Optimization of macroalgae based biorefinery producing fuel and chemicals with potential zero carbon emissions

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Process flowsheet optimization of seaweed-based biorefinery coproducing succinic acid, ethanol and protein rich solids was performed. Biochemical process for ethanol production produces 25% carbon dioxide as a byproduct. This immense amount of carbon dioxide is a threat for environment. Products such as succinic acid use carbon dioxide as a precursor, reducing the greenhouse gas emissions from such biorefineries. Most promising industrial design alternatives were selected to build a superstructure. A separable programming was employed to approximate mixed integer nonlinear programming (MINLP) master problem to mixed integer linear programming (MILP) and solved in GAMS software by using CPLEX solver. The aim was to determine optimal biorefinery designs which produce minimum amount of emissions and achieve high economic potential. Former aim was achieved by optimizing production rate of succinic acid to minimize carbon dioxide emission, while latter was accomplished by maximizing rigorous economic objective function i.e. net present value (NPV). Furthermore, sensitivity analysis was performed to identify the major cost drivers to process.