Chapter 4
Automation of the Process of Charge Sampling at Metallurgical Enterprises Using Robots

Sergei Jatsun
South-West State University, Russia

Jamil Safarov
https://orcid.org/0009-0004-0392-3860
University of Technology of Azerbaijan, Ganja, Azerbaijan

Egor Tistsov
https://orcid.org/0009-0004-1779-5396
South-West State University, Kursk, Russia

Dmitrii Efremov
https://orcid.org/0009-0004-5408-6986
South-West State University, Russia

Gavriil Fursov
South-West State University, Russia

ABSTRACT

This chapter per the authors reveal the problem of the complexity of selecting the fired charge from the furnace and propose automation of this. They talk about the development of a robot for automatic charge selection, as well as modeling its bucket using a fifth-order polynomial in analog and discrete spaces. The calculation results are presented, as well as graphs of the position, speed, acceleration,

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torque, and changes in motor current when the bucket is moved. The chapter also contains a description of the sampler job and its main parts, such as a control cabinet, a manipulator arm, and a laser protective barrier. This chapter describes the intended modes of operation of the charge sampling robot, such as timer operation and single sampling.

INTRODUCTION

Metallurgical enterprises offer great prospects for industrial robots. This is easily explained if we take into account the conditions of metallurgical production: high temperatures, the weight of each unit, etc.

In metallurgical production, there are a large number of operations currently performed using various mechanisms and machines with the participation of an operator, which can be successfully assigned to robots.

An analysis of the sites and workshops of metallurgical production to be robotized allows us to conclude that mass-produced industrial robots are not suitable for use in this production, for example, due to the presence in many cases of significant dynamic loads associated with the need not to simply move some part in space, but to perform additional mechanical work. Created mainly for use in mechanical engineering, serial robots are usually not adapted to work in aggressive environments and at high temperatures typical of metallurgical production (Yin, 2021; Arents & Greitans, 2022; Dzedzickis et al., 2021).

The charge is one of the key components in metallurgical production, which plays an important role in the metal production process. Understanding what a charge is and how it is used makes it possible to optimize production processes and improve the quality of the final product. It is a mixture of various materials used in metallurgical production to produce metals and alloys. The charge includes metal ores, fluxes and fuels, which together ensure efficient ore melting and impurity removal. The main problems associated with the preparation of the charge include the complexity of accurate calculations, the need to use specialized equipment and the dependence of the quality of the charge on the quality of the raw materials. To do this, automation of the charge sampling process must be widely implemented.

In many enterprises, the analytical control services are based on the principle of periodic manual sampling of technological products followed by their chemical or hardware analysis.

The sampling frequency is 1-3 hours. If you add 1-2 hours of receiving the test results, then the analysis data may be up to 3-5 hours late relative to the sampling time. If we take into account that the variability of the quality of the feedstock has a characteristic time of 1-3 hours, then the resulting delay in obtaining information