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A Study on Conventional Die Design for open extrusion Process by Finite Element Method

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***Abstract*: In this project work effort made to study on conventional die design by finite element method. The basic parameters of the open die extrusion where extrusion of strains is varied due die included angle, corresponding limit range of deformation is obtained. Metals of fixed cross-section were extruded through open dies of varying die included angle and land diameter.**

***Keywords*: Land Diameter, Deformation, Conventional Die Design.**

1. Introduction

Conical dies used for axisymmetric open Die Extrusion is designed using Finite Element Method. The entry diameter, exit diameter and semi cone die angle will determine the dimensions of the extrude in axisymmetric extrusion. The external diameter of the die will determine the volume of the die material (High speed steel steel) required and the stresses that can be withstood without cracking and breaking of the die. It has enormous potential for application involving small length components. Upsetting and buckling are two major disadvantages. Moreover, this process is restricted to only small strains. But a higher overall strain can be given, if carried out in stages.

2. Literature Survey

In metal forming, the starting material has a relatively simple geometry, ability-is plastically deformed between tools or dies, to obtain the desired final configuration. Formation to near net shape dimensions drastically reduces metal removal requirements, resulting in significant material and energy saving. Especially in medium and large production quantities, where tool cost can be easily amortized. Among various metals forming processes one category is flow through process. A die with an opening separates the raw material from the product. Usually the product is a straight rod identical to that of the opening of the die. The opening of the die may have a variety of shapes, and several openings may serve as the die for the production of several rods from a single stock. The opening may also be of tubular shapes for the production hollow components.

Zou Lin & Xia Juchen (1) as per project survey based on the die profile for improving die life in extrusion process, where matrix alloys tends to deform in plastic manner. As per the study shear stresses acting on particle clusters during extrusion cause to break-up and form the uniform particle distribution.

D James (2) carried out simulation for direct extrusion process using FEM where stresses, strains and temperature distribution for extruded materials analyzed. Experimented study noted on direction load varies directly proportional to die angle. The quality of product and dimensional accuracy will be satisfactory with help of numerical study.

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3.Tools and Die Design Factor

The tooling for hot extrusion consists of components such as punch, container, die, die holder, space block etc. The tooling necessary for any particular process depends on the product i.e. rod, tube section, the type of press available, and the alloy to be worked. Tooling can be classified into extrusion tooling and auxiliary tooling. Auxiliary tooling includes container, steam and the like, which are considered to be components of press. The extrusion tools include the die, mandrel etc. Which are used for deformation and have to be continually replaced because they are subjected to high rate of wear.

Dies are the tools, which completely or in part contain the negative contour of the work piece and transmit this to the work piece. The latter thus being deformed in the dies or contact an already performed work piece so that it can be further processed. Forces, heat and material movement because stresses exerted on the die in deformation processes such as extrusion. All materials shrink upon cooling after hot extrusion, therefore a shrinkage allowance must be provided in the design of the dies.

Flat Faced Dies

- When billets are entering to the die section, the areas where entry level and internally forms a shear zone and forms an own die angle. Reworking of the flat face on the entrance side can be done without effecting the tolerance on exit diameter.

Die with feeder plate

- They facilitate the control of material flow with sections made up from parts of different thickness. They improve the possibility of pressing one billet after another. They reduce bending in the case of long thin sections.

4. Methodology

Concept of FEM: In the finite element analysis, the continuum is divided in to a finite number of elements, having finite dimensions and reducing the continuum having infinite degrees of freedom to finite degree of freedom. The elements are interconnected at joints, called nodes or nodal points. An important ingredient of the FEA is the behavior of the 12 individual elements. The function ϕ which might represent any of the several physical quantities varies smoothly in an actual structure, within each element ϕ is a smooth function called an interpolating polynomial. The degree of interpolation function depends on the number of nodes in the element and the order of differential equation being solved. The equations over all the elements of collection are connected by the continuity of primary variables. FEA can also be employed for non-engineering applications, such as in case of medical research activities, on the simulation of a particular organ of a human body. Example We can determine the fatigue produced on the valves of the heart due to the pumping action.

5. Conventional Die Design Profile.

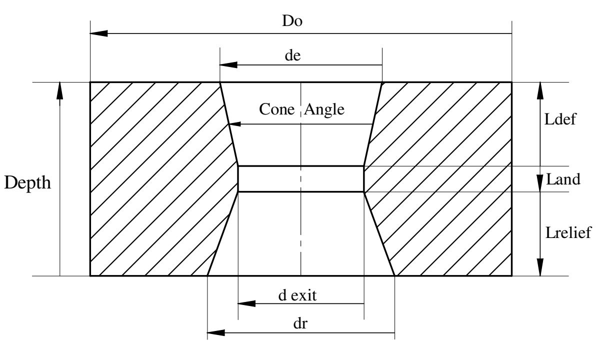

Fig 1: Conventional Die with all parameters

External diameter of die in (mm)					
90	110	130	135	136	137
Note: Ansys Macro used for analysis -with factory of safety 2					

Table.1 Steps for analysis of die with FOS

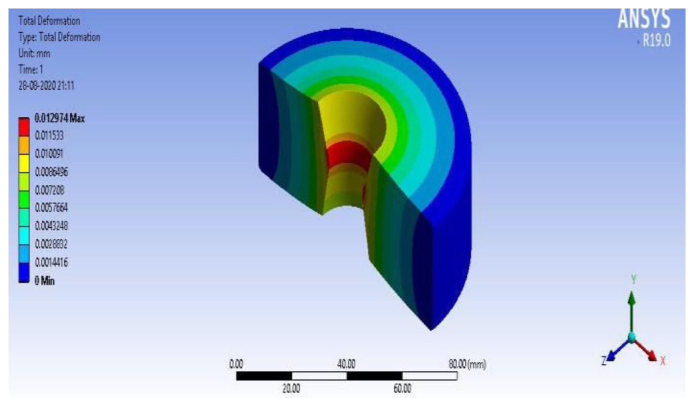

Fig 2. Total Deformation for 90mm Diameter Die.

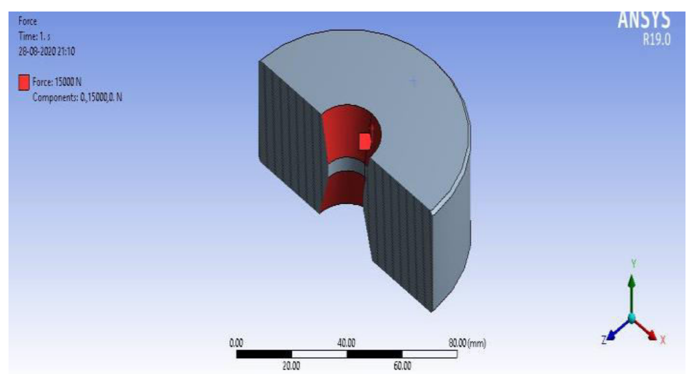

Fig 3. The Force 15000N applied to 90mm Die the at upward position

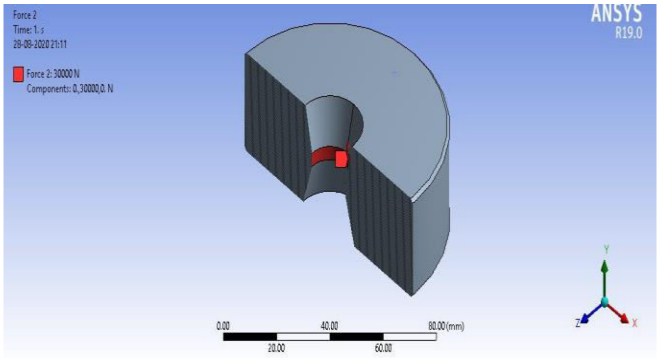

Fig 4. 30KN force applied to the die at the land position.

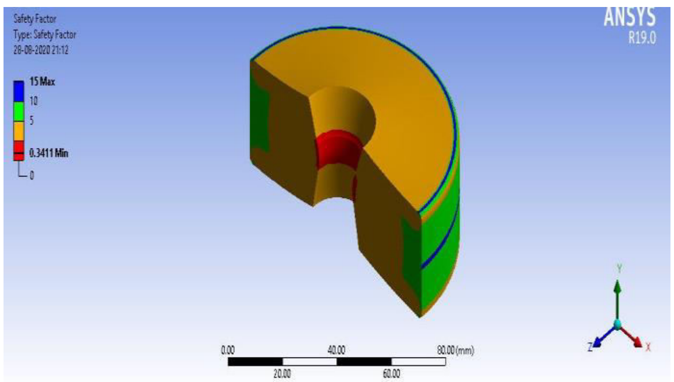

Fig 5. Half sectional 90mm diameter die with factory of safety value range 2.

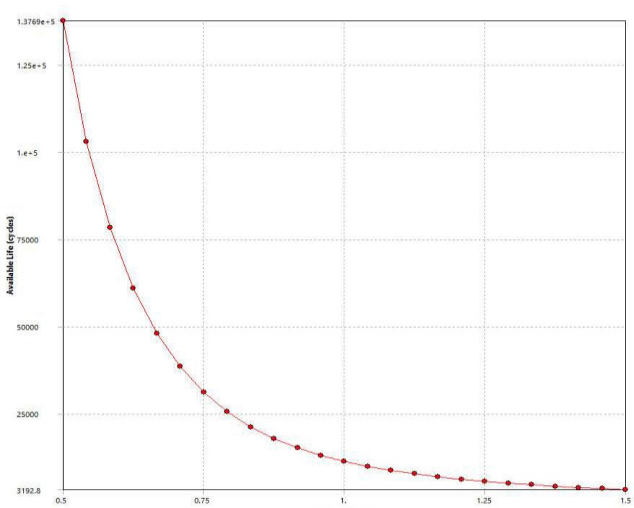

Fig 6. Life cycle of die with respect Load factor

6.Conclusion

- The experimental validation of extrusion die profile, which is optimized to produce tube of desirable size at maximum production speed and minimum left out material in the die. The die profile design is calculated with help of Numerical Simulation of Axisymmetric and Asymmetric Extrusion Process.
- The strain values obtained in experimental data is higher as compare to theoretical data.
- Temperature distribution during deformation and fatigue deformation in terms available life v/s loading history has been determined from FEM modeling

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