World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:14, No:07, 2020

Optimization of Waste Plastic to Fuel Oil Plants' Deployment Using Mixed Integer Programming

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Abstract : Mixed Integer Programming (MIP) is an approach that involves the optimization of a range of decision variables in order to minimize or maximize a particular objective function. The main objective of this study was to apply the MIP approach to optimize the deployment of waste plastic to fuel oil processing plants in Uganda. The processing plants are meant to reduce plastic pollution by pyrolyzing the waste plastic into a cleaner fuel that can be used to power diesel/paraffin engines, so as (1) to reduce the negative environmental impacts associated with plastic pollution and also (2) to curb down the energy gap by utilizing the fuel oil. A programming model was established and tested in two case study applications that are, small-scale applications in rural towns and large-scale deployment across major cities in the country. In order to design the supply chain, optimal decisions on the types of waste plastic to be processed, size, location and number of plants, and downstream fuel applications were concurrently made based on the payback period, investor requirements for capital cost and production cost of fuel and electricity. The model comprises qualitative data gathered from waste plastic pickers at landfills and potential investors, and quantitative data obtained from primary research. It was found out from the study that a distributed system is suitable for small rural towns, whereas a decentralized system is only suitable for big cities. Small towns of Kalagi, Mukono, Ishaka, and Jinja were found to be the ideal locations for the deployment of distributed processing systems, whereas Kampala, Mbarara, and Gulu cities were found to be the ideal locations initially utilize the decentralized pyrolysis technology system. We conclude that the model findings will be most important to investors, engineers, plant developers, and municipalities interested in waste plastic to fuel processing in Uganda and elsewhere in developing economy.

Keywords : mixed integer programming, fuel oil plants, optimisation of waste plastics, plastic pollution, pyrolyzing
Conference Title : ICFFMET 2020 : International Conference on Fossil Fuels and Modern Energy Technologies
Conference Location : Stockholm, Sweden
Conference Dates : July 16-17, 2020