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Utilization of electric arc furnace dust (EAFD) as raw material for cement production

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Abstract – This work investigates the use of electric arc furnace dust (EAFD) produced during steel manufacture as raw material for cement production. Thus, an EAFD was added replacing clay or as a complementary source of iron. The so-produced cement presented alite (Ca_3SiO_5) and belite (Ca_2Si_4), which are the principal mineral phases of the cement, in similar values to conventional cements.

During the steel manufacture process via Electric Arc Furnace (EAF), the scrap metal is melted due to a voltaic arc. The energy applied during the process combined with the raw material features provoke the formation of an extremely fine powder, so called electric arc furnace dust (EAFD), in quantities of 15 to 20kg/ton of produced steel [1]. Brazil generates approximately 100.000 to 200.000 tons of this material per year [2]. This residue is formed during metal's evaporation, like zinc and lead metals, or can also be obtained as oxides, like MFe_2O_4 (M=Zn, Mn, Ni). The final chemical composition of EAFDs will depend upon the raw materials utilized as scrap, the manufacture process and the steel quality. In the current country, most of researches carried out in this field aim the utilization of the residual powder remained from EAF process as a possible raw material to be returned to the metal manufacture process. In the present research, it was investigated the potential application of EAFD in cement production in order to fit into place a residue as a raw material able to be used in the manufacture of a final product.

Chemical and mineralogical composition, size distribution and contaminants content of an EAFD were evaluated in order to optimize the cement mixture as an attempt to obtain novel cements. It was also added silica (SiO_2), calcium carbonate ($CaCO_3$), alumina (Al_2O_3) (Figure 1). The determination of each raw material quantities was attained through the chemical parameter used as quality standard in Brazilian cement industries, such as lime saturation factor (LSF), silica modulus (SM) and alumina-iron factor (AIF) and mineralogical phases (Bogue potential). Cement mixtures were burned in a laboratory oven at 1350°C, 1400°C and 1450°C (Figure 2). Chemical composition (by means of infra-red fluorescence), mineralogical phases (via x-ray powder diffraction) and phase constituents and percentages (via SEM) were obtained in order to characterize the novel cement. Results indicate that it is possible to replace FeO with the addition of EAFD without diminishing the final cement qualities.

Figure 1: Non-burned cements.

Figure 2 – Burned cements.

[1] RECUPAC – Groupe Wheelabrator Allevard, *site* - http://www.recupac.com/eaf_dust.htm
[2] IISI, International Iron &Steel Institute *site* www.worldsteel.org