OBTAINMENT OF CERAMIC PIGMENTS FROM INDUSTRIAL STEEL WASTES

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ABSTRACT

The obtainment of ceramic pigments from industrial steel wastes, heat treated at several temperatures, has been studied using Differential Thermal Analysis (DTA), Thermogravimetric Analysis (TG), X-Ray Diffraction (XRD) and Colorimetric analysis by Spectroscopy. The results obtained show that the studied materials, with high iron contents, can be used as ceramic pigments for several applications in the industrial field.

1. INTRODUCTION

The word pigment means a substance consisting of small particles, which is practically insoluble in the applied medium and is used on account of its colouring, protective, or magnetic properties [1]. Iron oxides are the most widely used pigments. The continually increasing importance of iron oxide pigments is based on their non-toxicity; chemical stability; wide variety of colours ranging from yellow, orange, red, brown, to black; and low price. Furthermore, most of the feedstock for synthetic iron oxide is derived from scrap metal and the major markets for iron oxide pigments are coatings, concrete products and building materials. In this context and taking in account steel scraps from Brazilian steel plants, iron oxide pigments were prepared and characterized.

2. EXPERIMENTAL PROCEDURES

Iron oxide samples from steel scraps collected in Brazilian steel plants were prepared and wet milled. Heat-treatments of calcinations were carried out in a laboratory electric furnace in the 300-1200°C temperature range for 120 min in air by applying a heating rate of 20°C min^{-1} after which the samples were cooled down to the room temperature. The heat-treated samples were then subjected to differential (DTA) and thermogravimetric (TGA) analysis, chemical analysis, X-ray diffraction (XRD) and colorimetric measurements.

3. RESULTS AND DISCUSSION

Chemical analysis of the samples shows that the steel scraps contain 98% Fe_2O_3 and other oxides in small amounts. XRD (Figure 1) shows that in the 20-700°C temperature range, the main crystalline phases are magnetite (Fe_3O_4), hematite (Fe_2O_3) and wustite (FeO). At 800°C wustite disappeared, leaving only hematite and magnetite. When temperature was increased from 800 to 1200°C, hematite was the only crystalline phase. Simultaneous thermal analysis (DTA, TGA) revealed that an exothermic event occurred in the 200-1200°C temperature range, which is associated with a weight increase of about 5.6%. In fact, oxidation from FeO to Fe_2O_3 took place in this temperature interval. Comparing the colorimetric coordinate results range L (from 22.1 to 27.2), a* (from 0.09 to 13.2), b* (from -1.88 to 1.78) with the obtained pigments (visual analysis) shows that the heat-treated iron oxide pigments have a remarkable brown colour.

4. CONCLUSIONS

Iron oxide pigments processed from steel scraps were economically obtained. When the steel scrap samples were heated from 300 to 1200°C, hematite was the only crystalline phase, so that the resulting pigments show a brown colour. At least, it can be concluded that the iron oxide pigments obtained from steel scraps are potential candidates for a number of applications, but in particular for colouring concrete products and building materials.

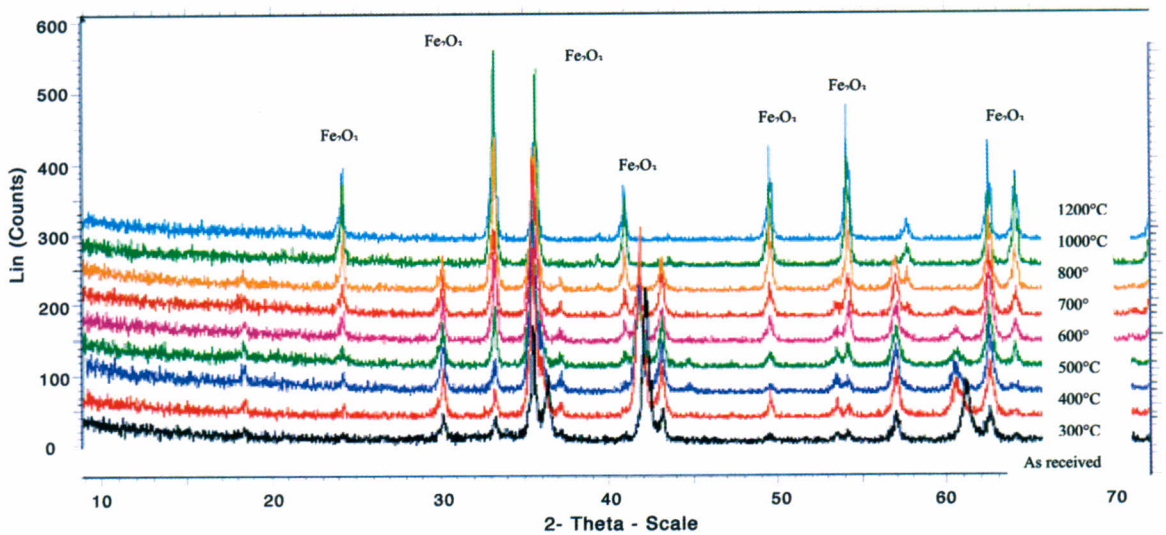

Figure 1. XRD at different calcination temperatures for the iron oxide pigments processed from steel scraps.

REFERENCES

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