

# **Material Balance Based Modeling of BLSS with Matlab/Simulink. The MELiSSA Loop Case in Steady-State Conditions.**

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Solving material balances in Biological Life Support Systems (BLSS) affords mass flow rates, and chemical elements (C, H, O, N, S, P, etc.) in all parts of these very intricate and complex systems; this helps defining and optimizing the performance of the entire recycling loop in terms of closedness and necessary flow inputs.

The complete MELiSSA loop was modeled using MatLab/Simulink and a mass balance simulator for the loop was released. In order to build the complete MELiSSA loop material balance simulator with Matlab/Simulink, it was necessary:

- 1- To establish steady-state models, on the basis of mass-balances and elements-balances, for each compartment and each subsystem of the loop; for biological processes in the MELiSSA compartments within the loop, stoichiometric equations including biomass were derived;
- 2- To develop, for each compartments and subsystems, the associated Matlab/Simulink S-blocks in which models are included;
- 3- To assemble the different S-blocks of the loop flowchart, giving as a result the flow rates in the entire recycling loop. The simulation parameters are easily managed using the graphical dialog boxes.

The simulator is used to test the behavior of the loop in different operating conditions, typically by varying the composition of the food produced in the loop.