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Summary of doctoral dissertation of Marcin Więcek, under the title.: Experimental analysis of indirect and direct reduction of mill scale in the range 900-1050°C

The choice of the issue was determined by the need to investigate the reduction of mill scale with used gas reducers (CO, H_2, CO-H_2), and compared the results with other fine-grained waste materials – like dusts and sludges, because there are few publications, where the reduction is carried out in a mixture of CO- H_2. In addition, there are few publications which in iron-bearing waste materials are reduced in its original form.

The main aim was obtained a material with high purity, appropriate chemical properties and a high degree of reduction and metallization. The sponge iron was obtained during the research and will be able to be the starting material for the production of quality steels based on the converter process. Research experiments were carried out of used rolling scale, dust and sludge. The influence of several factors on reduction research of iron oxides was verified: temperature, grain size, basicity (CaO / SiO2), layer height of the sample in the crucible and the type of reducer - CO, H_2 and gas mixture (50% vol. CO + 50% vol. H_2) for the reduction process.

The dissertation was divided into two parts: literature part (two chapters) and research part (eight chapters). The first chapter described the most frequently forms of recycling fine-grained waste materials. The second chapter was described the properties of carbon monoxide, hydrogen and a mixture of CO-H_2 and described how use them in the reduction of iron oxides. The third chapter was contained the thesis and purpose of the work. The fourth chapter presented the scope of research on the reduction of iron-bearing waste materials with CO and H_2. In the fifth chapter was characterized the material used in the research, furthermore the chemical and granulometric composition of the mill scale, dusts and sludges was given. The sixth chapter was contained a description of the research methodology and description of the test bench of reduction sample in the stationary layer - in the Tammann furnace and the test bench of reduction sample in the mobile layer - in a laboratory rotary tube furnace. The seventh chapter was presented research plans in stationary conditions and the results of indirect reduction of mill scale, dusts and sludges with use CO, H_2 and mixture CO-H_2 as a reducing agents. Chapter eight was contained the characteristics of mixed reduction of iron oxides in stationary conditions from dust and sludge with use mixture CO-H_2 and a fixed carbon as a reducing agents. The ninth chapter was presented research plans, chemical composition, results of metallization and results of reduction mill scale, dusts and sludges carried out in a laboratory rotary tube furnace with use CO and mixture CO-H_2 as a reducing agents. Chapter ten was contained statements and conclusions.

The degree of metallization which is require when it use the material as a metallic charge in electric steelworks was obtained in laboratory rotary tube furnace during reduction of mill scale with an increased flow of CO and during reduction sludge with use CO and mixture CO-H_2 as a reducing agents.

Keywords: mill scale, dust, sludges, reduction, carbon monoxide, hydrogen

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