuned in cooperation with the specialists for maintenance and for production of Edelstahl Buderus. It involved a complete revamping of the supply side of the hydraulic drive system.

The concept included: a new, larger tank *(Fig. 4)* which was to be put into a room that was now available right next to the existing pump room, because a furnace had been removed from there a few years ago. New and better low pressure boost pumps with increased capacity to feed the main pumps through 10 micron filters (full flow filtration). Also increased was the capacity for the pilot oil and auxiliary systems. During this change the piping and valve arrangement of the entire low pressure system could be improved. Further new technology for the control system could be installed.

This concept required a much larger investment but also offered a number of advantages: First of all the full number of twelve main pumps could be put safely into permanent service, which increases the pressing speed, which results in higher productivity and in many cases also in better quality through reduced number of re-heats. Secondly the handling times could be shortened because of the increased capacity of the pilot and auxiliary supply. Third, the full flow fine filtering reduces the wear on all hydraulic components and gives longer service life, less requirement for scheduled maintenance and cer-

Fig. 3 Main pumps in the pump room

tainly also less unplanned down time. This in turn would result in more availability of the production machine and at the same time less maintenance costs. Fourth, the new boost system offered the chance with an intelligent control to reduce the power consumption of the hydraulic drive especially during the periods where the press and along with it the drive system was idling. This is quite an interesting factor because on a large press with typical free forging products the handling of the forging for loading and unloading, the handling between strokes, between passes and between reheats leads easily to idle times between 40 and 60% of the actual operating time.

All these advantages plus the possibility using the higher pressing speed to even increase the product range could be calculated into a considerable return on the investment. Consequently this solution was selected and a plan for its realization was worked out.

Fig. 4 New 50 m³ tank with filling pumps and filters

4. IMPLEMENTATION

The demand of Edelstahl Buderus was to loose no production time because of this modernization. The order books were full and the products could not be moved to another production facility without extra costs, and of course any down time also produces costs that would have to be booked onto this investment. Therefore the installation and commissioning of the new equipment was split into two major portions. The building of the new pump room extension was done first without interrupting production. During the regular scheduled Christmas shut down 2000/2001, the new extension was connected with the old pump room, the foundation modifications, the changes on the electrical system were prepared and some modification on the building structure to accept the new piping were done. Further the new tank with the new boost pumps and filters plus some of the new piping were installed.

For another year the old system operated the press. The big step then happened during the next Christmas shut down 2001/2002. The old tank was disconnected and pulled out together with it the old boost pumps. Into that hole came the new larger drain and circulating tank with new circulation pump, filter and re-arranged coolers. The old low pressure piping was removed and completely replaced by new lines. The new electric connections were hooked up both for the power supply of the new pumps and also for the new valves and transducers for the power savings system. New software was installed in the existing and not very old electronic control system. This happened within remarkably short three weeks. After all we are looking at equipment for a very fast and powerful 55MN press.

We had finally one week left for testing of the new equipment and software including tuning of the entire system to forge now with 12 main pumps plus some forging tests. This also turned out to be just enough time to meet the deadline for restarting regular production.

5. RESULTS

In the first week after commissioning the press went into full scale production and had no unscheduled interruption since then because of the hydraulic drive system. That means a remarkable 1 ½ years of trouble free operation till the day this paper was filed. The actual pressing speed was increased permanently by 30%. The monitoring of the power consumption showed a substantial drop in electricity used per ton of forging to a level around 30% lower than the average before *(Fig. 5)*.

These three effects led to a substantial increase in productivity of the forging operation, which helps to pay back for this investment in a short time.

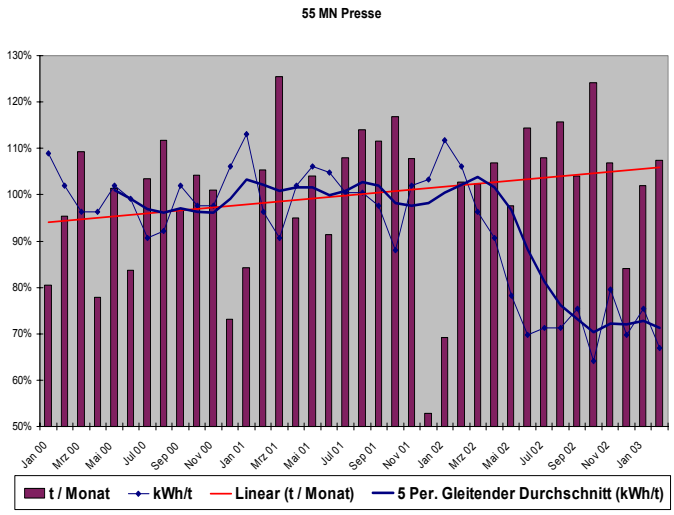

Fig. 5 Relative power consumption per ton of forging

6. DISCUSSION

The results reached here in terms of reliability, energy savings and productivity can certainly not be reached in the exact same amounts on other presses. The reliability for example depends definitely also on the selection of components used, the quality of the assembly and start-up teams, and even more so on the quality of the maintenance staff and organization, which are fortunately both very good at Buderus.

The energy consumption and the potential for reduction depend not only on the system design but also on the type and size of the press installation with all its accessories and to a large extent on the product mix that is going across this equipment.

However it can definitely be assumed that the tendency of the results will be there when you do the same modifications on any similar press installation.

7. CONCLUSION

Intelligent solutions for the design of the hydraulic drive system both for the power (high pressure) part of the system and the (low pressure) supply system coupled with an equally smart electronic control will nor only give a more reliable and more productive forging machine but also leads to substantial energy savings. This is not only a commercial advantage, it also helps conserving environmental resources.

This case of a revamping of an open die forging press shows that such improvements are not only possible on newly designed installations, but that with reasonable efforts and costs it can be installed in existing systems.

As a last remark we would like to point out that the same principles and techniques can of course be applied to other machines with similar hydraulic drives.