



Title: Integration of Waste-to-energy Incineration in the Municipal Solid Waste Management System of Santiago Island: Planning, Process Control and Complementary Activities

ABSTRACT

This thesis analyses the sustainable integration of waste management systems in isolated communities, like Santiago Island, Cape Verde, with inadequate waste treatment and lack of fossil energy resources and potable water. MSW incineration with energy recovery for thermal seawater desalination constitutes the main topic of the thesis. A thermodynamic model quantifies the energy, environmental and economic aspects of different designed scenarios characterising different sustainable solutions. Multivariate statistical methods are applied to develop a monitoring and control process of an actual MSW incineration, aiming at both improving early detection of abnormal situations and predicting the flow rates of the generated superheated steam in order to guarantee a stable operation. GIS-based multi-criteria evaluation is used to assess and rank the land according to its suitability for an incineration plant siting, combining analytic hierarchy processing for estimating weights of the evaluation criteria with GIS for spatial data analysis. A new GIS-based three-dimensional modelling allows routes to be optimised for minimum fuel consumption considering the effects of road inclination and vehicle load. Furthermore, to evaluate the performance of the developed model, a campaign of experimental work is carried out under real conditions, with a waste collection and transportation truck during its normal daily activities.

KEY-WORDS: MSW incineration, waste-to-energy, process monitoring and control, a MSW incineration plant siting, vehicle routing optimisation, environmental assessment.