CORROSIVE REACTION TEXTURES OF FIRECLAY CAUSED BY H_2SO_4 ATTACK

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A crucial factor in producing highly pure titanium dioxide pigments by the sulphate process is the corrosive reaction of the sulphuric acid with the mullite, cristobalite and glassy phase bearing refractory fireclay. Detailed and systematic observations of reaction textures in combination with mineral chemical analyses from the immediate hot face to the cold end of used Al_2O_3-SiO_2 bricks allow a reconstruction of a two-step thermo-chemical modification of the fireclay grains in the presence of sulphuric acid. In an initial step, mullite decomposition appears at the edges of fireclay grains, resulting in the growth of a blocky amorphous silica corona and aluminium-sulphate. This texture can be explained by the H_2O releasing reaction $Al_6Si_2O_{13} + 9\ H_2SO_4 = 3\ Al_2(SO_4)_3 + 2\ SiO_{2\ (amorphous)} + 9\ H_2O_{\ (g)}$. In a second step, when temperature reaching minimum ~770 °C, the newly formed aluminium-sulphate is transformed to corundum. The formation of this pseudomorphic corundum after aluminium-sulphate occurs through the reaction $Al_2(SO_4)_3 = Al_2O_3 + 3\ SO_{3\ (g)}$ and appears mainly at the hot face of the studied bricks. This interpretation is consistent with decreasing SO_3 concentrations from the cold end (~20 wt.%) to the immediate hot face (~3 wt.%) of the bricks. To improve the resistance against sulphuric acid attack on such fireclay bearing refractories, a special impregnation is recommended.