Forging Die Life Improvement with Process Analysis

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***Abstract* - The estimation of forging die wear and cost are both important issues. Die wear accounts for a large portion (almost 70%) of die failures. This leads to increased costs to replace the die, through downtime and the cost of the die itself. Through finite element method (FEM), forging processes can be simulated and the die wear can be predicted. This allows for optimization of the forging process and increase in die life, as well as reduction in die try-out time and a proactive in processes action taking o die to better die life and more production rate and replacement of dies, which helps reduce scrap and downtime. Through two case studies of elevated temperature extrusion, it is shown that wear and plastic deformation prediction is possible. With these predictions, the extrusion processes can be improved for better die life by getting on process corrective action on die and their repair by machining process.. The procedure of tacking corrective action on die has increasing die life.**

I.INTRODUCTION

Die Failure Information

There are many types of die failures including deformation, fracture, cracking, wear, erosion, etching, pitting, and exfoliation. Of these failures, there are many possible causes. To decrease the likelihood of failure the following criteria should be met.

1. Design that is compatible with the die material selected and with the planned processing procedure
2. Selection of material that is compatible with the design and processing procedure
3. Selection of a heat-treating procedure that is compatible with design and material
4. Control of the specified heat-treating procedure
5. Control of the grinding and other finishing operations
6. Control of die setup (particularly alignment) in the equipment
7. Die operation, specifically avoidance of overloading11 "All the potential failure causes are associated with stress present in the die, which are generated during its manufacture, or during its service life, or both." Design errors such as: sharp corners, undersized fillet radii, inadequate grooves or notches, and thin sections or sudden variations in section thickness, are often the causes of these stresses that can cause die failure.

Die wear-out

It seems logical to focus on the sources of wear-out given a die that is sunk to "target" dimensions that are intentionally aimed at minimum (or maximum) part dimensions — where tool wear will eventually take the tool to maximum (or minimum) dimensions after continued use. By contrast, a die sunk to "nominal" dimensions will usually be "partially worn out" at the beginning of the set up.

In other words, a die sunk to exactly mid-point on the print tolerances will have about 40 to 60% less die life than one that is sunk to the ideal dimensions of about the low 20% of the print tolerances where wear moves each particular dimension.

The goal here is to estimate which dimensions must be altered either down or up to account for the expected wear, and by how much, and still make good forgings at start up. These pre-planned adjustments are important aspects of the successful precision forging of gears and other very tight tolerance parts. They should also apply to any forging. In other words, a die sunk to exactly mid-point on the print tolerances will have about 40 to 60% less die life than one sunk to the ideal dimensions of about the low 20% of the print tolerances.

Causes of die wear-out

There are a variety of causes of die wear-out. Dies are too soft at the outset of production. The die deforms in central regions. The die material may not have responded to heat treatment through the large section size, causing soft centers in the dies. Higher alloy die steel may be called for.

Die softening from heat up. In this case, the die actually deforms. The die material exceeds the softening temperature due to excessive contact times with hot parts, combined with insufficient cooling between forgings. Use water to cool off the dies, being careful about heat checking from the resultant thermal cycling. Die steels with more Cr and W will help develop greater heat resistance, but they also will show a greater tendency to crack under water cooling conditions that aren't controlled properly. Welding selected portions of a die with cobalt-based alloys (e.g. Satellite) will also improve resistance to softening.

Die erosion caused by abrasion of oxides/scale.
Again, die hardness can have a pronounced effect — harder dies wear more slowly — but can crack more quickly. Lubrication may reduce wear out from this reason. Consider using inserts. Attention should be paid to a powder-like scale formed on heating. Induction heating is favored for this.

Dies deform. Even hard dies.
This is often caused by excessive pressure/or extra un-needed forging blows — possibly by cold material or by designing flash too thin for the configuration. Essentially the die fills up before the part is reduced to size, causing unnecessarily high stresses on the dies. It is important to adopt design modifications for reducing cavity pressure to extend die life.

Thermal fatigue, die checking.
This can result in both spalling and galling on projections, and it is especially common when hard facing is welded on, or when electro-deposited coatings are used on the die surfaces.

Die fracture, breakage
Invade quite support of die/insert in holder. Frequently caused by out-of-flat conditions or loose shims, this is the reason for nearly half of all die fractures. There are times when H-section plates are used to extend ejectors over a large range of areas beneath the dies. This approach can lead to a lack of die support and expose dies to bending and eventual fracture.
Sections of die too thin to support loading during forging. Failures often originate through dowel notches or in fillet radii at shanks under impression — which are the most common locations for complete fracture. Check the die size versus the depth of the pockets.
Forging on cold dies where they are brittle. Typically, small cracks in the impression open up to form larger ones or originate at the base of pockets in dies (typically for forming ribs on forgings.) Except in rare cases, forging in dies at temperatures below 200°F risk brittle fracture in most die steels. Excessive blows after the dies fill. This tends to overload the die impression and can cause serious, and catastrophic, fracture. This is a common occurrence when forging in dies with relatively deep die cavities at the edges of the forgings, where the lateral loads on dies are highest. Use of supporting tooling should be considered.
Trapped lubricants in un-vented press dies. This is a frequent problem in forging dies containing impressions of varying depth. Crankshafts are a good example of this, as are wheel spindles. What happens is that the lubricant vapor or steam pressure has no escape in presses and when the cavity begins to fill, the gas compresses and begins to encroach into any small cracks in the die. This is a poorer practice than for hammer forgings, where deformation in more progressive and where the trapped steam is more of helpful in removing forging from the dies. This is why blind vents are usually adequate for hammer dies.
Lack of circumferential support on deep round dies. This is where there is a tendency to split a deeply pocketed die with a punch while back-extruding a conical or cylindrical part. External die support such as shrink bands are called for.
An example of a problem is the centrally located transverse fracture of long slender dies in presses and hammers — usually the failure is traceable to a lack of support — but then, maintaining tool holders perfectly flat for every set up is not always practicable. The alternative of using insert holders with "pre-cracked" multiple-section dies can often be the best approach this problem
For example, instead of sinking a 12-ft long die block with the attendant risk of breakage, it can be more practical to build a somewhat longer sub-die holder and then either wedge fit, shrink fit, or press fit two or more die inserts into the sub-die holder. This total assembly then becomes the die block, which is fitted to the sow block or master tool holder in the press in the conventional way. The selection of the parting planes between the inserts is based on where the die

would have been most likely to have cracked during forging in a one-piece die. This can result in some minor die finning if the joining die inserts are not fitted properly. But, the likelihood of catastrophic failures is almost totally eliminated. This inserting technique can also be used in hammers but attention to the locking features is critical to avoid disassembly, or breakage on impact.

III. RESEARCH OUTLINE

1) Research Outline:

This chapter present detail working out analyses of die wear out condition any die failure condition analyses by using various soft wear such as CATI and METLAB and out maximum failure can done by such condition and their solution.

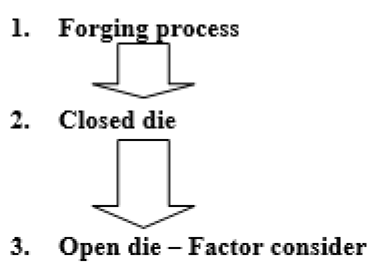
Typical Failure Appearance of Forging Dies

During closed-die forging, dies are exposed to complex thermo-mechanical loading conditions [1]. The requirements for forging dies include:

- High wear resistance at high temperatures
- Good form stability
- High die life time
- Good weldability (for repair)
- High thermal conductivity
- Optimal surface hardness (40-44 HRC)
- Economic repair possibility

IV. EXPERIMENTAL SETUP

EXPERIMENTAL SETUP



1. High wear resistance at high temperatures
2. Good form stability
3. Forging force
4. Micro structure Material Steady
5. Testing of die

On process corrective action

- Polishing
- Grinding
- Preheating
- Counter cutting

VI. SCOPE OF PROJECT

Scope

As described in previous sections, the service life of dies depends so much on die wear, therefore wear analysis is an important matter for industry due to economical reasons. The wear process as a dynamic process depends on many parameters that make it so complicated for investigation. In this study, the analysis of die wear will be focused. Results from die life. It deferent parameters compared with the measurement on the worn die taken from industry and evaluation of wear coefficient from comparison.

Analyzing the fracture surfaces, the modes of failure will be determined and solutions will be proposed. A great deal of information can be deduced from the fracture surface of any failure. Stereomicroscopy and scanning electron microscopy will be utilized to gain the most information possible from these surfaces.

Therefore, sufficient heat treatment may not be performed by the manufacturer of the pre-hardened stock. Comparing the differences in chemical composition and microstructure between the dies in service may provide insight into the cause of the failures and possible solutions.

Fracture toughness of any material in severe impact scenarios is crucial to the life of the part. The ability to resist defect propagation will increase the life of the die. Therefore, fracture toughness testing shall be performed in order to determine any differences between the two types of stock.

VII. CONCLUSION

In die 128 having actual production life are 9500 job but some affecting parameter in production analysis of this code actual production done 6000 job only. Carry after that production die get wear out so that problem get analysis don by that project.

High wear resistance athigh temperatures.

Good form stability.

Forging force.

Microstructure Material Steady .

Testing of die.

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