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Hazard assessment of runaway reaction chemistry

Exothermic chemical reactions release heat and consequently give rise to increase in temperature in reaction vessels. Temperature increase, in turn, influences the reaction rate leading to exponential growth in reaction rate unless increase in temperature is under control. On an industrial scale, when such reactions are operative, heat has to be removed as fast as possible, lest uncontrolled reaction rate may result in accidents involving fire, explosion or rupture of reaction vessel and the like. Assessment of such hazards and continuous monitoring of process parameters are part of accident prevention risk management strategy.

Several laboratory techniques, known collectively as microcalorimetric techniques are useful for off-line assessment of reactions for thermal runaway and hazard potential as well as for on line monitoring and feedback to the process-monitoring personnel.

Surianarayanan *et al.* review (page 738) basic aspects of microcalorimetry and its role in runaway reaction potential assessment and evaluation of the nature of implicit thermal hazard. After discussing the causes and contributing factors for thermal runaway reactions, 'temperature of no return' beyond which such reactions fail to be controlled, they enumerate various industrial and environmental accident scenarios. The authors observe that 'notwithstanding these facts, con-

sequences of runaway reactions have not received much attention, compared to the consequences of chemical release...' The grim reminder of Bhopal gas release can be made in this context. In the following sections, a few microcalorimetric techniques, namely, thermal analysis, accelerator rate calorimetry, reaction calorimetry, etc. are described. 'No single technique will be adequate to study all aspects of thermal hazards in the process.'

At the Central Leather Research Institute, Chennai, an integrated method to assess thermal hazards has been formulated. Some aspects of this methodology are discussed in the paper. Studies relating to agrochemicals, bulk drugs and polymers have been conducted using this approach.

K. R. Rao

Diabetes and oxidative stress

Diabetes is rapidly becoming a major health problem, particularly in urban India. Increased levels of blood glucose over prolonged periods of time can lead to slow chemical modification of proteins. Indeed, protein glycation may be an initial step in the multitude of physiological problems associated with diabetes. The first indication that a very simple chemical reaction between glucose and free amino groups on proteins can lead to irreversible modification, came with the characterization of haemoglobin A_{1c}, which has the N-terminus of the

β -chain linked to glucose. The reaction of sugars with amino groups is over a century old, the venerable Maillard reaction, an old favourite with food chemists. The key steps in the modification of proteins by glucose is Schiff base formation (fast and reversible), followed by the Amadori rearrangement (slow and irreversible). The Amadori product can then undergo oxidative cleavage, resulting in the formation of advanced glycation end products (AGEs), which in turn appear to be the root cause of the pathological complications of diabetes. Interestingly, diabetes may be viewed as an accelerated form of ageing; an inevitable consequence of being incubated with glucose for long periods of time. Tissue damage is generally correlated with the formation of reactive oxygen species, a consequence of 'oxidative stress'. On page 770, Kar and Chakraborti report that glycosylated haemoglobin (HbA_{1c}) demonstrates much greater H₂O₂-induced iron release than its non-glycosylated analog. Furthermore, in the presence of H₂O₂, HbA_{1c} 'degrades arachidonic acid and deoxyribose more efficiently' than normal haemoglobin. The authors suggest that modified functional properties of glycosylated haemoglobin may be indicative of mechanisms for the increased formation of free radicals and oxidative stress in diabetes mellitus.

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