World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:8, No:02, 2014

Statistical Modeling of Constituents in Ash Evolved From Pulverized Coal Combustion

Authors : Esam Jassim

Abstract : Industries using conventional fossil fuels have an interest in better understanding the mechanism of particulate formation during combustion since such is responsible for emission of undesired inorganic elements that directly impact the atmospheric pollution level. Fine and ultrafine particulates have tendency to escape the flue gas cleaning devices to the atmosphere. They also preferentially collect on surfaces in power systems resulting in ascending in corrosion inclination, descending in the heat transfer thermal unit, and severe impact on human health. This adverseness manifests particularly in the regions of world where coal is the dominated source of energy for consumption. This study highlights the behavior of calcium transformation as mineral grains verses organically associated inorganic components during pulverized coal combustion. The influence of existing type of calcium on the coarse, fine and ultrafine mode formation mechanisms is also presented. The impact of two sub-bituminous coals on particle size and calcium composition evolution during combustion is to be assessed. Three mixed blends named Blends 1, 2, and 3 are selected according to the ration of coal A to coal B by weight. Calcium percentage in original coal increases as going from Blend 1 to 3. A mathematical model and a new approach of describing constituent distribution are proposed. Analysis of experiments of calcium distribution in ash is also modeled using Poisson distribution. A novel parameter, called elemental index λ, is introduced as a measuring factor of element distribution. Results show that calcium in ash that originally in coal as mineral grains has index of 17, whereas organically associated calcium transformed to fly ash shown to be best described when elemental index λ is 7. As an alkaline-earth element, calcium is considered the fundamental element responsible for boiler deficiency since it is the major player in the mechanism of ash slagging process. The mechanism of particle size distribution and mineral species of ash particles are presented using CCSEM and size-segregated ash characteristics. Conclusions are drawn from the analysis of pulverized coal ash generated from a utility-scale boiler.

Keywords : coal combustion, inorganic element, calcium evolution, fluid dynamics
Conference Title : ICCFD 2014 : International Conference on Computational Fluid Dynamics
Conference Location : Barcelona, Spain
Conference Dates : February 27-28, 2014