The task for International Students Olympiad in Hot Bulk Forging and Extrusion Technologies 2023

Development of the forging process using the numerical simulation

Task

The engine plant received an order for the production of forgings for the manufacture of hubs for a new gearbox. It is required to design a manufacturing technology of a gear with the highest possible material utilization rate and according to the local standards. Compliance with the following points of the order is required for successful contract fulfillment:

• Compliance of machining allowances with the drawing of the part with allowances provided by the customer

• No stamping defects

Note: the customer provided a drawing of the part with minimal allowances, it is necessary to skip the stage of calculating allowances and proceed to the design of hot forging (choose draft angles and so on).

The factory is equipped with the following machines: mechanical crank presses with nominal loads 10, 16, 25, 40 MN and cutting-out press with nominal load 2.5 MN.

Design the forging technology please by selecting the existing equipment considering the load/energy and available table dimensions.

Report

Prepare a report with a description of process development and results. The report should include drawings, calculations, illustrations, justifications and conclusion. QForm simulation is an additional tool.

Only the reference number (code) should be indicated on the first page. Surname, name, university, city, etc. should not be filled out.

Evaluation

The final evaluation of the work is influenced by the quality of developed technology and justification of decisions, especially: selection of the optimal workpiece, selection of forging operations (of the operations number, geometry of die impressions, evaluation of the metal utilization factor, forging load, etc.), selection of equipment (evaluation of performance, load and energy parameters, die space dimensions, the final performance of the production line), analysis of possible defects in forged component, analysis of the tool stresses as well as general quality of the report.

Six (6) hours are given to complete the task. The archive (the archive name – is the reference number (code) issued by local Organizer (University)) containing the report and the folder with final version of process simulation in QForm have to be created.

As a recommendation, every report will be evaluated according to the special criteria table. The list of maximum points for each item of the completed task are shown in the following evaluating table.

Please note that the task is considered to be completed if the report contains its description. The final score is multiplied by technology ratio which evaluates the quality and correctness of the simulation results and plagiarism ratio (50% of plagiarism is allowed).

Crank forging presses parameters

Nominal load, MN	10	16	25	40
Stroke length, mm	280	400	350	400
Maximum press stroke frequency, min^{-1}	90	50	70	50
Single activations frequency, min^{-1}	26	20	20	14
Table dimensions, mm	1000x930	1300x1260	1280 x 1400	1710 x 1620
Crank radius / connecting rod length ratio	0.19	0.17	0.17	0.15

Cutting-out crank press parameters

Nominal load, MN	2.5
Stroke length, mm	25…200
Maximum press stroke frequency, min^{-1}	61
Single activations frequency, min^{-1}	26
Table dimensions, mm	1120 x 750
Crank radius / connecting rod length ratio	0.17

Evaluating table

The recommended list of the completed task items and the corresponding maximum points are given in the table. The final number of points for each item is determined using the quality coefficient: didn't calculate=0, wrong=0.33, had some issues 0.66, excellent=1.

Item of the completed task	Points
Evaluation number of technological steps	3
Performance calculations	2
Hot forging design	11
Workpiece temperature range evaluation	3
Tool temperature range evaluation	3
Die filling evaluation	4
Verifying compliance with energy and forging load parameters	4
Verification of the influence of dimensions	5
Verifying of flash gap and flash gutter filling	2
Evaluation of occurrence of wrinkles in workpiece	2
Evaluation “minimum distance to surface” field	2
Evaluation of occurrence of wrinkles in workpiece	4
Evaluation fibrostructure in the workpiece	4
Positioning of the workpiece evaluation	4
Evaluation of potential destruction areas of the tools	4
Evaluation of tool cyclic failure	3
Investigation of the effect of assembled tools	3
Forging die design	5
Evaluation of the die wear	3
Tool dimensions verification	4
Optimization of the technological parameter	5
Additional points (for the quality of the report and drawings)	0..10
Total	**100**