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Simulation of the Flow Processes in the Waste Water Treatment Plant

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Abstract: *In order to accomplish the flows from the existing processes simulation in a wastewater treatment plant there has been used a software tool called GPS-X, version 6.1.1.The steps of simulation were the following: it has been designed the flow station wastewater treatment plant; settings have been configured for installation components; subsequently input data have been changed according to the number of inhabitants, interchangeable.*
Through simulation, there has been established loading type and subsistence change input data.
In the end, there runs the process of simulation of waste water treatment plants, listing the values of waste water parameters monitored through simulation, before the evacuation into natural receiver. Through this work one can see that the values of the analyzed parameters did waste water purified; to discharge into natural receiver values are reduced from those set at the input of the plant, making it possible to purify water according to the standards in force. Sustainable development implies the control of environmental pollution through the use of easy and efficient software tools.

Keywords: *Simulation, waste water treatment plant, flow, environment6al pollution, GPS-X software*

1. Introduction

In order to secure there place on the international market all countries seek to implement useful tools for increasing the competitiveness of their products, falling into effective, modern systems of quality assurance.
The International Organization for Standardization has developed and published designs for such schemes in ISO standards series 9000, which currently underlie quality systems implemented in many enterprises and their compliance certification. Currently such certification of conformity to the requirements of ISO 9000 standards is done by international accreditation bodies.
Economic development in the past decades through industrialization, urbanisation materialized on chemical transformation of agriculture, brought the issues related to the impact on the natural environment through increased consumption of natural resources, but also the introduction of disruptive factors, pollutants. The problem of modeling the process of wastewater treatment plant is an important issue, particularly in the field of topical environmental pollution. Sustainable development involves pollution control environment relative to economic growth. The use of complex software tools, such as GPS-X, is a real help in validating the reaction process, generating simulated graphs of parameter variation.
Through this paper one can see that the values of the analyzed parameters did waste water purified; to discharge into natural receiver values are reduced from those set at the input of the plant, making it possible to obtain water purified according to the standards in force.

2. Technological flow design of waste water treatment plant

There has been designed the technological flow for the wastewater treatment plant (WWTP) (Figure 1).

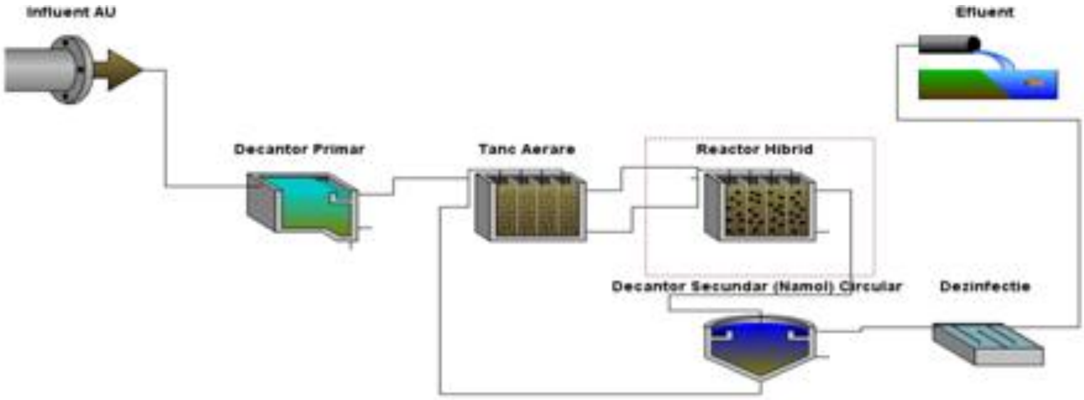

Fig. 1. Technological flow for WWT

Constituents are: Influent-waste water from public network, primary settler (chosen to rectangular), aeration basin, hybrid reactor (anaerobic biodegradation, biogas generation subsequently used as an energy source), secondary settler (radial), and for advanced treatment plant; there are available filtering options (slowly filtration, quickly filtration, sands filters, membrane filtration) and disinfection.
Configure the settings as follows: component installations, initial concentration in primary settler (Fig. 2), aeration basin (Fig. 3), number of reactors in the aeration basin (Fig. 4), number of reactors in the hybrid reactor (Fig. 5) - specific surface of biofilm is 530 l/m, secondary settler (Fig. 6), disinfection (Fig. 7). Aeration basin is a basin of pneumatic aeration with the introduction of air bubbles (1.5-3 mm).

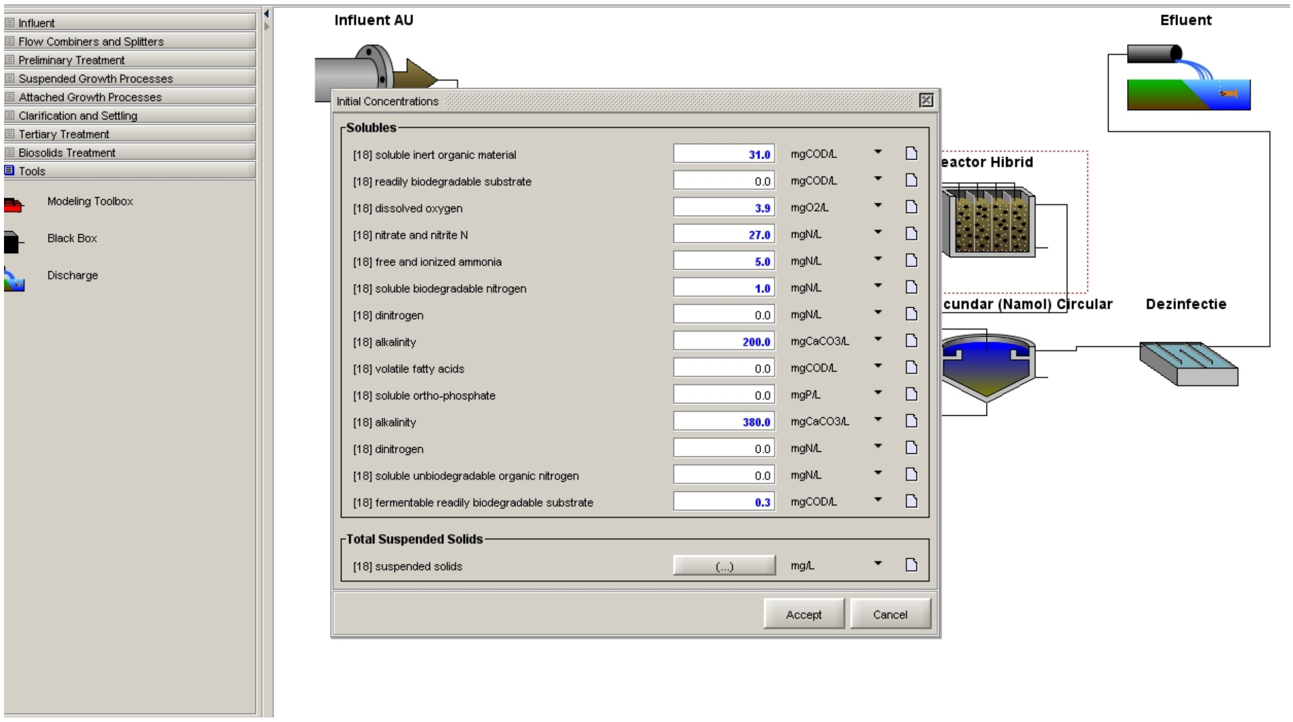

Fig. 2. Initial concentrations

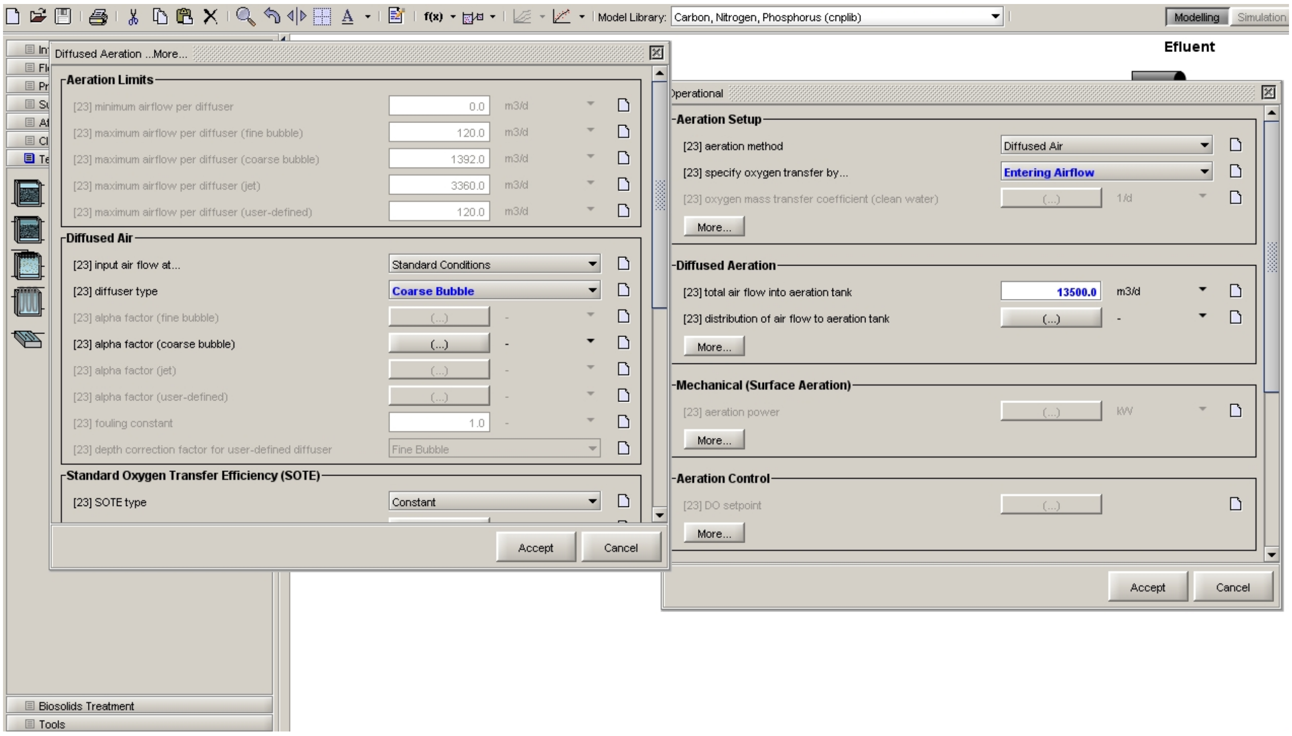

Fig. 3. Aeration setup

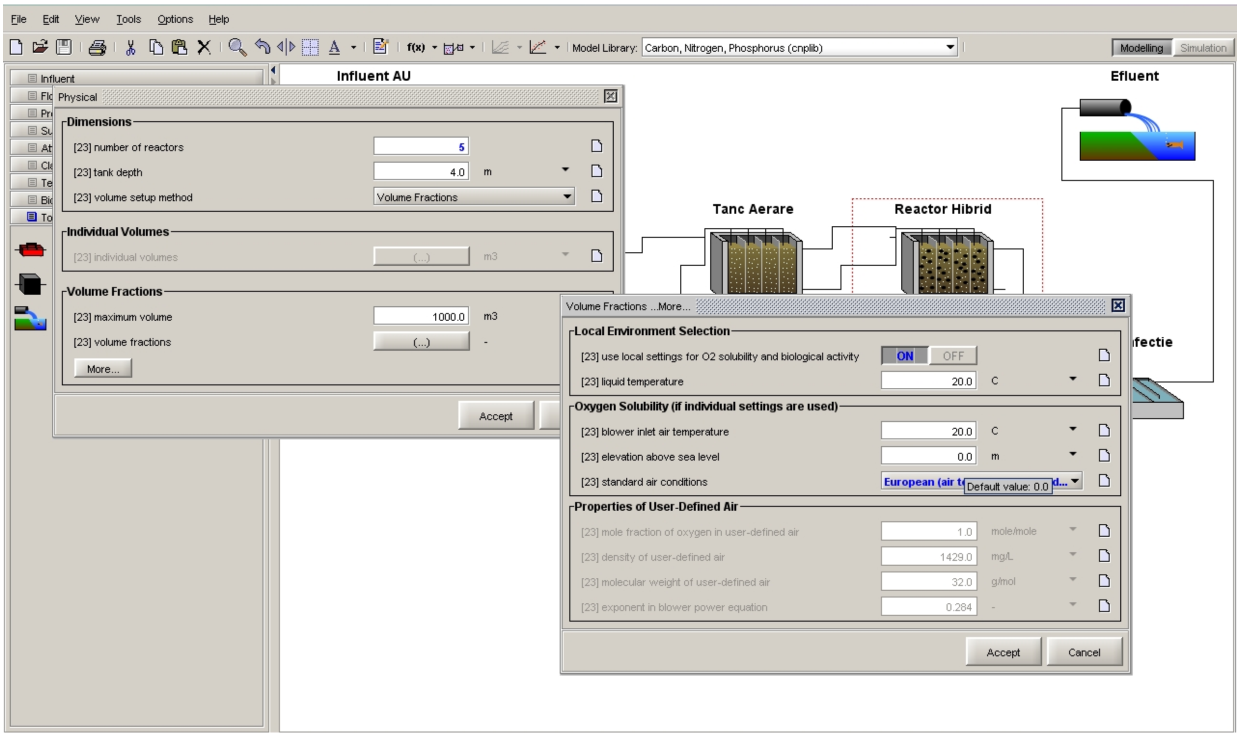

Fig. 4. Number of reactors in the aeration basin-5

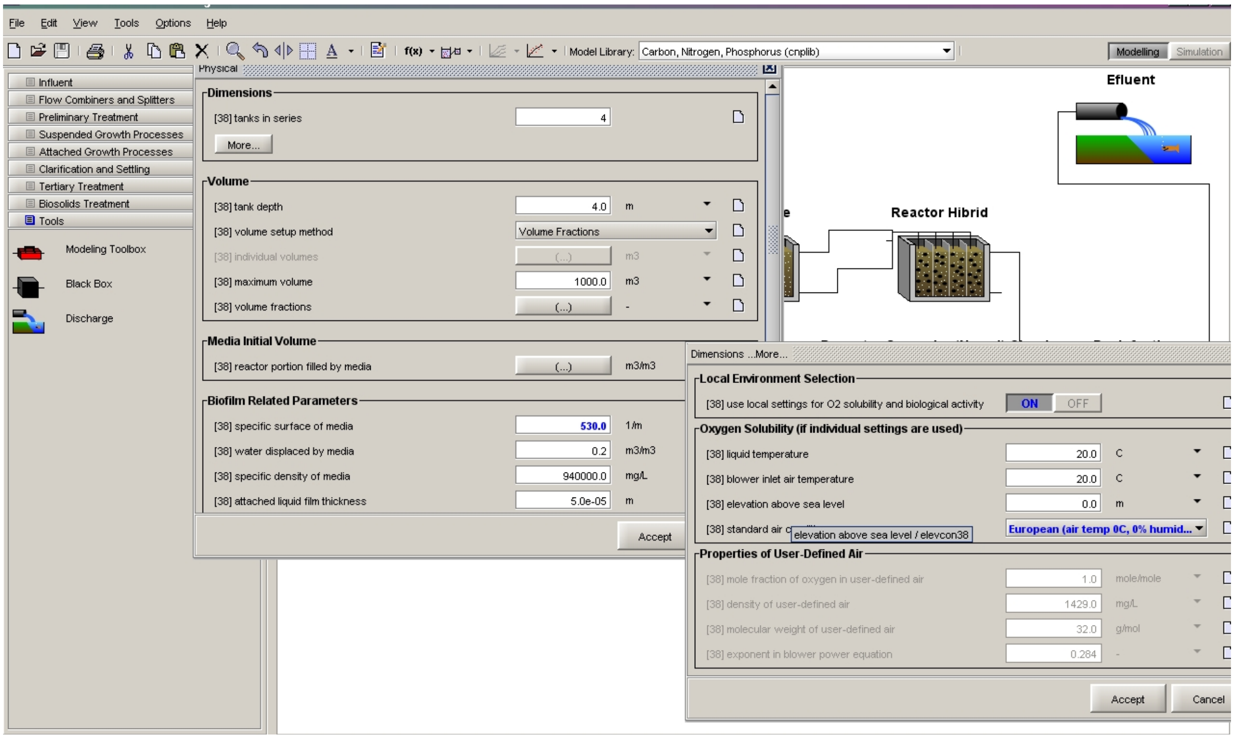

Fig. 5. Number of reactors in the hybrid reactor-4

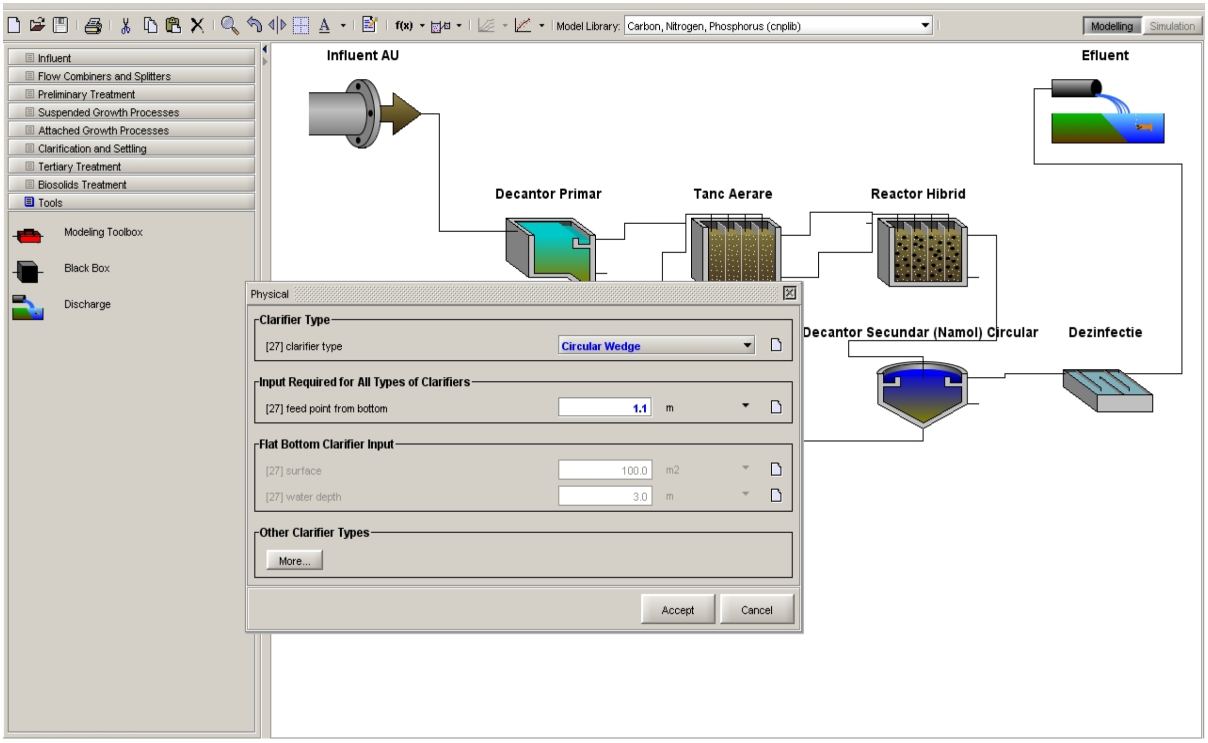

Fig. 6. Circular secondary settler WWT

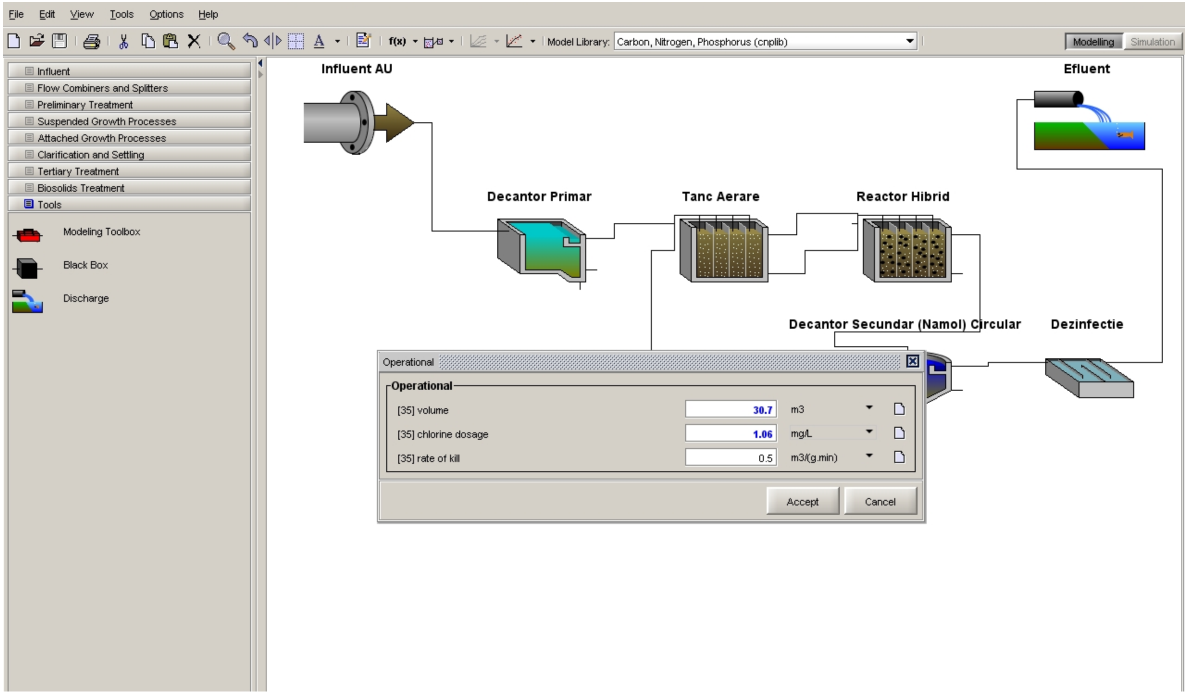

Fig. 7. Disinfection

2.1 Input data

Then introduction/modification of the input data follows (Fig. 8).

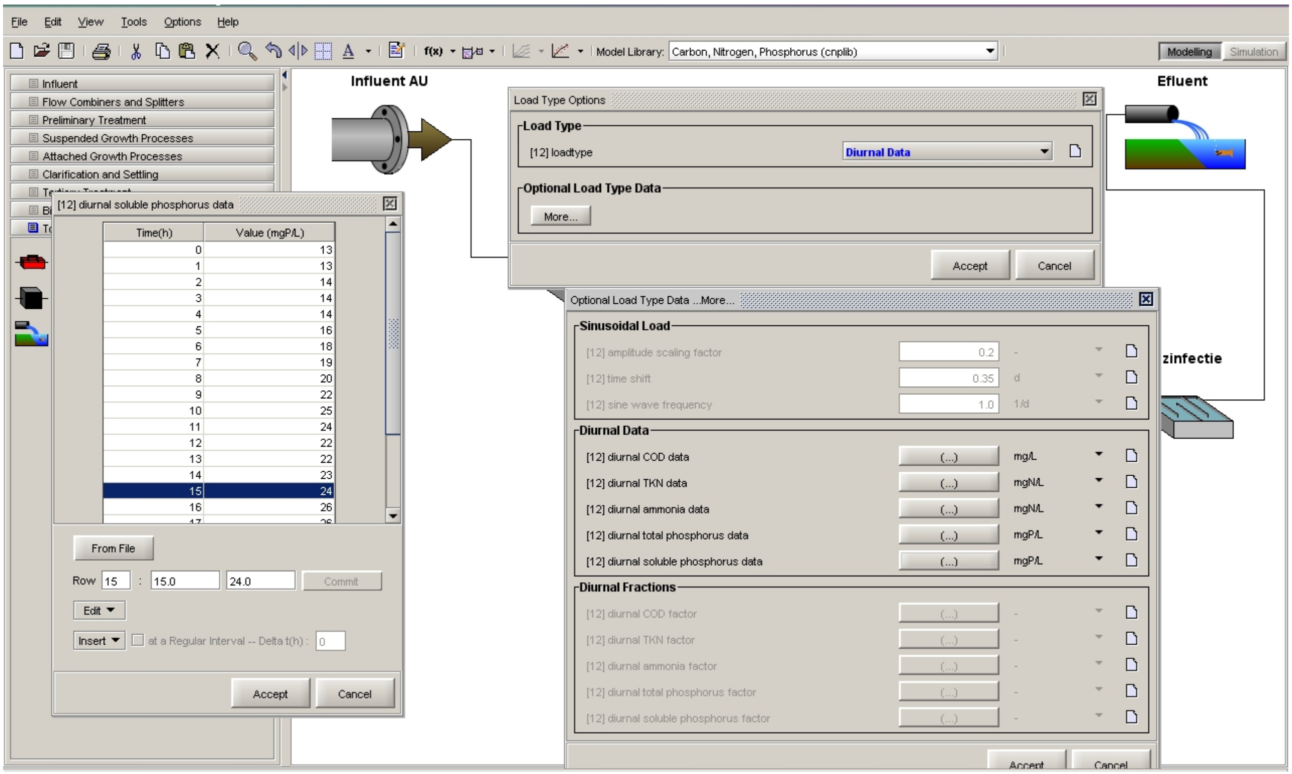

Fig. 8. Diurnal data

Input data are (Fig. 9):

COD – Chemical Oxygen Demand -500 g/m^3; Total Kjeldhal Azoth (TKN)- 40 g/m^3, Total Phosphorus (TP) – 15 g/m^3. The amount of phosphates compounds (Ortho-phosphates soluble)-9 g/m^3, nitrogen compounds- 29 g/m^3, free ammonia and ionized, nitrates and nitrites- 0.2 g/m^3. Influent alkalinity will be 9 moles/m^3.

CCO reports/SSV (volatile suspended solids), Bod5/BOD expanded, SSV/SST (total suspended solids) will have the values of 1.1, 0.53 respectively 0.81. Organic fractions of influence: fraction of inert soluble matter on total CCO-0.05, fraction of biodegradable material, through fermentation from total CCO-0.7, particulate inert fraction from total CCO-0.13. Amount of insoluble solids suspensions -26.7 g/m^3; the soluble inert organic materials-25 g CCO/m^3; easy biodegradable substrate-350 g CCO/m^3; inert organic matter particulata-65 g CCO/m^3; hardly biodegradable substrate-60 g CCO/m^3; quantities of SST, SSW and SSIT (total inorganic solids suspensions)-140.3 g /m^3, 113.6 g/m^3, respectively, 26.7 g /m^3.

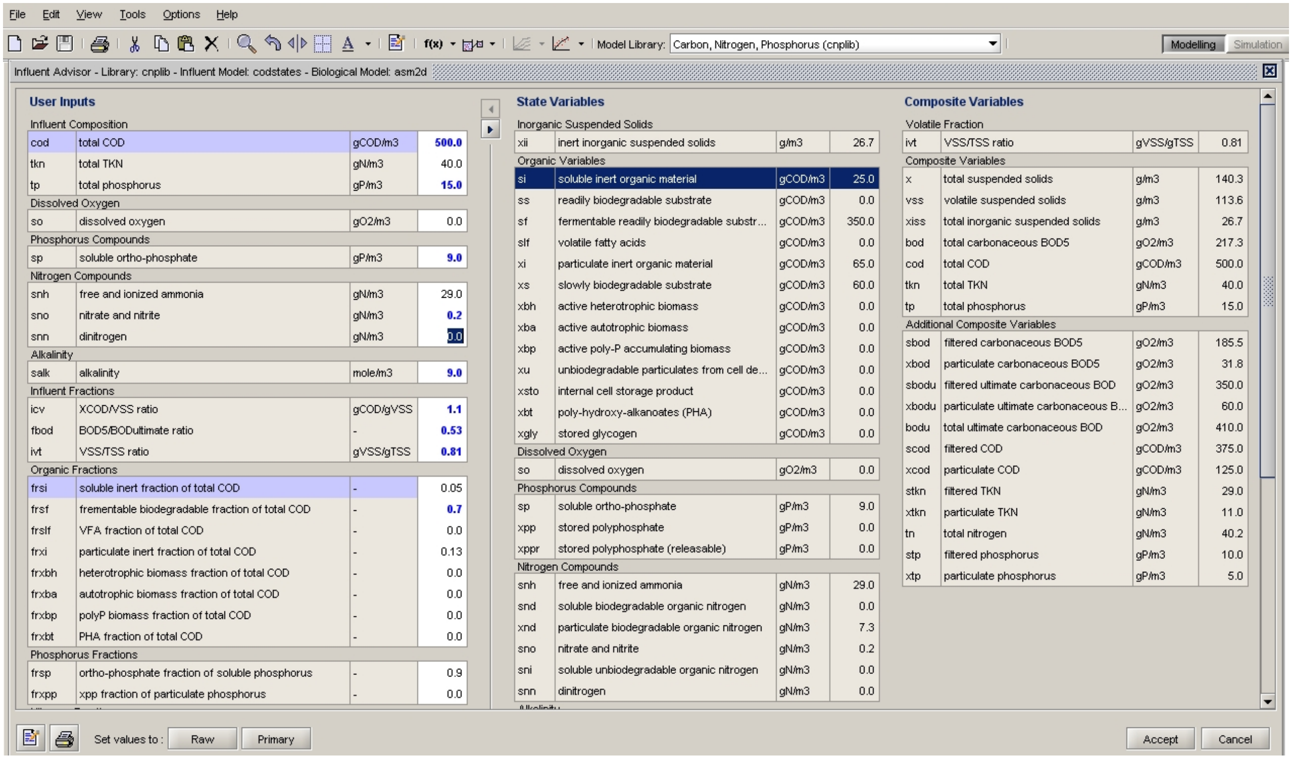

Fig. 9. Input data

Following the presentation of user inputs, state variables and composite variables, simulation will run.

3. Simulation of processes from WWTP

The process of simulation of waste water treatment plants begins, listing the values of waste water parameters monitored through simulation, before the evacuation (Fig. 10).

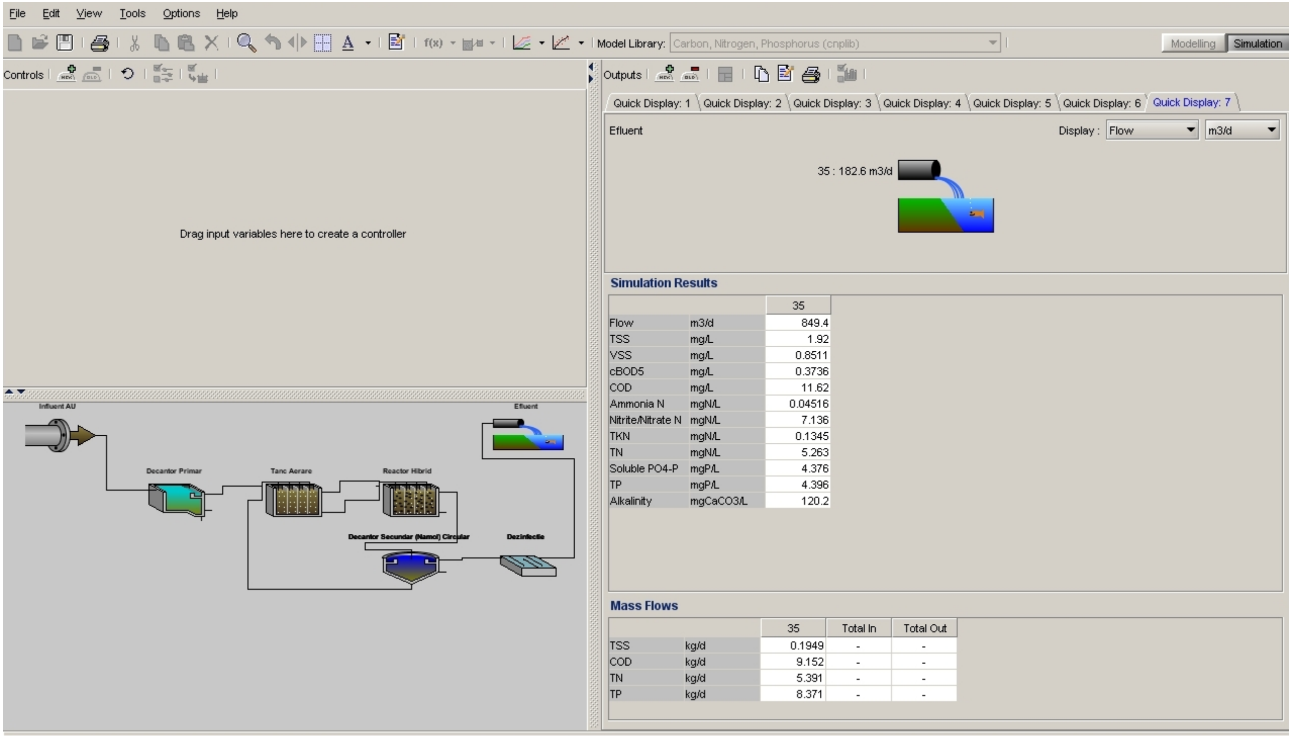

Fig. 10. The analyzed parameters of treated water

4. Results of simulation

The results of simulation are for: mass flow-influent (Fig. 11), primary settler (Fig. 12), operational data for primary settler (Fig. 13), operational results for aeration tank (Fig. 14), for hybrid reactor (Fig. 15), for biological reactor (Fig. 16), operational variables for secondary settler (Fig. 17), segregation mud in secondary settler (Fig. 18), operational data for disinfection (Fig. 19), effluent data in natural receiver (Fig. 20).

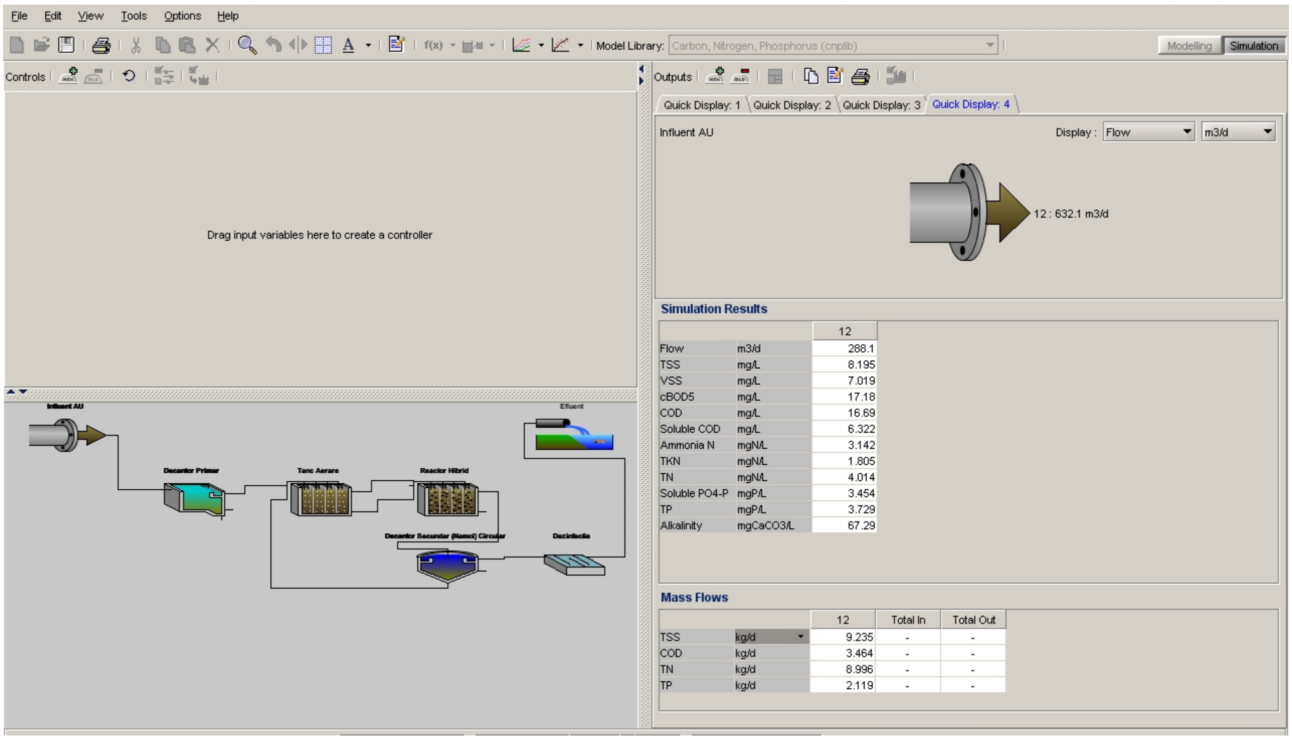

Fig. 11. Mass flow results

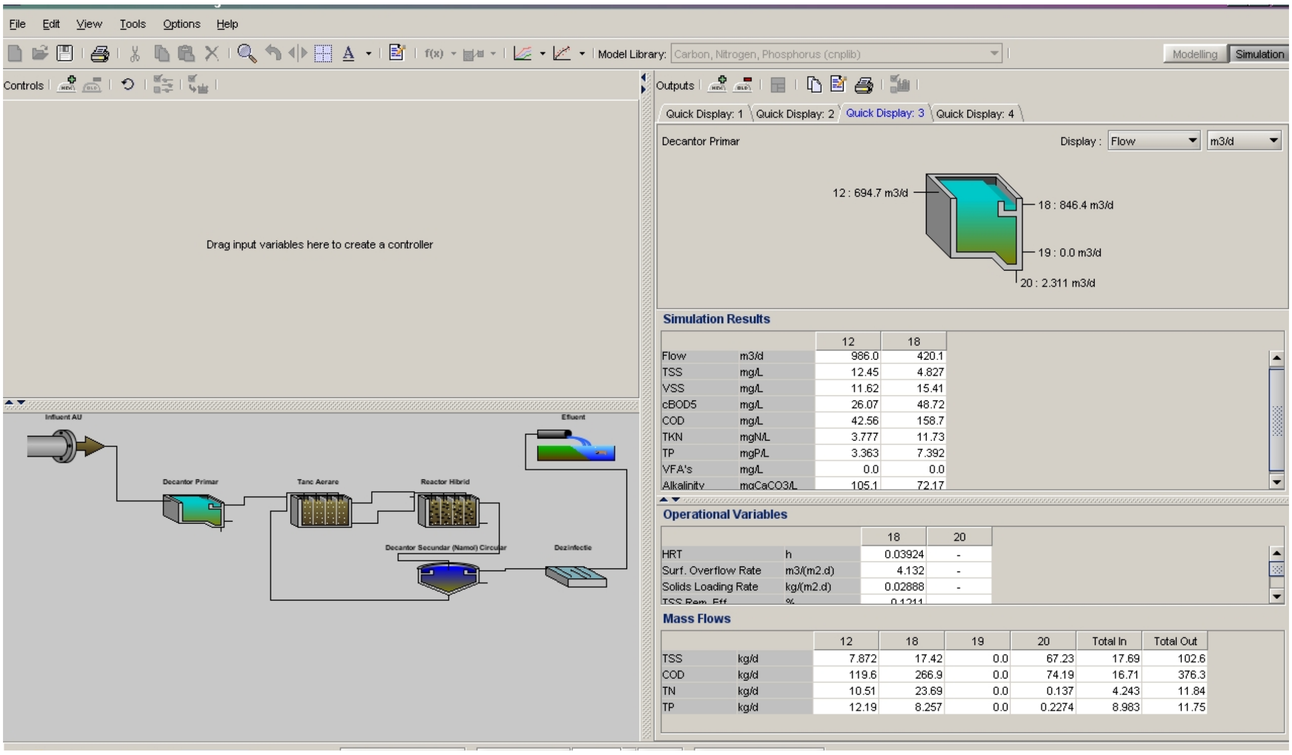

Fig. 12. Results for primary settler

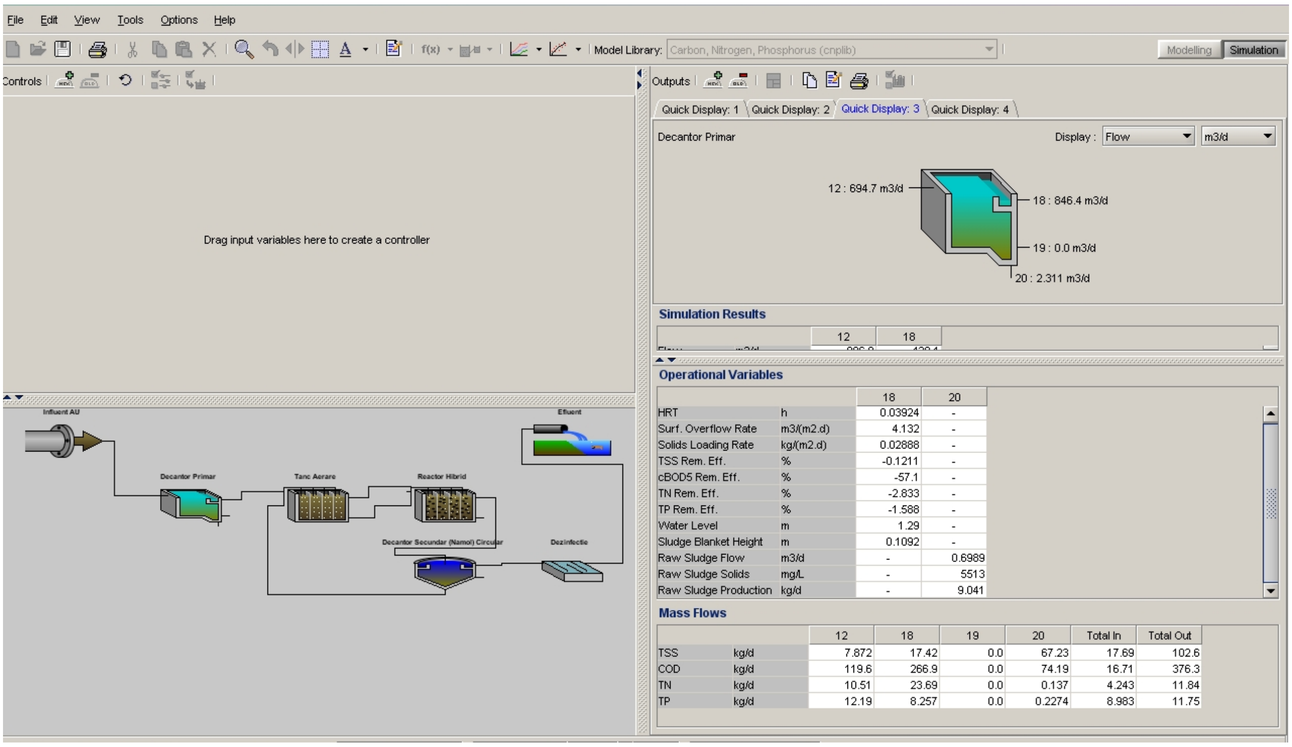

Fig. 13. Operational results for primary settler

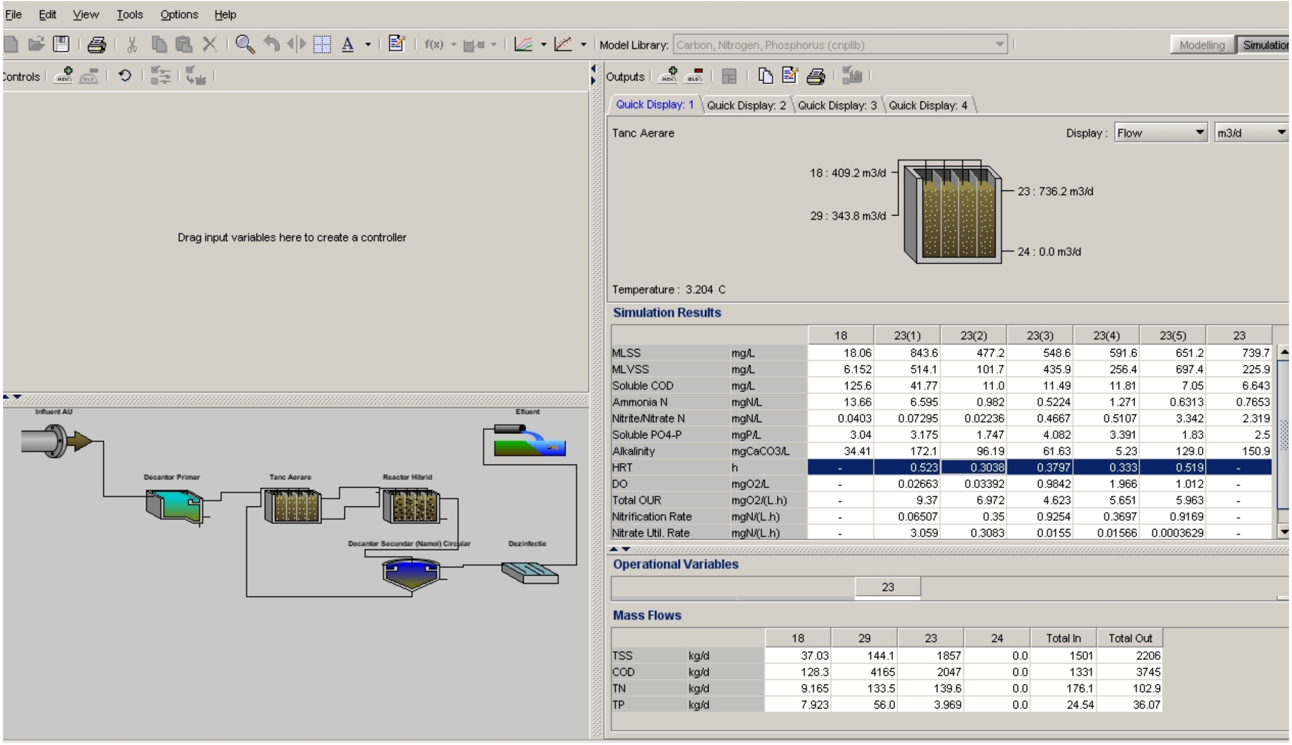

Fig. 14. Operational results for aeration tank

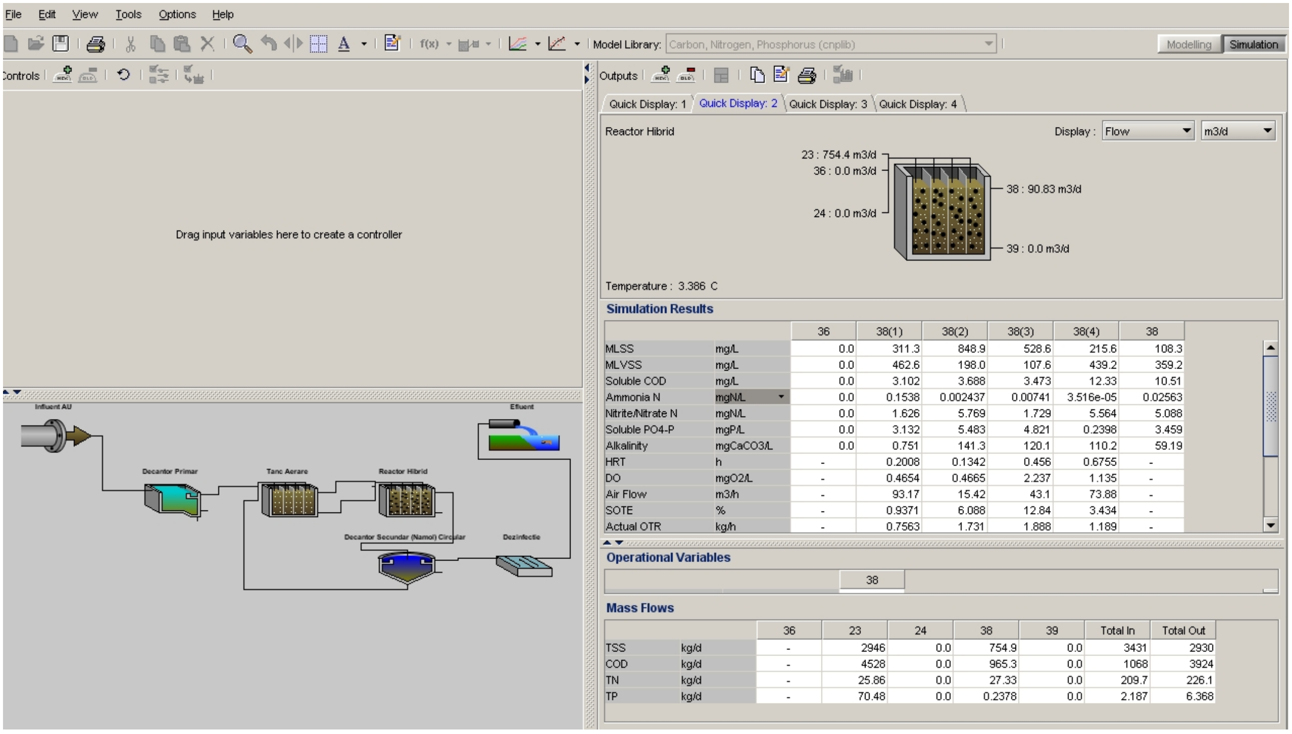

Fig. 15. Operational variables for hybrid reactor

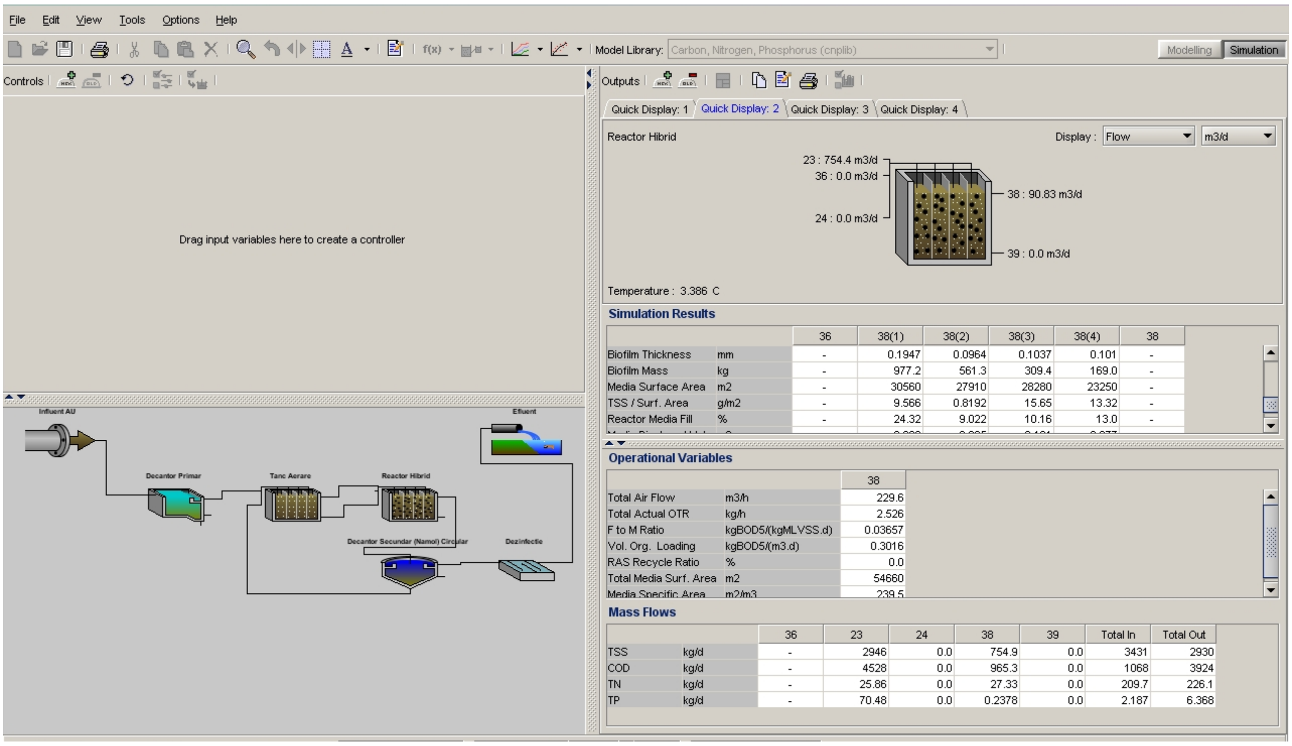

Fig. 16. Operational variables for biological reactor

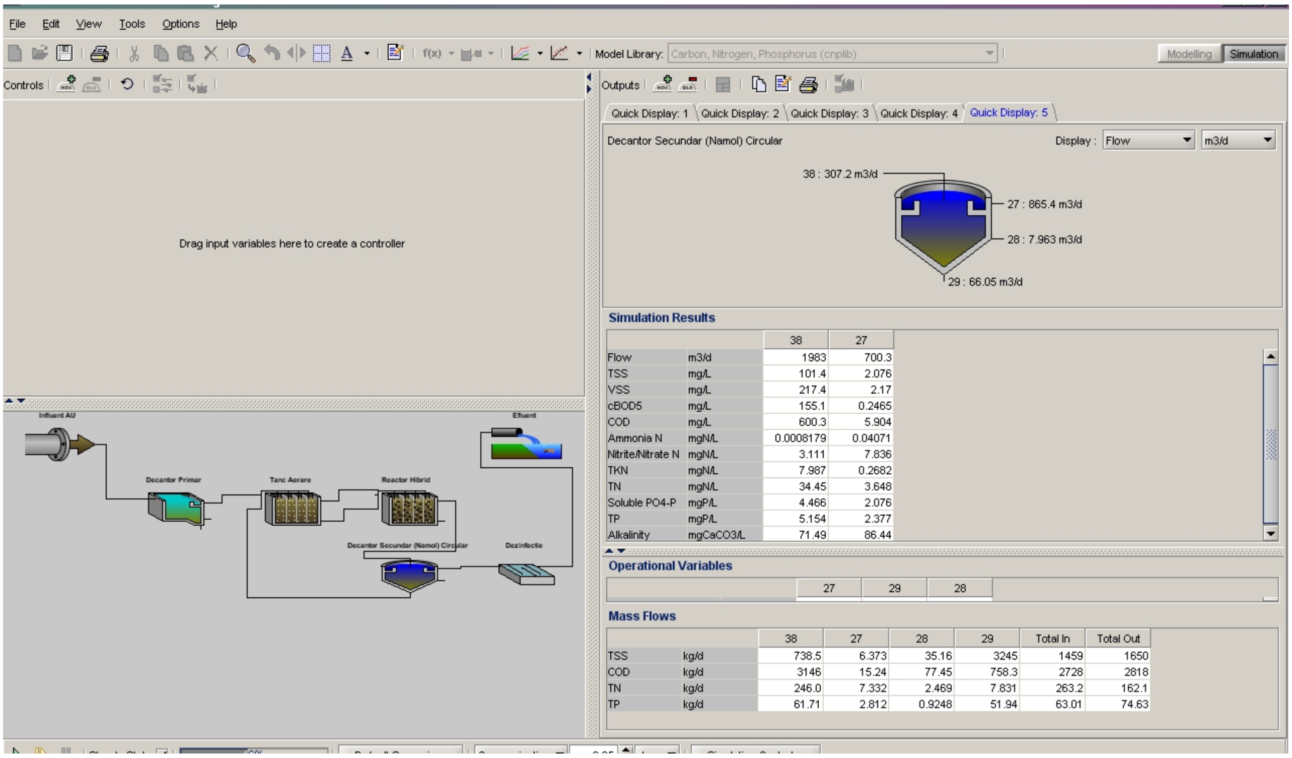

Fig. 17. Operational variables for secondary settler

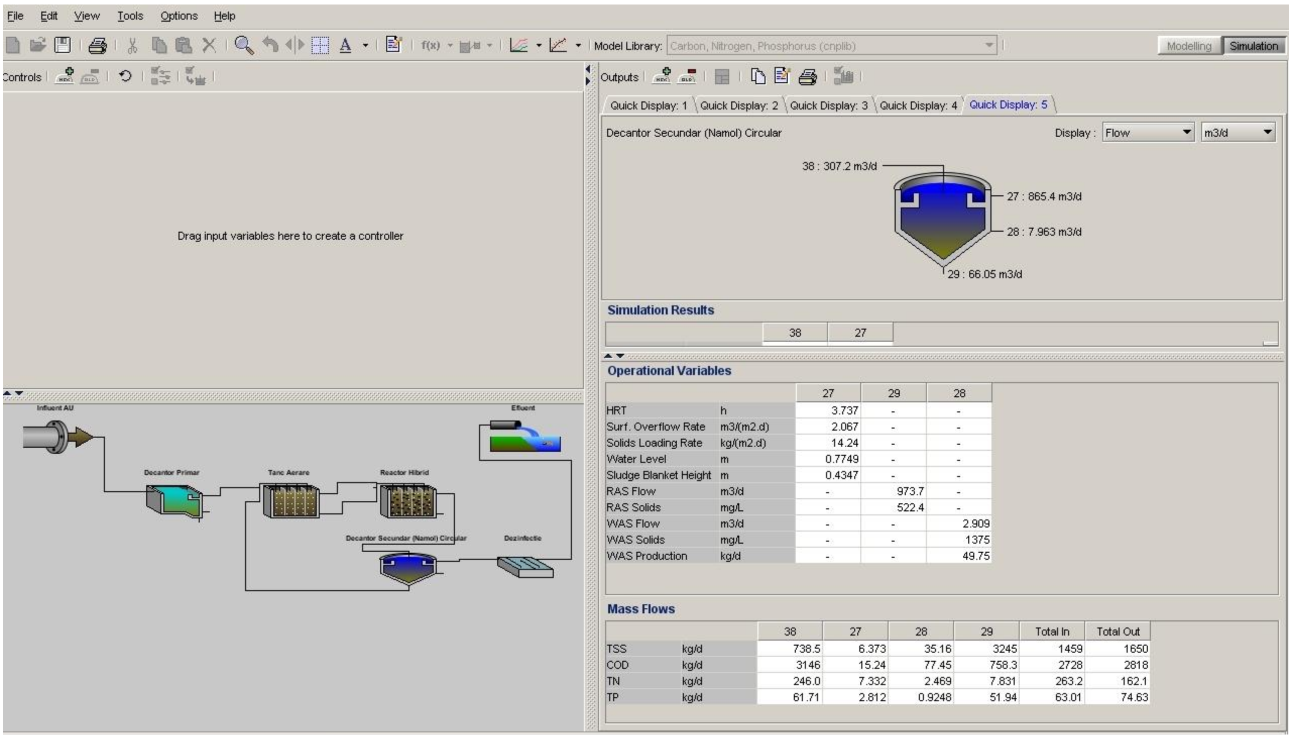

Fig. 18. Segregation mud in secondary circular settler

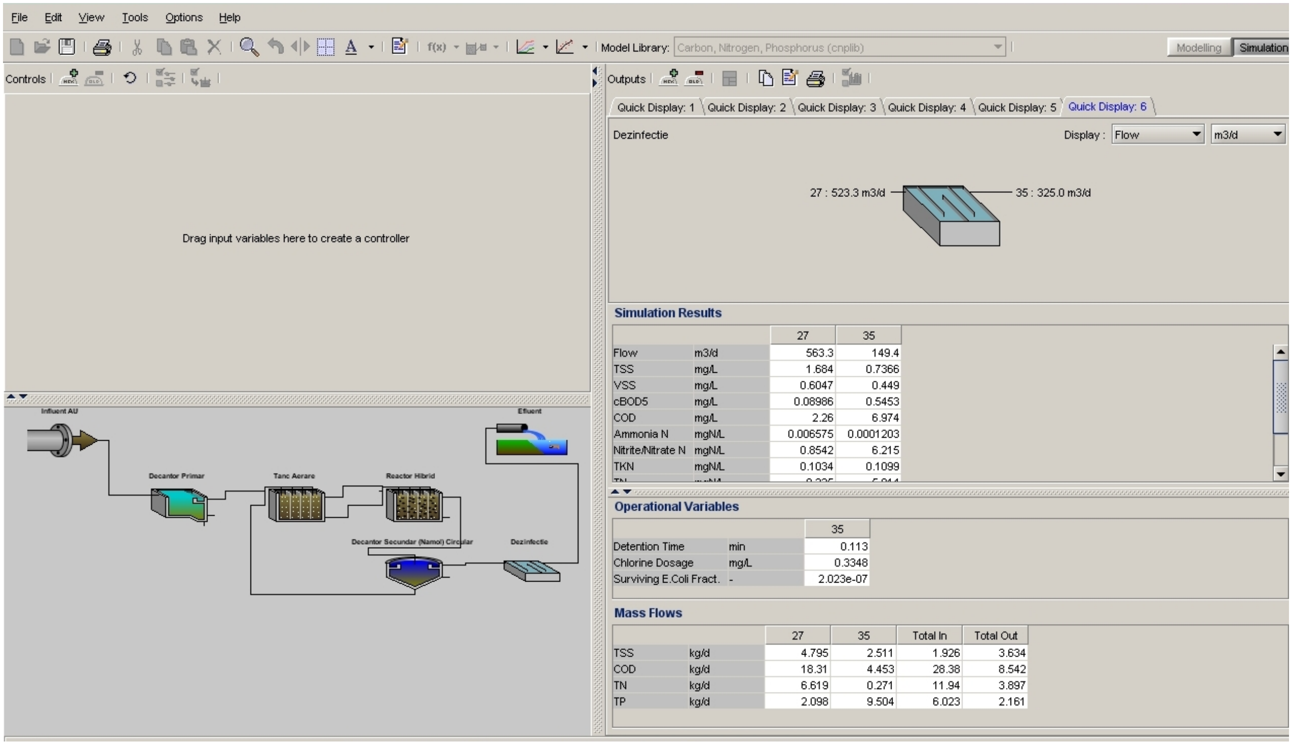

Fig. 19. Disinfection-operational data

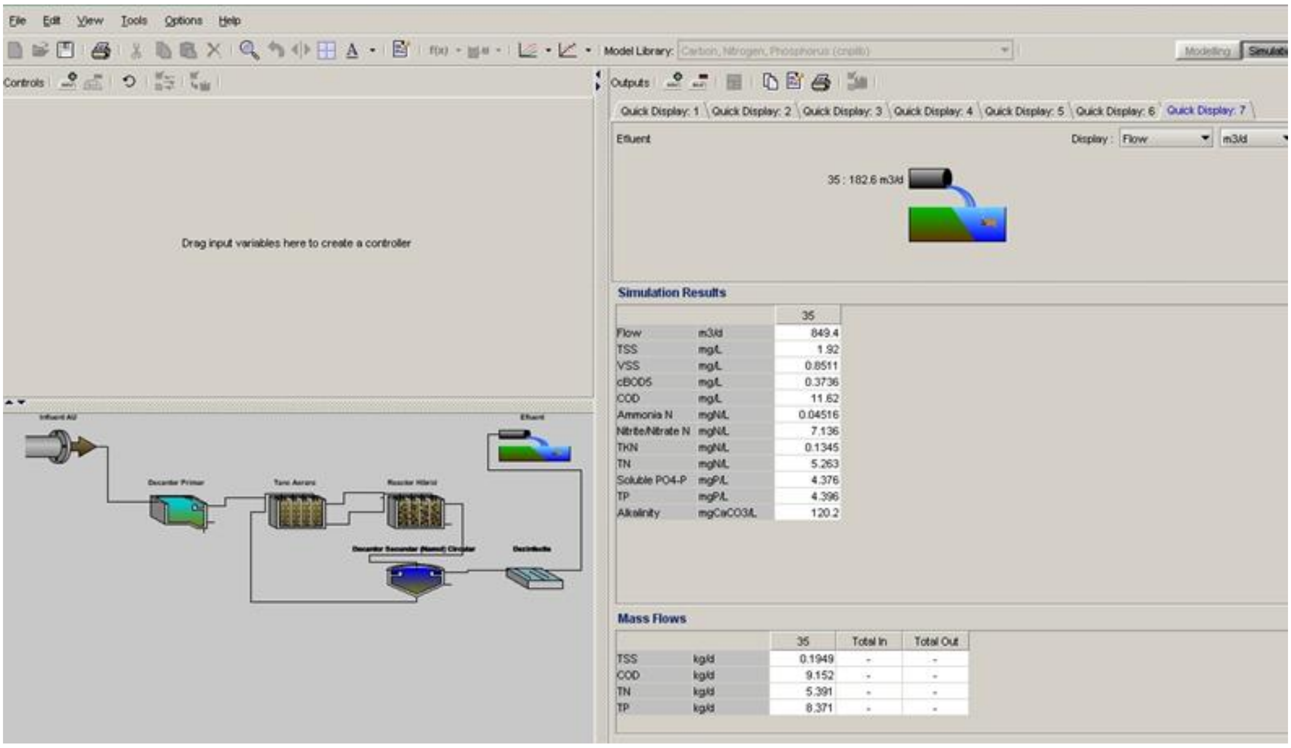

Fig. 20. Effluent data in natural receiver

5. Conclusions

It has been designed the flow station wastewater treatment plant.
Settings have been configured for installation components.
Subsequently input data have been changed according to the number of inhabitants, interchangeable.
Through simulation, it is an established type loading and subsistence change input data.
In the end, it runs the simulation process of waste water treatment plants, listing the values of waste water parameters monitored through simulation, before the evacuation into natural receiver.
Through this work it can be seen that the values of the analyzed parameters did waste water purified, to escape into natural receiver values are reduced from those set at the entrance of the plant, making it possible to obtain water purified according to standards in force.
Sustainable development implies the control of environmental pollution through the use of easy and efficient software tools.
GPS-X tools are very efficient tool for control of processes from waste water treatment plants and very useful instrument for operational training.

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