SINTERED CERAMIC MATERIALS MADE MAINLY FROM PULVERIZED FUEL ASH USING "STICKY" PFA AS A BINDING AGENT

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This invention relates to a kind of ceramic material, a specially sintered ceramic material, using "sticky" PFA as a binding agent.

Pulverised fuel ash waste from power plants is becoming a serious threat because of the occupation of farmland to build ash yards and the environmental pollution caused by PFA. Patent SU 1537-665-A, CN 87101036 made public some technical programs for producing ceramic materials by using PFA from power plants. Their special common feature is the addition to PFA of a considerable weight percentage of plastic clay. Therefore, the attempt to solve the problem of PFA reuse raises a new threat of destruction of available farmland.

The aim of this invention is to offer a technical program for sintered ceramic material produced mainly from pulverised fuel ash using "sticky" PFA as a binder, so that the problem of PFA reuse can be solved completely.

The achievement of the invention is based on the long-time experience of the inventor in the synthetic use of PFA, from which he discovered that PFA from power plants may be classified into two major kinds: non-sticky and "sticky". The composition of non-sticky PFA expressed in the percentage ranges of its chemical compounds is: SiO_2 44-59%, Al_2O_3 14-38%, Fe_2O_3 4-17%, CaO 2-12%, MgO 0.2 - 3.6%, the percentage composition of "sticky" PFA is: SiO_2 7-51%, Al_2O_3 2-18%, Fe_2O_3 5-24%, CaO 13-30%, MgO 1-3%. The mixture of "sticky" PFA and water will become "viscous" to a certain extent, yielding a plasticity index >7 and satisfying the technical requirement. However, as the weight percentages CaO, Fe_2O_3, MgO in "sticky" PFA are a little bit higher, and the weight percentage of Al_2O_3 is a little bit lower than ordinary ash, taking into account the requirements for the chemical compositions of the raw materials for sintered materials, the proportion of $Al_2O_3 > 10\%$ to ensure the mechanical strength of the products, $Fe_2O_3 < 10\%$ so as not to lower the firing temperature and heat resistance of the products, CaO < 10% to assure a wider range of sintering temperature, MgO < to prevent swelling and delayed crazing of the products after being sintered. From this point of view, in order to

assure the sintered PFA products have the best synthetic property, we should define the range of compounding ratio of non-sticky and "sticky" PFA, from which to define the weight percentage ratio of the chemical components of this invention product.

This invention refers to a sintered ceramic product made from PFA by using "sticky" PFA as a binding agent. Its components include PFA and binders. The characteristic feature is: the said PFA is non-sticky PFA with percentage composition: SiO_2 44-59%, Al_2O_3 14-38%, Fe_2O_3 4-17%, CaO 2-12%, MgO 0.2 - 3.6%, the said binder is "sticky" PFA with percentage composition: SiO_2 7-51%, Al_2O_3 2-18%, Fe_2O_3 5-24%, CaO 13-30%, MgO 1-3%. The mixture of the two powders has a plasticity index > 7.

As a practical example of this invention, the chemical composition of the non-sticky PFA was: SiO_2 56.6%, Fe_2O_3 32.6%, CaO 2%, MgO 0.5%. The chemical composition of the "sticky" PFA was: SiO_2 45%, Fe_2O_3 11%, Al_2O_3 14% CaO 14%, MgO 1%.

In one of the practical examples, the ratio of the weight proportion of non-sticky to "sticky" PFA was 50:50, the chemical composition of the mixed powder was: SiO_2 50.8%, Al2O3 23.3%, Fe_2O_3, Fe_2O_3 8.3%, CaO 8.0%, MgO 0.75%. The plasticity index of the mixture of the two tested powders was 7%. The Al_2O_3, Fe_2O_3, CaO, MgO component contents all fulfilled the requirements for the raw materials of the sintered products.

In second practical example, the ratio of the weight proportion of non-sticky to "sticky" PFA was 35:65, the chemical composition of the mixed powder was: SiO_2 49.1%, Al_2O_3 20.5%, Fe_2O_3 9.1%, CaO 9.8%, MgO 0.83%. The plasticity index of the mixture of the two tested powders was 7.5%. The Al_2O_3, Fe_2O_3, CaO, MgO component contents also fulfilled the requirements for the raw materials of the sintered products.

From the above two practical examples we see that the ratio of the weight proportions of the above non-sticky to "sticky" PFAs should lie between 50:50 and 35:65. When the weight percentage of "sticky" PFA exceeds 65%, the component contents of Fe_2O_3, CaO will exceed 10%. The plasticity index will be less than 7 when its content is less than 50%. No complying products can be made in both cases.

The compressive strength of the two sintered test blocks was 25 and 22 megapascal; the flexural strength was 2.4 and 2 megapascal respectively, and specific gravity was 1300 kg/m^3. Both sample blocks passed when tested against 25 freezing and thawing cycles.

According to the results of the above tests, the chemical composition of the components of the material produced as best practical example was: SiO_2 49-50.8%, Al_2O_3 20.5-23.3%, Fe_2O_3 8.3-9.1%, CaO 8.0-9.8%, MgO 0.75-0.83%.