Scientific and technic report – stage 3
The achievement of the basic software and hardware components for the HILS structure of the biorefinery plant

Abstract

Stage 3 of the project No. 269/2014 – **BIOCON** (*The accomplishment of the basic software and hardware components for the HILS structure of the biorefinery plant*) had two main objectives: 1). Accomplishing the equipment for the experiments in stage 4 and 2). testing in numerical simulation an optimal algorithm for the control of the biorefinery plant. To fulfil the two objectives, there were performed six activities as follows: Activity 3.1 – *The acquisition and the achievement of the sub-ensembles of the experimental photobioreactor, according to the design specifications in activity II.2*, Activity A3.2 – *The design of the basic software for the biorefinery according to the adopted functional structure HILS*, Activity 3.3 – *The design and the validation in numerical simulation of the optimal control for the biorefinery plant*, Activity A 3.4 – *The dissemination activity of the results*, Activity – A 3.5 – *The integration of the sub-ensembles of the experimental photobioreactor, according to the design specification in activity II.2*, Activity A 3.6 – *To put into operation the photobioreactor* and Activity A 3.7 – *Cold checking the functionality of the photobioreactor*.

Activity 3.1: There were purchased the elements of the photobioreactor. There were put together the command cabinet, the body of the photobioreactor and the LED panel for the artificial lighting of the photobioreactor, according to the project done in stage II.

Activity 3.2: Starting from the electric project and the automatization of the biorefinery plant the basic software for the control of the biorefinery plant was accomplished, under the form of a Simulink model with the following modules: the control module, the signal acquisition from the transducer and the control of the execution elements.

Activity 3.3: It was accomplished the optimization of the biorefinery through the optimization of the photobioreactor in relation with the main performance criterion (the photobioreactor productivity), using the reduction of the optimal control problem to a loop of biomass control with an optimal reference, as well as through the optimization of the digester in relation with a criterion that can contain penalization factors of the pollution of the water and air with CO_2.

Activity 3.4: The results obtained in this stage of the project were disseminated in 12 scientific papers published in the proceedings of some conferences and symposiums indeed in international data bases (IEEExplore, Scopus). Some of these papers are pending ISI Proceedings indexation.

Activity 3.5: All the components mentioned were integrated into a unitary structure of the photobioreactor as follows: there were installed elements of the command and monitoring equipment in the command cabinet (the power sources of the equipment, the adaptors for transducers – turbidity, pH, CO_2, etc., the command circuits for pumps, the peristaltic pumps, the fan for the cooling of the equipment, the power switches for all the equipment and command circuits). The transducers were installed on the body of the photobioreactor and there were made the electric connections between the equipment and the extension of the dSpace board in the process computer of the biorefinery, according to the electric project presented in activity A 3.2.

Activity 3.6: The photobioreactor was set into operation. It was powered for 8 hours and there were performed measurements according to the acquisition and command signals of the peristaltic pumps.

Activity 3.7: The transducers and the peristaltic pumps were tested individually. Their characteristics were raised as follows: for transducers, there were made sample solutions of different concentrations or pH and there were measured the values of the current (between 0 and 20 mA) on the corresponding analogue outputs. Based on these measurements, there were determined the scaling factors used in the Simulink models for measurement and command.

In conclusion, **all the activities of the stage 3 of the project have been 100% fulfilled**, the results constituting a solid base for the achievement, in stage 4 and the final stage of the project, of experiments for the experimental validation of the solutions currently found.