UPP, a Modern Concept

Daniel Felber [1,a], Paul Zbinden[2,b], Stefan Haltner[3,c]

[1,2,3] Industriering 4, 3250 Lyss, Switzerland
[a]daniel.felber@osterwalder-ag.ch, [b]paul.zbinden@osterwalder-ag.ch,
[c]stefan.haltner@osterwalder-ag.ch

Abstract

The well-established Universal Powder Press UPP, designed by the Swiss press manufacturer Osterwalder AG in Lyss, went through a major improvement process. The result is a high efficient production machine with state-of-the-art technology. It will be shown the technical design, some process engineering as well as the influence of PRP - =Part-Related-Programming, first published in 1994 - on the set-up time. This development has enabled Osterwalder to round off their range of presses, the mechanical-hydraulic KPP as well as the hydraulic CA-NC II and UPP, to an attractive offer ranging from 120 kN up to 10'000 kN.

Keywords: UPP, Osterwalder AG, PRP, powder presses, process technology

1. Introduction

The Powder Metallurgy industry ranks among the most rapidly growing manufacturing techniques and continuously gains in importance. However, the demands of the market to the PM industry correspond to those of the competing processes, which is to be faster, more economical and to be able to provide better quality. The process offering the best solution will be in a leading position. The main gain is to design and deliver advanced press systems which cover these market requirements. The main object is to produce complex structural parts with higher density and smaller tolerances faster and more efficiently.

Driven by these requirements, Osterwalder has undertaken a major improvement process on their Universal Powder Press, UPP, with the goal to fulfil these increased demands fully. The result is a hydraulically driven, high efficient production machine with state-of-the-art technology.

2. Entering a new concept

The redesign of the UPP was carried out on different fields. On one side the long year experience on powder pressing has brought out some profitable mechanical and hydraulic properties. On the other side the systematic structure of the control system could be refined to an unseen level.

2.1. Mechanical and hydraulic design

Mechanically, latest designing technology has been used to grant an ideal durability for the expected performance. All mechanical components with subject to high stress have been calculated by FEM. The result is a four-column press frame with pre-stressed columns. The prestressing is realised by a special method, enabling a simultaneous prestress of all four columns. This enables the structure to settle evenly, compared to alternative solutions on the market.

The upper part of the frame is made of shock absorbing spherical cast iron and guarantees maximum rigidity.

The elongation of the press frame under full load is only about 1mm. It is compensated by a special placement of the measuring systems.

The very high rigidity of the press frame, together with the die-set increases the tool lifetime by a large amount. Especially, since the load is not always in the centre of the press.

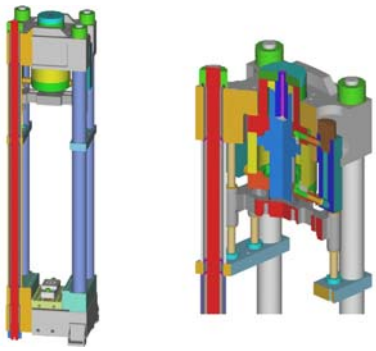

Fig. 1 Entire structure and detail on upper section

Hydraulically, the - 1994 introduced - double cylinder system, with the rapid movement cylinder and the working cylinder, has been optimised. First of all the use of *polynomial curves* (→*Polynomial curves*) have been implemented for moving the axes. Secondly, the rapid speed cylinder gained in importance. In the first section of the pressing cycle the rapid speed cylinder is automatically used for features such as pre-compacting (if needed), powder transfer as well as start of compacting. As soon as the rapid

cylinder reaches his maximal force, a controlled intervention of the working cylinder happens. At the end of decompression the rapid speed cylinder is used for the entire ejection motion. The benefit of this system is that the press can operate with minimal oil consumption at high velocity.

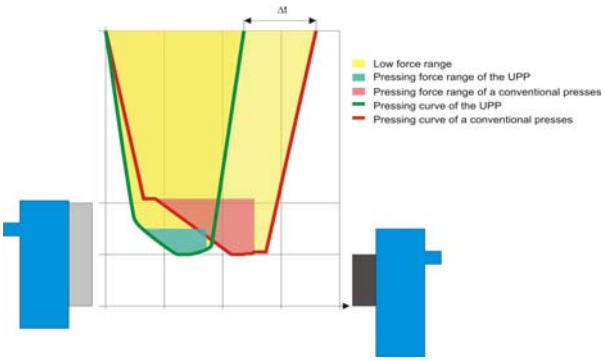

Fig. 2 Comparison of old and new movements

An identical piston system is used for the die movement. This provides enough counterforce for parts with a stepped die. It will also provide enough withdrawal force for long parts with a large surface.

However, 90% of the parts can be pressed with the rapid movement cylinder, only. This reduces the oil consumption and therefore the power consumption by a large amount.

Polynomial curves; In the past the press cycle was either connected to a cam or to a linear movement. The disadvantage of the cam was the dependence on a defined program sequence that could only be changed in a certain range or by changing the entire cam, mechanically.

With the linear movement on the other side, the acceleration change had to be infinite. This acceleration change was reflected in a noisy shock in the servo valves and the pipe work and resulted in cracks.

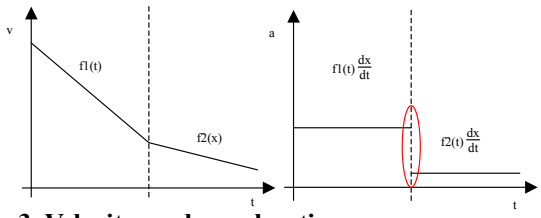

Fig. 3 Velocity and acceleration curve

The control system of Osterwalder uses polynomial curves to smoothen the movements. This has a positive effect on crack elimination.

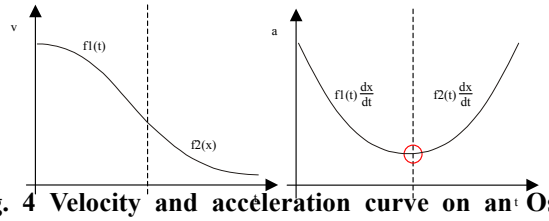

Fig. 4 Velocity and acceleration curve on an Osterwalder press

2.2. Systematic programming

The HMI (Human Machine Interface) of Osterwalder AG is probably the most powerful powder press programming tool, available on the market. It enables the users to create a press program within 5 minutes, only needing the shape of the part, the powder specification and the tool concept. The result is a theoretical calculated, fully feasible press cycle, with powder transfer and ejection including near-optimal weight, densities and dimensions.

On a further level the part can be optimised in density, weight and height through a systematic iteration process. The "time-to-good-part" can be reduced to a minimum, using about two to three loops the maximum, for a standard synchronizer hub.

2.3. Comparison to conventional processes

Compared to conventional presses, the combination of the techniques described in the passages above is, that systematic is controlling the process and not estimating by different operators.

Further is seen that hydraulic presses of today's generation do not comply with the general thought of a slow machine, as you can see from an overview on stroke rates.

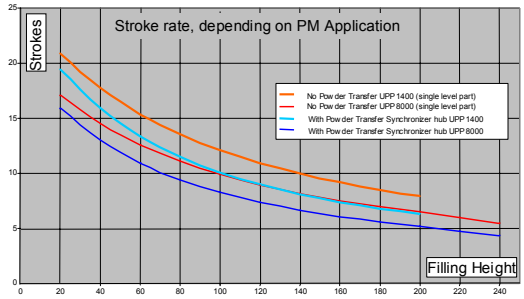

Fig. 5 Speed/ stroke rate diagram

3. Conclusion

The arguments mentioned above lead to this conclusion:

The new UPP press is not the limiting factor for production on a large scale, today. It will be essential to carry on research in fields, limiting the press process such as Flow properties of the powder, Temperature as well as the Lifetime of the tools (new materials, coatings…). Improvement in these areas is a further step towards full density.

Osterwalder however offers already today the equipment to grant a customer tailored press cycle, meeting and exceeding all demands.

4. References

1. UPP Catalogue of Osterwalder AG
2. Alex Wehrli, Daniel Felber, Daniel Pfister, Innovative Powder Compacting Technology (2003)