258b Experimental Study of the Bunsen Reaction for the S-I Thermochemical Cycle

Giampaolo Caputo, Claudio Felici, Alberto Giaconia, Michela Lanchi, Raffaele Liberatore, and Salvatore Sau

Bunsen reaction is the key step of the Sulfur-Iodine (S-I) thermochemical cycle with the generation of sulfuric and hydriodic acid that must be separated prior feeding the relative downstream concentration and decomposition sections. From the engineering point of view the development of the three sections in which the whole cycle can be divided involves the solution of different problems. Hence, the sulfuric acid concentration/decomposition section is critical for the highest temperatures involved (800-1000°C), with consequent issues dealing with material corrosion and the coupling with the primary energy source, as well as the study of catalyst activity and stability. Also the hydriodic acid concentration/decomposition section is critical for material resistance, the lack of reliable thermodynamic data for HI/I2/H2O mixtures and the development of the most convenient route (reactive distillation, extractive distillation, electrodyalisis coupled to a distillation column and a membrane reactor, etc.). Bunsen reaction, on the other hand, can be carried out at relatively mild temperatures (< 120°C) to obtain high yields with a very small energy input (the reaction itself is exothermic). Nevertheless, the operative conditions for this section must be optimized in order to reduce the possibility of side reactions (side products must be avoided especially for such a cyclic process) and to obtain two concentrated acid streams. An experimental study of the Bunsen reaction and product separation will be presented. Phase equilibrium data and side reaction study will be illustrated. Different process configurations are analyzed and discussed with the general aim of obtaining two separated streams as pure and concentrated as possible in the two acids (sulfuric and hydriodic) in order to facilitate the processes in the downstream sections.