

Simulating the process of vibroimpact cutting in precision investment casting

© V.E. Eremyants

Kyrgyz–Russian Slavic University named after B.N. Yeltsin,
Bishkek, 720000, Kyrgyz Republic

The article deals with separating castings from the central gate channel, that is, the sprue, which is one of the most labour-intensive operations in precision investment casting. In practice, the vibroimpact method is considered the most promising way of carrying out this operation, not only increasing operation efficiency, but also decreasing time spent and material lost over the course of subsequent operations, and making it possible to exclude certain operations whatsoever. In order to coordinate cluster parameters and impact load characteristics that ensure optimum casting separation without any damage to the sprue, it is necessary to investigate and analyse impact dynamics in the cluster. We suggest simulating the cluster as a rigged rod with distributed parameters. We provide a mathematical description of the dynamics inside the cluster and establish how loads and stresses in the sprue cross-sections and runners connecting castings to the sprue depend on various factors. The patterns revealed provide sound reasons to select certain approaches to designing clusters and specifying impact load parameters.

Keywords: *precision casting, cluster, sprue, runners, castings, model, rigged rod, impact, stresses*

REFERENCES

- [1] Alimov O.D., Basov S.A., Eremyants V.E., Nevenchanny Yu.V., Pisarenko N.G. *Vibroudarnyy sposob otdeleniya otlivok ot blokov, poluchaemykh litem po vyplavlyaemykh modelyam* [Vibroimpact method of separating castings from clusters in investment casting]. Frunze, Ilim Publ., 1986, 26 p.
- [2] Eremyants V.E., Nevenchanny Yu.V., Pisarenko N.G. *Udarnoe nagruzhenie osnashchennykh sterzhney* [Impact loading of rigged rods]. Frunze, Ilim Publ., 1987, 164 p.
- [3] Alimov O.D., Nevenchanny Yu.V., Pisarenko N.G. *Gidravlicheskie stanki vibroudarnogo deystviya dlya otdeleniya otlivok ot blokov* [Hydraulic vibroimpact machines for separating castings from clusters]. *Povyshenie kachestva i effektivnosti litya po vyplavlyaemykh modelyam: Materialy seminara* [Increasing quality and efficiency of investment casting: Workshop materials]. Moscow, Moscow House of Scientific and Technical Propaganda Publ., 1986, pp. 131–136.
- [4] Maslov V.S., Grebnev V.I., Melnichenko G.G. *Liteynoe proizvodstvo — Foundry. Technologies and Equipment*, 1986, no. 11, pp. 34.
- [5] Eremyants V.E., Nevenchanny Yu.V., Kharchenko A.K., Fesenko A.V. *Liteynoe proizvodstvo — Foundry. Technologies and Equipment*, 1991, no. 1, pp. 33–35.
- [6] Alimov O.D., Eremyants V.E., Nevenchanny Yu.V. *Izvestiya AN Kirgizskoy SSR. Fiziko-matematicheskie i tekhnicheskie nauki (Proc. of the Academy of Sciences of Kyrgyz SSR. Physical, mathematical and technical sciences)*, 1988, no. 4, pp. 35–41.
- [7] Alimov O.D., Eremyants V.E., Nevenchanny Yu.V. *Liteynoe proizvodstvo — Foundry. Technologies and Equipment*, 1989, no. 11, pp. 31–32.

- [8] Fabizhevskiy K.B. *Prikladnaya mekhanika — International Applied Mechanics*, 1977, vol. XIII, no. 6, pp. 97–101.
- [9] Alimov O.D., Eremyants V.E. *Izvestiya AN Kirgizskoy SSR. Fiziko-matematicheskie i tekhnicheskie nauki (Proc. of the Academy of Sciences of Kyrgyz SSR. Physical, mathematical and technical sciences)*, 1987, no. 3, pp. 24–32.
- [10] Eremyants V.E. *Izvestiya AN Kirgizskoy SSR. Fiziko-matematicheskie i tekhnicheskie nauki (Proc. of the Academy of Sciences of Kyrgyz SSR. Physical, mathematical and technical sciences)*, 1990, no. 4, pp. 40–47.
- [11] Eremyants V.E., Drozdova I.S. Model osnashchennogo sterzhnya s raspredeleennyimi parametrami [Rigged rod model with distributed parameters]. *Sovremennyye problemy mekhaniki sploshnykh sred* [Contemporary problems of continuum mechanics], no. 16. Bishkek, Institute of Geomechanics and Subsoil Development, 2012, pp. 285–290.
- [12] Vepruk A.M., Voznyuk P.D., Krupenin V.L., Chirkov I.M. *Shirokopolosnye vibroudarnyye generatory mekhanicheskikh kolebaniy* [Broadband vibroimpact generators of mechanical vibrations]. Ragulskis K.M., ed. Leningrad, Mashinostroenie Publ., 1987, 78 p.
- [13] Eremyants V.E., Drozdova I.S., Muktarbekova G.M. Raschet sobstvennykh form i chastot kolebaniy osnashchennogo sterzhnya, opisyvaemogo razlichnymi modelyami [Computing eigenforms and vibration frequencies in a rigged rod described by means of various models]. *Sovremennyye problemy mekhaniki sploshnoy sredy. Trudy XVI mezhdunar. nauch. konf. (Rostov-na-Donu, 16–19 okt. 2012 g.)* [Contemporary problems of continuum mechanics. Proc. of the 16th International scientific conference (Rostov-on-Don, October 16–19th, 2012)]. Bishkek, National Academy of Sciences of the Republic of Kyrgyzstan Publ., 2012, pp. 374–378.
- [14] Eremyants V.E., Drozdova I.S. *Vestnik KRSU*, 2013, vol. 13, no. 7, pp. 32–36.

Eremyants V.E., Dr. Sc. (Eng.), Professor, Department of Mechanics, Kyrgyz–Russian Slavic University named after B.N. Yeltsin. Specialises in impact theory, dynamics of impact-based machines and mechanisms for various industries.
e-mail: eremyants@inbox.ru