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A COMPARATIVE STUDY ON ELECTRODIALYTIC TREATED BIO-ASH AND MSWI-APC RESIDUE FOR USE IN BRICKS

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Abstract

In this study, two particulate residues (a) co-combusted straw and wood fly ash (EFA) and (b) municipal solid waste incineration air pollution control (MSWI-APC) residue, were considered for partly clay replacement (≤ 25%) in brick production. The two residues are often considered hazardous waste because of a high concentration of heavy metals. Cadmium is the main heavy metal of concern in EFA, while the MSWI-APC residue is much more toxic and various heavy metals exceed the Danish limiting values for use. An electrodialytic remediation (EDR) method was used for removal of heavy metals from the residues. The Cd concentration in the EFA was lowered to well below the Danish limiting value of 5 mg/kg during the EDR. The heavy metal leaching from the MSWI-APC residue was reduced substantially during EDR. So achieving this, the two treated ashes are considered potential resources for use as partly substitution for clay in the production of bricks. Using particulate waste products as clay substitute has the following advantages: (1) to utilize the waste as secondary resources and to landfilling less; (2) to solve the shortage of natural recourses, such as clay in some areas.

An experimental screening on the use of the two EDR treated residues in bricks was made. Brick pellets were made with clay from a brick producer and with different percentages of the residues (maximum 25%) substituting clay. The diameter of the pellets was 20 mm and the dry mass 2 g and they were made under pressure of 47 M Pa. After drying, the pellets were fired in a laboratory furnace at 1000 ^{0}C for 1 hour. At 25% clay replacement, the total shrinkage was less than that of the pellets from clay alone (< 4%). The weight loss during firing, vacuum water absorption and the apparent porosity of the sintered pellets all show the following order: *clay < 25% EFA < 25% MSWI-APC residue*. The increase in the apparent porosity can explain the increase in water absorption. However, the corresponding bulk density values are in the reverse order, i.e. *clay (1.77* g/cm^3*) > 25% EFA (1.55* g/cm^3*) > 25% MSWI-APC residue* (*1.53* g/cm^3). The appearance the fired pellets with 25 % residues were different. The pellets with 25% EFA showed a slight color fading in comparison to the yellow pellets from clay alone. The pellets with 25% MSWI-APC residue were pale and looked dusty. All the pellet characteristics were thus influenced of the type of residue used. By lowering the clay substitution to 15% of EDR treated MSWI-APC residue a density of 1.67 g/cm^3 was obtained, but the appearance did not improve. At a further lowering of the clay substitution to 5%, only white spots were seen on the surface.

X-ray diffraction showed that SiO_2 was the main crystalline phase in the EDR treated EFA, while $CaCO_3$ was the dominating phase in the EDR treated MSWI-APC residue. The results from the brick pellet production showed that the treated EFA was a significantly better clay substitute than the treated MSWI-APC residue. The high $CaCO_3$ was probably the main problem in relation to the MSWI-APC residue.