A Thermal Explosion Theory for Parallel Reactions.

Okoya, Samuel Segun

M.Sc. Mathematics

Department of Mathematics

Obafemi Awolowo University, Ile Ife, Nigeria

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Abstract:

The equations for reacting fluids were considered with particular interest on the effect of pre-exponential factor. We assumed constant and variable pre-exponential factors and considered parallel reactions.

Essentially our notion of blow up implies non-existence and so we consider in general uniqueness and existence of the resulting equations. We also examined the conditions for thermal explosion.

We show that even where there is reactant consumption; there exist one, two or more solutions of the problem depending on the activation energy of the system when the vessel is spherical.

Analytical solutions were obtained for the system and bounds on solutions were provided in cases of interest. We discussed the effects of Frank-Kamenetskii parameter, the so called parameter from the introduction of effective activation energy and the initial temperature.

Important theorems were stated and proved with respect to these parameters. To emphasize these theorems we illustrated the conclusions graphically.
We established that for finite activation energy in unsteady case there is no thermal explosion whether there is diffusion or otherwise. In the limit of large activation energy we compared the explosion time for two step reactions with that obtained when effective activation energy is employed.
We discuss in details the conditions for the occurrence of steady solutions.

Keywords: Frank-Kamenetskii parameter/ thermal explosion theory

Supervisor: R.O. Ayeniss

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