A new process simulator to optimize production design according to the local context: case of cassava flour

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The chosen case study is the production of cassava flour in Sub-Saharan Africa, because of the importance of this production and the possibilities of process optimization. In the process studied here, the roots are peeled, washed, grated, pressed, dried and ground. Drying, which is difficult to control, accounts for most of the production costs and environmental impact of processing. Mechanical dehydration has also a major role to play in limiting the drying of the product. A particular emphasis was therefore put on the simulation of dehydration so that the numerical tool proposes design solutions limiting energy consumption and, thus, improving the profitability of the units.

The simulator is structured in unit operations and developed in object-oriented programming (OOP) using open source langage Python, in order to be as generic and modular as possible. Its structure is built at the beginning of its development. All the knowledge collected and generated afterwards is aggregated in this structure. In order to describe objects of the same type in a generic way, we use structures called classes in OOP. In our simulator, there are two main classes: one for flows and one for unit operations. The inherited classes of these two classes have the same structure. The classes for the streams (i.e. product, co-products, utilities) contain their properties. The classes of unit operations contain the models as well as the economic and environmental data related to the operation. Thus, the transformation of different products, whose properties are known, can be simulated. Moreover, the simulated process can be easily modified, for example by adding unit operations whose models are known, or by changing their order. It also predicts the effluents and utilities consumption. Coupled with technical-economic data and indicators present in the classes of each operation, it predicts the costs (CAPEX & OPEX) and environmental impacts of each operation. An additional layer allows to estimate the costs of the whole transformation over one year.