Adiabatic Calorimeters

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Various types of calorimeters with significant design differences are used for different applications. DSCs, for instance, are scanning twin-cells heat-flow calorimeters that are widely used for material testing and chemical reaction screening. But their application range is limited because of relatively small sample sizes. Reaction calorimeters, on the other hand, are made to determine heat flow characteristics of liquid phase reactions under various experimental conditions. Sample containers are not relatively small sample pans but reactors that offer sufficient volume for process development related investigations and space for corresponding peripheral devices like additional sensors or dosing devices. Usually, reaction calorimeters are heat flow calorimeters without reference cells and are run more or less isothermally.

Results obtained in lab environments by DSCs and reaction calorimeters, however, can not be simply scaled up. In so called upset scenarios (e.g. loss of cooling) nearly all heat of reaction is kept in the reaction mixture and none is dissipated. In order to represent such a situation in a lab experiment, sample containers may accumulate almost no heat. Consequently, they must be low weight (phi factor ~ 1) and heat flows have to be suppressed (adiabatic conditions). Adiabatic calorimeters are designed to fulfill these conditions. Typical adiabatic calorimeters have maximum heating rates of 600K/min allowing test cell surroundings to heat up as rapidly as run away reactions. Fast pressure tracking prevents light weight test cells from rupturing.

Adiabatic calorimeters measure adiabatic temperature rises. Subsequent calculations determine heats of reactions, kinetic parameters (e.g. activation energy) and chemical safety parameters (e.g. TMR). Measured self heating rates are used in vent sizing calculations for emerging relief systems (ERS).

References:

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