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THE IMPROVEMENT OF LARGE GRADE FORGING TECHNOLOGY ON HYDRAULIC PRESS

СОВЕРШЕНСТВОВАНИЕ ТЕХНОЛОГИИ КОВКИ КРУПНОГО СОРТА НА ГИДРАВЛИЧЕСКИХ ПРЕССАХ

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Abstract: The paper considers the problems of increasing the efficiency in the production process of large grades from high alloy steels and alloys in the forge and press shops of metallurgical plants. Methods for improving forging productivity by optimizing the technological process in the forging and pressing sections are described.

Key words: forging, hydraulic press, large grade, productivity of forging units.

Аннотация: В работе рассмотрены проблемы повышения эффективности процесса производства крупного сорта из высоколегированных марок сталей и сплавов в кузнечно-прессовых цехах металлургических заводов. Приведены способы повышения производительности ковки за счет оптимизации технологического процесса в кузнечно-прессовых и адъюстажных участках.

Ключевые слова: ковка, гидравлический пресс, крупный сорт, производительность ковочных агрегатов.

Nowadays, the major production of the assortment out of special steels and alloys are made on hydraulic press, radial crimping machines, or hammers. Forging castings is time consuming technological processes, where technological forging techniques, selection of operations, their sequence, and forging efficiency can serve as a means of reducing of material consumption and increasing productivity. The improvement of forging efficiency can be achieved in such ways [1-7] :

-due to the shape of the tool that results in the improvement of stress-strain state and decrease carbide heterogeneity-C-ZF [1-3];

due to the shape and geometric parameters ingots [4, 5];

due to the optimization of technological methods of forging, for example, exclusion of ticketed operations or the progression from the forging cycle [5,6];

due to the combination of different types of heterogeneity, when forging, because of the heterogeneity of the temperature fields-[7]

by the improving accuracy and uniformity of dimensions for the length of the forging, which can save, for example, metal up to 18% and up to 33% on adjustage processing at forging tool steels.

The purpose of the work was to identify opportunities of the performance improving of forging aggregates, for example, on the basis of hydraulic presses with simultaneous | improving of quality and accuracy of forgings, saving forged steels and alloys.

The object of the study is the technology of forging ingots from high-grade grades of steels and alloys on forging units, based on hydraulic presses. The task was to exclude ticketing, smoothing and clogging corners with further performing them on separate, highly efficient basic equipment from the forging cycle. We must determine the factors, which affect the performance of the forging unit and quality and accuracy of high-alloy ingot forging steels and alloys. Forging data, done on hammers, were analyzed [8]. In addition, data obtained by the authors during the study the process of forging on a hydraulic press 63 MN were analyzed too. The results of studies are shown in table 1 and table 2.

Analysis of the given data according to forging results indicates that the component of the forging process depends on the degree of alloying of steels and alloys, which affects crystallization rate. Low recrystallization rate in comparison with the deformation rate does not help the conductivity of complete process of consolidation. The specified fact is confirmed by the data [8]. So when hammering alloys ZI37A, B and ZI617 are transformed from a hammer to the press at a forging temperature of 1000 ° C and the degree of deforming 30%, the resistance to deformation was respectively 62 those 12 kg / mm for ZI437A, B and 104 and 36 kg / mm2 ZI617.

In addition, table data indicates a significant share of auxiliary forging operations - smoothing, ticketing, and clogging corners, especially, in forging cycles. It can be noticeable when analyzing the components of forging heat resistant and precision alloys. So, part of the mentioned operation is 32.32% for ZI437B-U-VD alloy out of the total forging time, and it is 42,6% for alloy ZP708-VD. The same tendency is observed for high-allies tool steels (e.g. 4X5MFS, 4X5MZF this part is 39.93%). This means,that when the operation of forging ironing (ticketing, cornering),which needs 0.03-0.04 R nominal force, is removed, press can be used with high efficiency through enhancement productivity averaged 1.4 times.

Removed operations can be separately performed on crimpers built in the forging line unit, which is only designed for calibration of cross-sectional dimensions of the workpiece with small values of relative crimping or expense
transfer of the workpiece with a special wagon – thermos for crimping or pipe milling rolling mill.

The effort of rolling (calibration), calculated by known dependencies [9], does not exceed 2.5-4.0 MN, and power consumption cage from the network does not exceed 200 kW at rolling speed of 1 m / s.

Forging accuracy is influenced by characteristics of hydraulic press (rigidity of construction, inertia of the hydraulic actuator), and resistance of the workpiece to deformation, due to the duration of the hardening and hardening processes that take place in the metal billets. The data represented (Tables 1, 2) show that up to 40% of the forging time is consumed precisely to obtain the precision forging accuracy. Withdrawal of directional operations, directed on accuracy and transferring them to the rolling mill cage, allows providing quality of geometry and precision forging dimensions in addition to the above mentioned. How testify [10], The accuracy of the transverse dimensions of the forging, when forging on the press 63 MN is limited by

speed run, which is 7 mm, and by inertial run, which is 3.1 mm and the table deflection is 3-4 mm, then total height error reaches 14-15 mm.
In order to achieve the necessary precision forging we need to increase the duration of the smoothing, which is not profitable in terms of press efficiency, or to use other more effective ways for improving the accuracy of the forging dimensions.

Following all of this mentioned above, the use of rolling stands for cross calibration sizes of forgings are suggested. The increasing rigidity of the forging size and their approximation to a satisfactory size are enough effective way to increase productivity of forging units based on hydraulic presses.
The data given in table C indicate all above. Therefore, metal waste scrap can be reduced 2.8 times for steel 4X5MFS (4X5MZF), 2.4 times for type alloys ZI 437B (U) -VD and 2.6 times for precision alloys type RF 708-VD for investigated forging processes.

Further consideration of this problem with cost analysis of time for adjuster under the conditions of forging and press shows that the time, spent for ripping forgings, forged on the press 63 MN at an average length of the workpiece 4,0 m, for structural grades of steels covers about 11.2 hours. The time for tool steels is about 11.61 hours. The time for heat-resistant alloys is about 19, 24 hours. Reduction of allowances for tearing and extending the rods, forged to the sizes shown in table C, reduces the duration nearly a third part of the forged processing of forgings, which will increase productivity about 30-40%.

Table 1 - Parameters of the forging process of some tool grades of steels and heat-resistant alloys on a hammer with MPH 5000 kg

Brand of steel (alloy)	X12M X12Ф1	ЗИ437A	ЗИ811
Casting weight, kg	750	750	1000
Forging size mm	Ø 100	Ø 100	Ø 105
Forging duration, p	639	658	404
Procrastination, ticketing, cornering: - in c 54 87 181 - in% of the forging duration	54 8.5	87 13.2	181 44.8

Table 2 - Parameters of forging process of some tool grades of steels and heat-resistant alloys on hydraulic press 63 MN

Brand of steel (alloy)	4X5MФC 4X5M3Ф	ЗИ437Б-У-ВД	ЗП708-ВД
Casting weight, (electrode), kg	4360	1900	1100
The dimensions of the intersectionbillets, mm	630x630	0500	0370
Forged size,	Ø 460	Ø430	Ø325

Total forging duration, p	864	656	406
Smoothing: in p. in % out of total forging time	345 39,93	212 32,32	173 42,6

Table 3 - Results of forging of some steels and alloys on the press 63 MN

a) Steel 4X5MFS, 4X5MZF The good size is 0430+5mm Casting weight is 4360 kg			
Good size, mm	Ø460+5	Ø445+5	Ø440+5
Weight bearing kg	3805	4077	4160
Wastes -in kg -in%	555 12.7	5283 6.	200 4.6.
b) Steel ZI 437B (B) -VD The good size is 0400mm Casting weight 1900 kg			
Good size, mm	Ø425+5	Ø415+5	Ø410+5
Weight bearing kg	1678	1766	1807
Wastes -in kg -in%	222 11.7	134 7.1	93 4.9
c) Stop ZP 708-VD The passing size is 0300 mm Casting weight 1000 kg			
Good size, mm	Ø325+5	Ø315+5	Ø310+5
Weight bearing kg	859	918	946
Wastes -in kg -in%	141 14.1	82 8.2	54 5.4

Conclusion

The conducted investigations about forging on hydraulic press 63 MN show expediency removal of the smoothing operation and reductions it on a rolling stand from the forging cycle, which will allow improving the performance of the forging unit. A rolling stand can be fitted in one line with forging unit. Smoothing in rolling cage will also significantly reduce the allowances and machining tips, which in their turn will greatly improve the performance of the adjuster sections and output of ready-made metal.

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РАЗРАБОТКА ПОДХОДА К ВЫБОРУ СВОЙСТВ ПОКРЫТИЙ ДЛЯ НОРМИРОВАНИЯ В НОРМАТИВНОЙ И ТЕХНИЧЕСКОЙ ДОКУМЕНТАЦИИ

DEVELOPMENT OF THE APPROACH TO CHOICE OF COATINGS PROPERTIES FOR SETTING NORMS IN NORMATIVE AND TECHNICAL DOCUMENTATION

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