ON ENERGETICS OF HYDROCARBON CHEMICAL REACTIONS BY IONIZING IRRADIATION

Yu. A. Zaykin[1], R. F. Zaykina[1], G.Mirkin[2]

[1]Al Farabi Kazakh National University, Almaty, Kazakhstan
[2]Quanto International Co. Ltd., 260 Russel Hill Rd. Unit 21. Toronto, Ontario, M4V2T2 Canada

The present global energy crisis requires the industry to look for technologies that are more effective and, particularly, less energy consuming. The hydrocarbon processing technology based on the electron radiation-induced thermal chemical conversion has a great potential. Comparing the presently predominant thermocatalytic processing, it is much more energy efficient, because chemical conversions go at a minimal processing temperature and pressure.

To compare energy consumption by electron irradiation with thermal and thermocatalytic technologies of hydrocarbon processing one must see major differences between them. While traditional thermocatalytic processes are equilibrium and their energetics can be evaluated based on principles of classic thermodynamics, HEET processing is non-equilibrium and this evaluation approach is not valid for it.

However, a theoretical description of radiation-chemical conversion using reaction rate constants determined in thermally equilibrium systems is approximately adequate to radiation processes by substituting equilibrium concentrations of reacting particles as their non-equilibrium concentrations under irradiation. In particular, description of radical reactions initiated by radiation requires substitution of thermally equilibrium radical concentration by much higher concentration defined by the dynamic equilibrium of radical radiation generation and their recombination.

The paper presents the comparative analysis of energy consumption in different stages of hydrocarbon processing using classic thermal cracking by heating versus radiation induced cracking. It is shown that in the most energy-consuming stage of processing - the chain reaction initiation necessary for concentration of active radicals, irradiation processing has the great advantage compared to thermal cracking by heating and allows cutting down the total energy consumption by approximately 40%.