UDK 621.777.4

I.S. Aliiev[1]
V.L. Kaliuzhnyi[2]
V.M. Levchenko[3]

PERSPECTIVE DIRECTIONS OF DEVELOPMENT OF EXTRUSION TECHNOLOGIES

[1]Donbass State Engineering Academy, [2]National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», [3]O.Ya. Usikov Institute for Radiophysics and Electronics NAS of Ukraine

Abstract. Prospective methods of combined plastic deformation, which contribute to the development of technological capabilities, scope and competitiveness of precise volumetric extrusion processes, are considered.
Keywords: extrusion, combined deformation, force action, kinematic action, friction forces.

The development and implementation of new science-intensive technological processes is one of the most important areas for intensification of machine-building production. Cold and hot extrusion processes are resource-saving and competitive technologies for manufacturing precision parts of machines and devices.Combined and hybrid processing methods based on a combination of traditional working by pressure methods with additional effecting methods are becoming more widespread in machine-building [1–4]. In working by pressure this has led to the proposal of number of original technologies for combined action and processing, such as thixo stamping, isothermal stamping, roll and thermal friction stamping, local deformation, hydro- and screw extrusion.

Now, deformation processes with additional force and kinematic influences are becoming actively spread, which makes it possible to ensure optimal control and regulation of the metal flow in the deformation zone, the stress-strain state of the workpiece and, consequently, the quality of the formed part [2, 4]. The process can be considered as combined one if, in addition to the main action (method), it also uses an additional action on the workpiece, which can be a force and (or) kinematic effect. Creation of additional force actions by tension, counterpressure, directed friction forces, support, twisting, etc. requires, as a rule, the applying additional energy and additional movement to other parts of the technological tooling (equipment, dies). This may also require a special (generating) force action [4, 5].

Under the kinematic influence one should understand the influence on the kinematics of the flow process of the deformed workpiece by purposefully regulating (controlling) the direction of the flow, the nature of the deformation, ensuring freedom of flow, creating a different stress-strain state for the prevailing deformation scheme. The kinematic effect can contribute to a significant improvement in structure working of the deformed metal, even out deformation unevenness and eliminate stagnant zones. For processes of cold extrusion of hollow parts such as sleeves and cups with characteristic high total and unit loads, one of the main objectives of the kinematic action is to increase the degree of freedom of the flow [3–6].

A promising direction in the development of precision stamping technologies is the implementation of methods for combined extrusion of complexly profiled parts based on a combination of traditional longitudinal extrusion schemes with transverse (radial and side) extrusion methods in split dies [3, 4, 7]. These methods are distinguished by their multivariate versions. In addition to the advantages characteristic of combined schemes (optimal and self-regulating force mode, high degrees of forming), the inclusion of transverse radial flow schemes leads to a decreasing hydrostatic pressure in the deformation zone (Fig. 1, schemes 1–3) and to a noticeable increasing the complexity of the shape of the parts obtained.

The useful applying of contact friction forces is also an important reserve in the intensification of volumetric deformation processes. In this case, both the forces of active friction (created by the movement of the die in the direction of the flow of the metal or the support punch in the direction of movement of the punch) (see Fig. 1, scheme 4), and the forces of reactive friction acting on the surface of the part (scheme 5) [4] are useful. The application of tension forces to the formed part (scheme 6) is

aimed at reducing the load on the punch, and the counterpressure is aimed at improving the quality of the stamped parts [1, 5, 7].

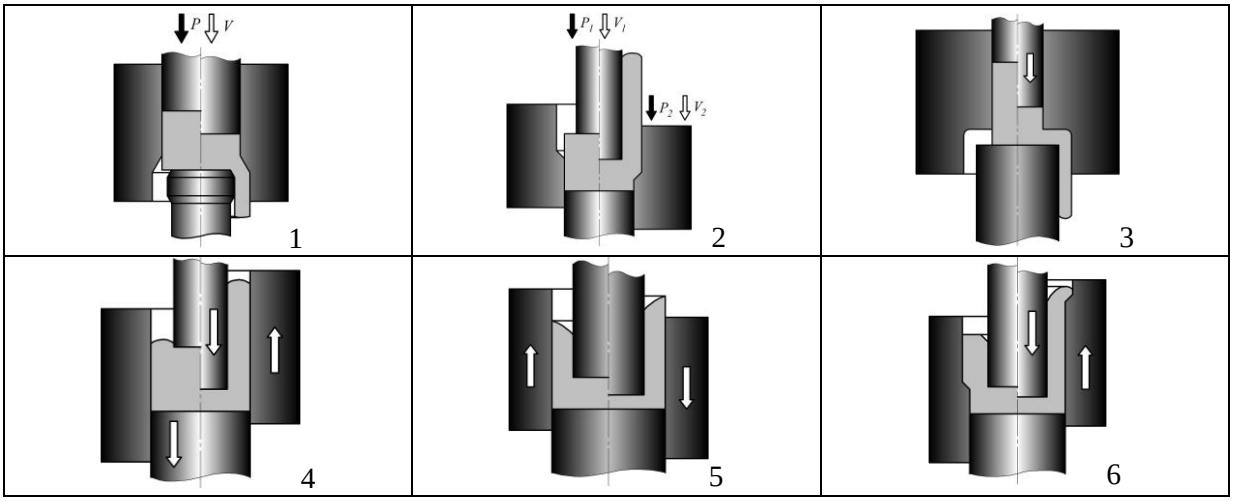

Fig. 1. Methods for extrusion of hollow parts

REFERENCES

1. Bhaduri A. Extrusion. In: Mechanical Properties and Working of Metals and Alloys. Springer Series in Materials Science. 2018. Vol. 264, pp. 599-646.

2. Aliieva L.I. Improvement of combined extrusion processes: monograph. Kramatorsk: LLC "Tiraj – 51". 2018. 352 p. ISBN 978-966-379-846-2. (Rus.).

3. Aliev I.S. Radial extrusion process. Soviet Forging and Metal Stamping Technology (English Translation of Kuznechno-Shtampovochnoe Proizvodstvo). New York: Allerton Press. 1988. Part 3, pp. 54–61. ISSN: 0891-334x. 7

4. Aliyeva L.I.; Gumenuk U.I., Usmanov D.V. Predictions of deviations of the shape of details at cold extrusion. In: *Proceedings of the 6th International Conference "New technologies and achievements in metallurgy, material engineering"*. Czenstchowa. 2005, pp. 383 -391. 9

5. Aliieva L.I. Controlling the forming of parts with a flange during cold extrusion. *Bulletin of the National Technical University "Kharkiv Polytechnic Institute"*. 2016. 30 (1202), pp. 13-20. (Rus.). 13

6. Aliiev I., Aliieva L., Abhari P., Goncharuk K. Investigation of defect in combined precision extrusion process with multiple ram. *Proceedings of the 16th International Conference "New technologies and achievements in metallurgy, material engineering and production engineering"*. Czestochowa. 2015, pp. 90–93. 14

***Igramotdin Serajutdinovich Aliiev**, Dr. Sc., Full Professor, Donbass State Engineering Academy, Kramatorsk, igramaliev@gmail.com; **Volodymyr Leonidovych Kaliuzhnyi**, Dr. Sc., Full Professor, Professor of the Department of Aircraft Manufacturing Technologies, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», kwl_2011@ukr.net; **Volodymyr Mykolaiovych Levchenko**, Ph. D., Senior Researcher, Junior Researcher of Department of Radiowave Propagation in Natural Media, O.Ya. Usikov Institute for Radiophysics and Electronics NAS of Ukraine, Kharkiv, goldangel271@gmail.com*

ПЕРСПЕКТИВНІ НАПРЯМКИ РОЗВИТКУ ТЕХНОЛОГІЙ ВИДАВЛЮВАННЯ

***Анотація.** Розглянуто перспективні способи комбінованого пластичного деформування, які сприяють розвитку технологічних можливостей, сфери застосування та конкурентоспроможності процесів точного об'ємного штампування видавлюванням.*

***Ключові слова:** видавлювання, комбіноване деформування, силовий вплив, кінематичний вплив, сили тертя.*

***Алієв Ігрaмотдін Сєражутдінович** – д.т.н., професор, завідувач кафедри обробки металів тиском, Донбаська державна машинобудівна академія, Краматорськ, igramaliev@gmail.com*

***Калюжний Володимир Леонідович** – д.т.н., професор, професор кафедри технології виробництва літальних апаратів, НТУ України «КПІ ім. І. Сікорського», Київ, kwl_2011@ukr.net*

***Левченко Володимир Миколайович** – к.т.н., ст. наук. співроб., молодший науковий співробітник відділу поширення радіохвиль в природних середовищах, Інститут радіофізики і електроніки НАН України, Харків, goldangel271@gmail.com*