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Simulation Based Optimization of a Cold Heading Process to Extend Die Life, using Simufact.forming

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ABSTRACT

Using simulation, a 6 station cold heading process was optimized to increase die life.

INTRODUCTION

In this paper we will demonstrate how simulation was used to improve die life of the 6th station in a cold-heading process, for the part shown in figure 1.

Figure 1: Cold Headed Part

The optimized process resulted in a 10x longer die life, significantly improving profitability.

THE BASE LINE PROCESS

The progression sequence for the baseline process is given in figure 2.

The typical die failure is shown in figure 3.

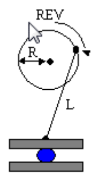
Figure 2: Baseline Progression Sequence

Figure 3: Baseline – Typical Die Failure

THE SIMULATION SETUP

The cold header is defined as a crank press, with following characteristics:

- Crank Radius (R) = 100 mm
- Rod Length (L) = 1000 mm
- Revolution (REV) = 80 RPM



The material of the part is AISI 1035, which is available in the Simufact.forming material database. Details of the material data is given in Figure 4.

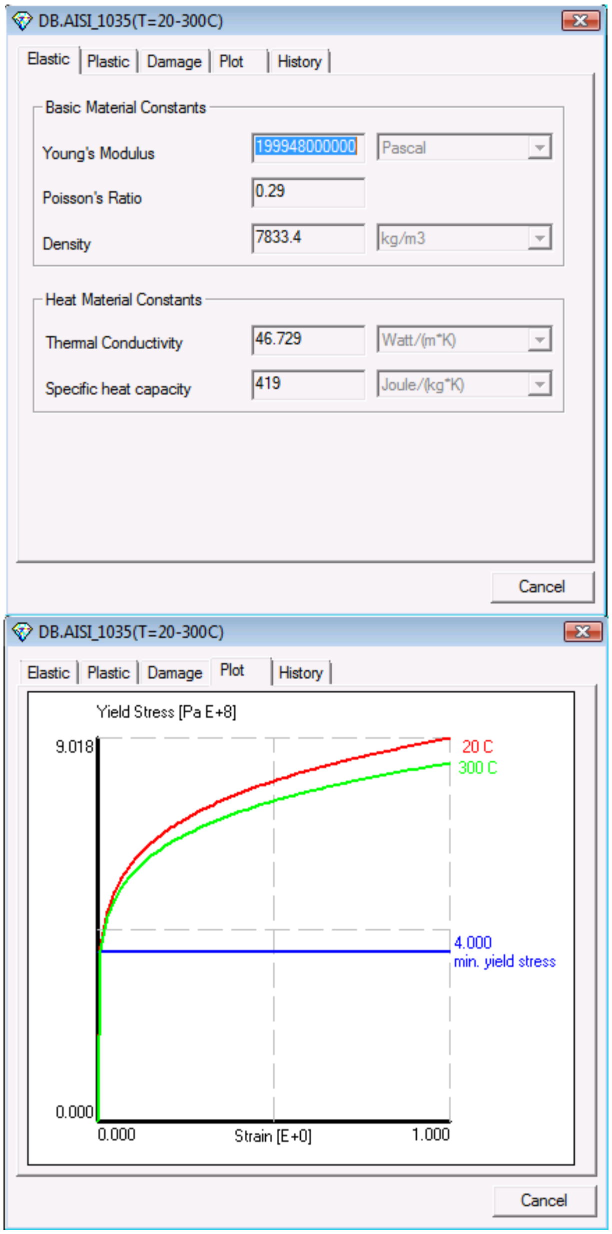


Figure 4: Material Data for AISI 1035

Lubrication was modeled using a Plastic Shear Friction of 0.12.

SIMULATION RESULTS - BASE LINE PROCESS

The simulated progression sequence for the baseline process is given in figure 5, and the required forces for each station in figure 6.

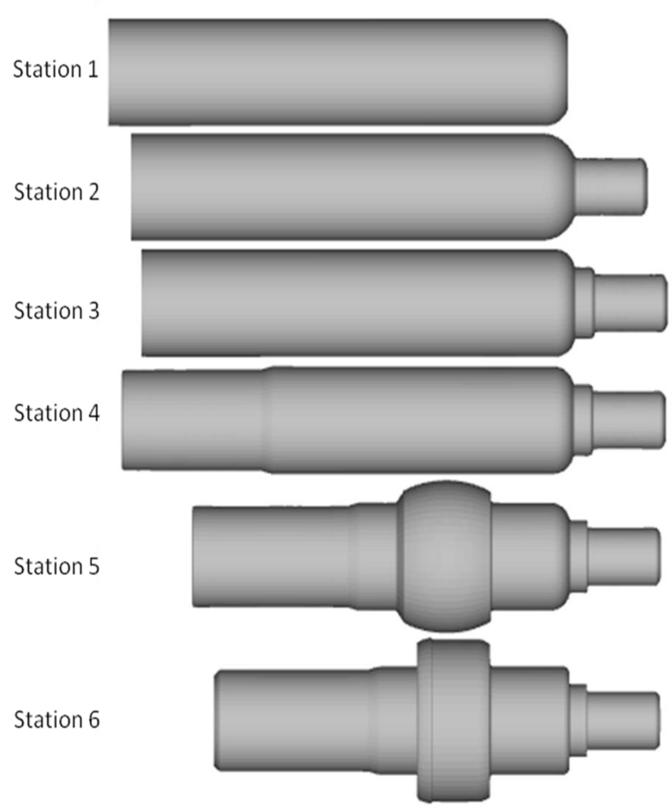


Figure 5: Baseline Progression Sequence – Simulated

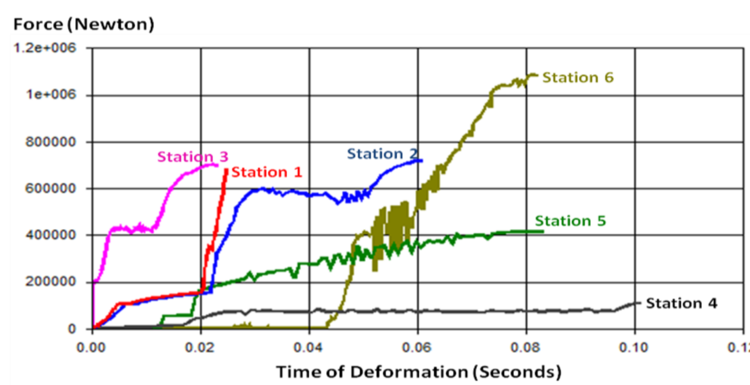


Figure 6: Baseline Forces - Simulated

As can be seen, the simulated shapes are identical to the actual part progressions. A close investigation showed that all details, including small under-fills in corners were correctly predicted. This gave high confidence that the model definition was correct, and formed a good basis for the optimization step.

THE OPTIMIZED PROCESS

Figure 6 of the baseline process, shows that the force needed in station 6 was excessively high, and about 3x higher than the force needed in station 5. The objective of the re-design was to perform more deformation work during station 5, and off load station 6. Only station 5 was modified.

The original and redesigned station 5 shapes are given in figure 7, and the forces in figure 8.

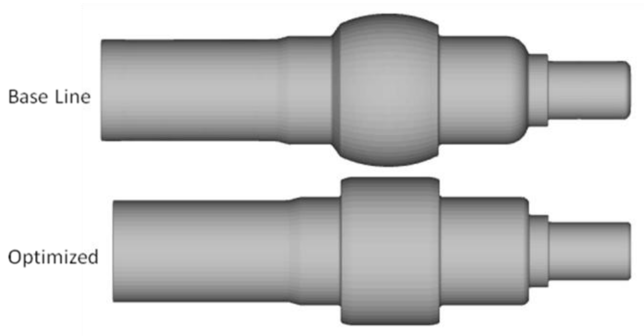


Figure 7: Baseline & Optimized Station 5

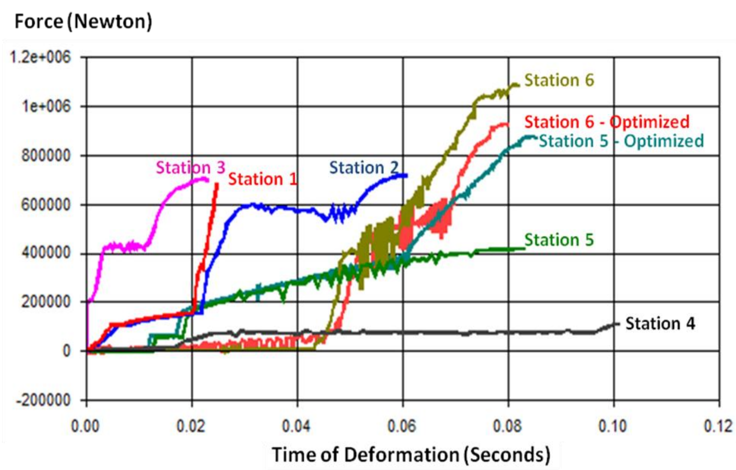


Figure 8: Baseline & Optimized Forces

CONCLUSION

Using the Simufact.forming simulation program, an existing cold heading process was successfully optimized.

From the force curves in figure 8, it is clear that a better force balance was achieved between station 5 and station 6, and most importantly, the required force for the last station was reduced significantly.

The result of this change was that the die life in station 6 was increased by a factor 10.

An additional benefit of the new design for station 5 was the creation of a better gripping surface for transfer between the stations.

CONTACT INFORMATION

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