CRITICAL CONDITIONS IN REACTION OF ALUMINUM WITH WATER

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Abstract: In aluminum powder/water reaction at higher temperatures, temperature runaways are experimentally found. Similar effect with sharp temperature rise has been found in the authors' experiments where water has been injected into molten aluminum. This study presents an explanation of these phenomena within the framework of the theory of thermal explosion. The critical condition of thermal explosion is formulated as the ratio of heat release in chemical reaction and heat loss into the walls of the reactor. Critical condition depends on the kinetic parameters of the reaction, on temperature, and on the net surface of the contact between aluminum and water, where reaction occurs. Solid products can be formed on the surface of the aluminum particles leading to degenerate regimes of thermal explosion.

Keywords: combustion of aluminum in water; aluminum-water reaction; thermal explosion; critical phenomena; combustion instability

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