Modelica Modelling of an Ammonia Stripper

J.A. Redford[1] A.B. Bisinella De Faria[2] J.-P. Saut[1] J. Robert[2] M. Albuquerque[2] J.-P. Merland[2] J.-M. Ghidaglia[3]

[1]Eurobios SCB, 61 av. du Président Wilson, Cachan, France. jredford@eurobios.com
[2]Veolia Recherche & Innovation, Chemin de la Digue, Maisons-Laffitte, France.
[3]CMLA, ENS Paris Saclay, 61 av. du Président Wilson, Cachan, France.

This work presents a Modelica model for an ammonia stripper that is used to process waste (digestate) from a biogas production unit.

Figure 1 shows the basic configuration of the simplified stripper along with the inputs, outputs and the processes under consideration. Digestate enters the stripper with a given flowrate and initial composition. Air is added at the base of the stripper with a given temperature and relative humidity. At the top, the result is a stripped gas containing air, water and ammonia. The liquid output is the digestate with reduced TAN (total ammonia nitrogen). Heat is lost from the liquid through warming of the gas and the liquid to gas water mass transfer (evaporation). Hence, heating is required to maintain the digestate at the correct temperature an ts of the stripper

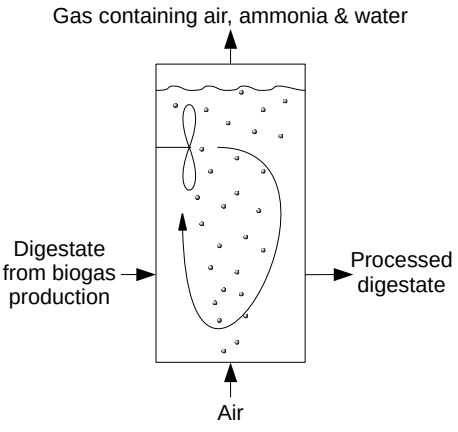

Figure 1. Stripping column exchanges.

The model includes the chemical balance equations between species in the liquid and gas, and includes the exchanges between both phases and the energy consumption of the unit. In Figure 2 the model inputs are in red and the outputs are in blue. The internal processes are in green, where the mass balances include $NH_{3(aq)}$, NH_4^+ , HCO_3^- , CO_3^{2-} , $CO_{2(aq)}$, N_{org} , H_2O , H^+ and OH^- species for the liquid phase, NH_3, $CO_2$and H_2O species in the gas phase. The energy balance includes water vaporisation and air heating. In order to model this process we must consider the chemical equilibrium between the TAN and DIC (dissolved inorganic carbon) species, the mass transfer of NH_3, $CO_2$and H_2O between liquid and gas, and an energy balance. The dynamics in the column depend on time lumn heigh g column

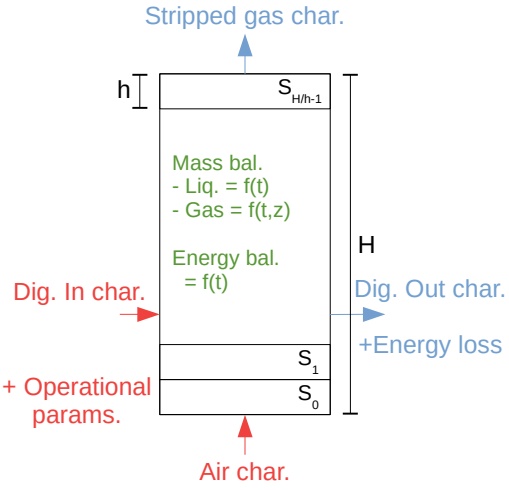

Figure 2. Stripping column schematic.

Results show the expected behaviour with an increasing p*H* with time (Figure 3), with further validation and calibration being necessary once experimental results are available. This is a novel use of Modelica designed to expand the library of processes that are simulated using this approach.

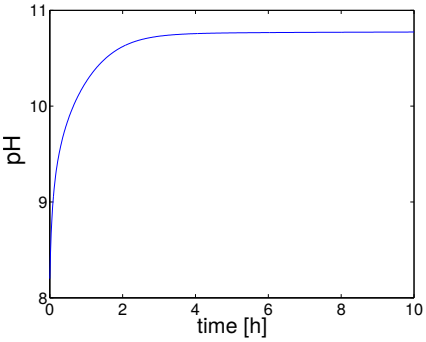

Figure 3. Change in p*H* with time.

Keywords: nutrients recovery, chemical reactions, process engineering, environment