PROCESS PARAMETER OPTIMIZATION OF WASHING PRETREATMENT FOR INORGANIC REMOVAL FROM RICE HUSK

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ABSTRACT

Rice husk is particularly known as one of the most common agricultural waste and the usage of rice husk in energy applications is typically via the combustion process. Using agricultural waste for combustion application can lead to slagging, corrosion and fouling of boilers due to some problematic elements such as K and Cl. Water washing removes those problematic elements from rice husk and hot water washing treatment improves the removal efficiency of those alkali oxides, halides and total ash content. Further, hot water washing pretreatment has been identified as an effective method compared to acid treatment and alkali treatment.

This study is aimed at optimizing the washing parameters; washing temperature, time and water to biomass ratio. Effectiveness of washing was directly evaluated by conductivity measurements and the removal of inorganic elements. The second order kinetic model was successfully applied for the leaching of K and Cl species and the kinetic parameters were obtained.

Washing temperature has significant effect on Si removal, a considerable effect on K removal and a very weak effect of Cl removal. Moreover, water/biomass ratio has an appreciable effect on K removal, a very weak effect on Cl removal whereas almost no effect of Si removal. Washing temperature of 65 ^{o}C and water to biomass ratio of 100 was selected as the optimum process conditions. At the selected optimum conditions, about 84% of K and 81% of Cl can be removed while Si removal is insignificant. Within 10 minutes leaching time, 97% of leachable Cl and 81% leachable K can be removed.

Key words: Rice husk, Washing, Alkali, Leaching kinetics

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NOMENCLATURE

Abbreviations

L/S ratio - Liquid over Solids ratio

ICP-OES - Inductively Coupled Plasma Optical Emission Spectroscopy

ICP-MS - Inductively Coupled Plasma Mass Spectroscopy

Symbols

$C_{i,s}$ - Equilibrium concentration of species i (mg/L)

$C_{i,t}$ - Concentration of species i in water at a leaching time t (mg/L)

k_i - First order leaching rate constant of species i (s^{-1})

k - Second order leaching rate constant (L $mg^{-1}s^{-1}$)

h - Initial leaching rate (mg L^{-1} s^{-1})

LIST OF APPENDICES