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POTENTIAL OF ASH FROM PELAGIC *SARGASSUM* spp. AS STABILISER IN EARTH-BASED MATERIALS: PHYSICAL, CHEMICAL AND THERMAL ASSESSMENT

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ABSTRACT

This study evaluates the effect of the pelagic *Sargassum* desalination process on its physico-chemical and thermal properties as well as on the chemical and mineral composition of the ash. Fresh pelagic *Sargassum* was subjected to two cycles of immersion in water at 40 min each to dissolve excess salt in the water. Characterisation of the raw and desalted *Sargassum* shows an increase in volatile matter from 43.74% to 50.82%, fixed carbon from 3.29% to 8.34% and porosity from 84.59% to 86.18%, while there is a reduction in ash content from 28.44% to 17.25% after desalination. Furthermore, the TGA and DTG results show a slight reduction in the degradation temperature, which is associated with a reduction in the amount of residual char from 35% to 27%. The results of the XRF analysis of the *Sargassum* ash showed a very low alumiosilica content ($\text{SiO}_3 + \text{Al}_2\text{O}_3 < 4\%$), but a significant increase in CaO content after desalination from 21.96% to 50.17% while K and Cl contents decreased to 48% for K and 73% for Cl. These chemical and mineral analyses of the ash suggest the possibility of using desalinated *Sargassum* ash as a partial substitute for cementitious materials for soil stabilisation to reduce greenhouse gas emissions from cement production.

INTRODUCTION

The massive invasion and proliferation of *Sargassum* algae on beaches and coasts in recent years is endangering people's livelihoods, climate-sensitive areas and local ecosystems (Tobío-Pérez et al., 2022). This *Sargassum* outbreak problem has prompted several Caribbean countries to declare a national state of emergency (Desrochers et al., 2020). Due to the severe environmental, health and economic impacts associated with the presence, mechanical cleaning and storage of *Sargassum* on costs and on the beach (Tobío-Pérez et al., 2022), the Caribbean Regional Fisheries Facility has estimated the cost of *Sargassum* clean-up in 2018 at US\$210 million (Davis et al., 2021). The complexity, economic impact and regional scope of *Sargassum* biomass management should lead to synergy between different actors (national and international) through interdisciplinary and transdisciplinary approaches (Robledo et al., 2021). The use of *Sargassum* as fertiliser has raised concerns about the bioaccumulation of metals such as Al, Ca, Fe, Mg, K, Na and Mn at concentrations higher than those in the surrounding seawater (Milledge et al., 2020). Research to develop sustainable value chains for *Sargassum* to promote economic opportunities that could help mitigate the impacts of mass influxes seems commendable. Although these algae represent a harmful marine resource for many Caribbean countries, they also represent a high-potential energy and building material opportunity that has been little explored.

RESULTS AND CONCLUSIONS

Fig. 1 show the thermo gravimetric (TGA) and derivative analysis (DTG) curves of pelagic Sargassum before and after pretreatment. The results reveal that TGA curve (Fig. 1a) is constituted of three zones in correlation to the pyrolysis results of various marine seaweed materials (López-Sosa et al., 2020). Zone I shows a very low percentage of mass loss ($\approx 17\%$ for S1 and $\approx 20\%$ for S2) due to dehydration in the temperature range of 40 to 204°C. The degradation of zone II accues between temperatures 204 and 602°C and displays the highest mass degradation ($\approx 35\%$ for S1 and $\approx 41\%$ for S2), which is related to the removal of various amounts of biopolymers from the algae (López-Sosa et al., 2020). The final degradation above 602°C (zone III) is attributed to the combustion of carbonaceous residues triggered by intense heating (Kumar et al., 2021).

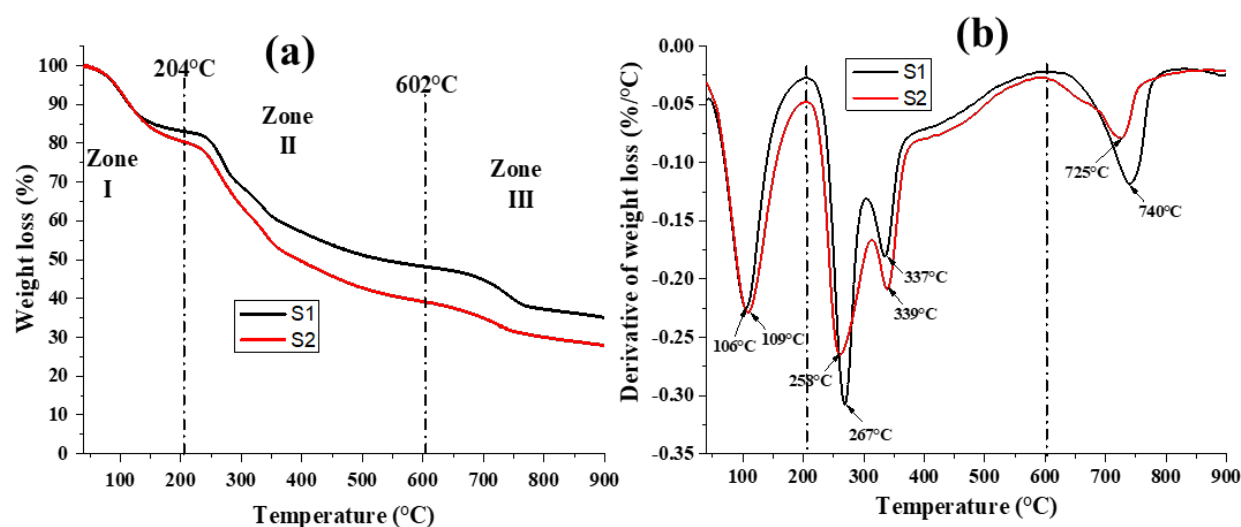


Fig.1 (a) TGA curve and (b) DTG curve of Sargassum seaweed before (S1) and after pretreatment (S2)

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