Effect of dimensionless numbers on production of energy from moisty organic dust particles

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Abstract

Nowadays Stirling engines are widely used in Baltic countries. Widespread usage of Stirling engines led to many investigations on organic dust combustion to enhance these engines efficiency. However many experimental studies have done in this subject, but lack of an integral analytical model is sensible. In this study we present an analytical model to simulate the combustion process of moist organic dust. One dimensional model is used to evaluate the flame characteristics. The flame structure is divided into three zones: preheat zone, reaction zone and post-flame zone. Also preheat zone is also divided into four subzones itself: first heating subzone and drying subzone, second heating subzone and volatile evaporation subzone. Finally, effect of moisture and also effects of some important parameters, like devolatization temperature, Da_{vap}, Da_{dry} and Lewis numbers are investigated. Increase in moisture content causes a reduction in burning velocity due to moisture evaporation resistance.

Keywords: Organic particles, Moisture content, Analytical model, Da_{vap} number, Da_{dry} number, Lewis number, Devolatization temperature.

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