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Diagnostics, Optimization and Mathematical Models of Coke-Sinter-Hot Metal Production Process

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INTRODUCTION

Modern operation of large blast furnaces, sinter plants and coke ovens require application of mathematical model and sub-systems to maintain stable conditions and rapidly react on dynamic changes in operation and conditions of blast furnace and other process units. Scientific foundations of such models are based on theory of heat exchange in shaft and blast furnaces, theory of metallurgical slags, thermodynamic description of processes at primary end of Iron & Steel Works etc., which are described in studies [1-12]. Such scientists and researches as B. Kitaev, O. Esin, P. Geld, E Vegman, Z. Nekrasov. A. Ramm, A. Gotlib, Yu. Usfin, Yu. Yaroshenko, V. Korotich etc. in former Soviet Union developed a solid analytical foundation of primary end processes. Similar work was done in parallel by many western scientists and researchers. This theoretical approach was complimented by practical and empirical rules of operation.

During this period some simple calculation methods of key performance indicators and their interdependencies were implemented for centralized control and information systems (CCS APCS). When the largest in Soviet Union at the time blast furnace No.9 of Krivoi Rog I & S Works (5,000 m^3 inner volume) was erected, local systems for analysis and cyclograms of process parameters deviation from the normal conditions were tested before blowing-in and ramp up of blast [14]. These systems incorporated advanced mathematical models of blast furnace smelting simulation developed by CIS design institutes and professionals and adopted an international experience from many leading metallurgical companies and equipment suppliers.

Starting from 1977 to 1989, mathematical models of process, algorithms of diagnostics and forecast along with logical rules and methods of process performance optimization of other large blast furnaces such as BF No. 6 at NLMK (3,300 m^3 inner volume, blew-in in 1978) and BF No. 5 at CherMK (5,500 m^3 inner volume, blew-in in 1986 were actively developed and tested. The most large-scale work on indicated above activities were performed in the leading design institute in the field of ferrous metallurgy - Iron and Steel Institute (Dnepropetrovsk), in the Urals region it is Urals Federal University and VNIIMT (Ekaterinburg), Sankt Petersburg (Leningrad) Polytechnic University, Central Design Bureau Soyuzpromavtomatika - VNIPI SAU (Moscow) and Ural Technical University (Ekaterinburg). These institutes had project teams, departments and laboratories involving professionals for analytical descriptions of primary end processes, there design, automation, applied

