# Operational Management with Application on Streamline Sewage Treatment Stations

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***Abstract:*** *The main objective of this paper is to propose technical solutions to streamline processes of purification and treatment of municipal and industrial wastewater by introducing mathematical models and simulations made for processes from a wastewater treatment plant, to identify the optimal values of operating parameters which lead to energy efficiency and reducing costs.*
*This paper proposes to develop the concept of optimizing the processes of wastewater treatment plant as part of a wastewater purification stations, through simulation with STOAT. As a case study, the Sewage Treatment station from Mangalia city has been chosen. Simulations of wastewater treatment processes are performed with STOAT software. The simulation results and the training of personnel help with optimizing the operating times.*

***Keywords:*** *Operational management, sewage treatment station, simulation, software, optimization, consumption, costs*

## 1. Introduction

Waste water treatment is a complex process-based physical, chemical and biological materials through which dissolved and dispersed in an aqueous environment are retained and neutralized so that spill into the environment not to harm population, flora and fauna. Wastewater treatment technology represents a sequence of unit processes each of which is designed to hold a specific category of watery environment bodies dissolved, dispersed or fine granular.
Wastewater treatment efficiency refers to the entire facility-overall efficiency of purification or judging process unit: restraint, sedimentation, separation, remove organic material, etc. [1].
For each unit process determine the effectiveness of restraint that can have values in the range 50...98% depending on the facility and appropriate equipment technology. It is evident that in the present circumstances to find that restraint and neutralization efficiency is raised in order to properly protect the environment.
The stations of the wastewater treatment plant (SEAU) in Romania have been designed and equipped with the appropriate mechanical equipment of the Decade of the7th century of the last century [2]. In the past two decades, with the support of EU funds have been running several municipal wastewater treatment plants, but the overall situation remains far behind the requirements imposed by the environment and legislation. As a result the researchers ' efforts have focused on the study of the processes that can rapidly restore the situation.
Processes used in treatment plants have a special character in that it addresses the processing of some waters loaded with different concentrations of these substances have the global economic exploitable. As such, the installations and equipment must be effective, safe in operation-high reliability to manage separation/destruction of polluting materials. At the same time it should be noted that in a wastewater treatment plant wastewater flow is continuous, without interruption; the wastewater treatment plant sewage waters from entering the network on an ongoing basis with inherent variations of flow and diurnal and seasonal loads.
Municipal treatment plants are major consumers of energy in the national energy system [2]. Costs of these energy consumption accounts for a significant share of the costs of operating a wastewater treatment plant [3].
For the stations of the wastewater treatment plant it is very difficult to make energy savings because the process is continuous.

On the one hand, the WWTP wastewater enters continuously water sewer network, and, on the other hand, the technology of wastewater treatment is based on uniform (physical, chemical, biological) processes that cannot be turned off or disconnected from the network [3].
The electricity consumption of a wastewater treatment plant wastewater is very high and in the context of the increase in the price it will be increasingly more difficult to cover these costs. At present the share of energy costs in total operating costs is of the order of 35 ... 45% which is very much [2, 3].
Considering the weight of the biological step in energy consumption of the entire wastewater treatment plant-more than 50% of the staff in research efforts have focused on increasing the efficiency of sewage treatment plants in this area. The complexity of the processes in this step requires knowledge of physical, chemical and biochemical which are on the border between the different areas of existing sciences.
The main objective of this paper is to propose technical solutions to streamline processes [3] of purification and treatment of municipal wastewater and industrial by introducing mathematical models and simulations, made for processes from a wastewater treatment plant, to identify the optimal values of operating parameters which lead to energy efficiency and reducing costs.
The methods used at present are exceeded and the consideration of the actual items is now available to engineers and specialists in the field.

## 2. Materials and Researches

This paper proposes to develop the concept of optimizing the processes of wastewater treatment plant as part of a wastewater purification stations, through simulation with STOAT software [4]. Urban wastewater contains a number of pollutants and contaminants. Prior to discharge water into the mouth, should be made for a reduction of the quantity of harmful substances in accordance with local standards for wastewater.
With regard to the prevention of water pollution, the main agents of pollution from wastewater are compounds of carbon, nitrogen and phosphorus.
Thus these contaminants must be eliminated to a large extent. In most stations municipal sewage treatment, this will be achieved through a biological process. A number of micro-organisms play the role of a biological purifier in the process.
As a case study, we have chosen Sewage Treatment Station from Mangalia city (photo 1), which has three stages of purification: mechanical treatment, biological-physical treatment and sludge treatment.

**Photo 1.** Mangalia WWTP

Simulation of wastewater treatment processes are performed with the STOAT and software aims to streamline costs and operating times. Software help and the training of personnel are useful in order to optimize operating times.
To make a simulation of the process of active sludge treatment is the general layout of the WWTP (waste water treatment plant) (Fig. 1) [3]:

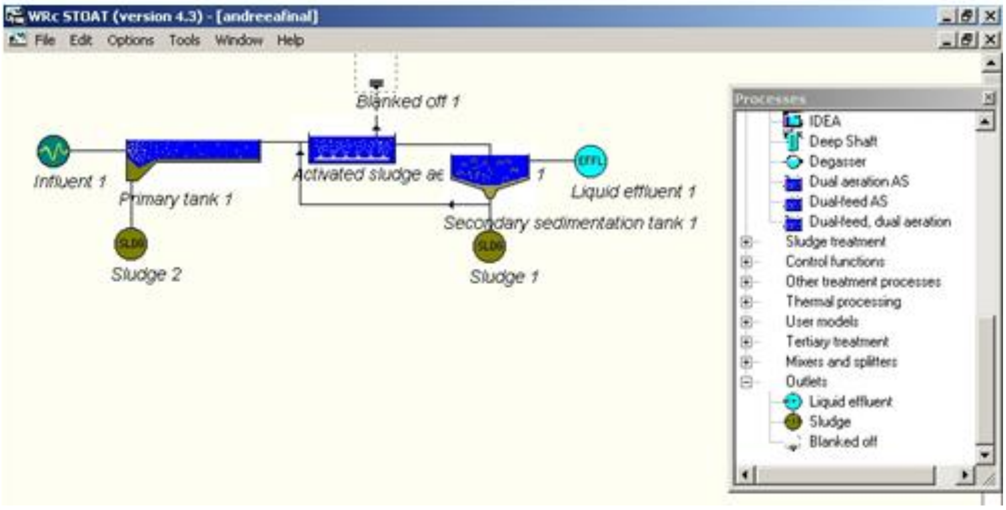



**Fig. 1.** General layout of the WWTP Mangalia

After it have defined the physical schema of the data have been entered and appropriate for each process in hand, follows the effective running of the simulation process of active sludge treatment (Fig. 2).

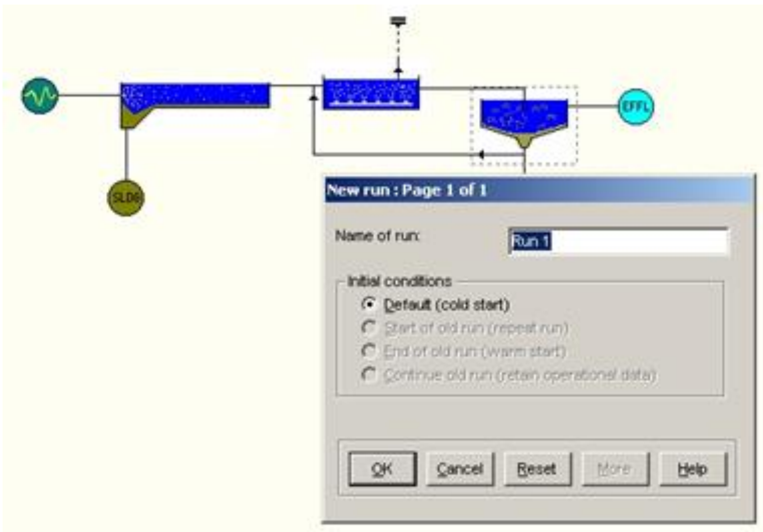


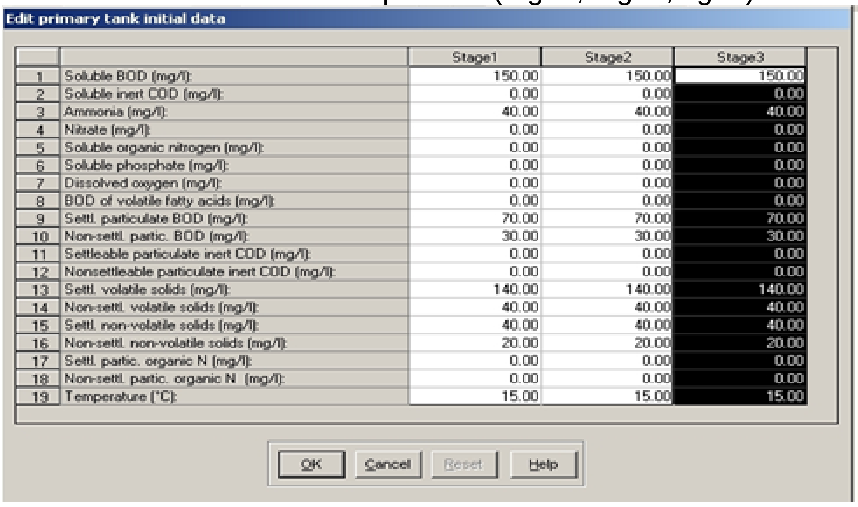

**Fig. 2.** The first step of simulation

Specify an appropriate set of values, but when using the STOAT, the first simulation program should be established for 20-40 days and should be treated primarily, as a rolling sighting, to evaluate a set of reasonable values for initial conditions.
(For activated sludge systems, normally this is sludge age, and would need to recompile three ages of sludge to be sure that we are looking for a state of dynamic equilibrium, rather than the effect of initial conditions. There will be other occasions when there is a good starting point and there are interested in steady state dynamic, but the effect of short-term changes in initial conditions defined). The simulation will last for two days at 15 ° C.

### 2.1 Input data for simulation

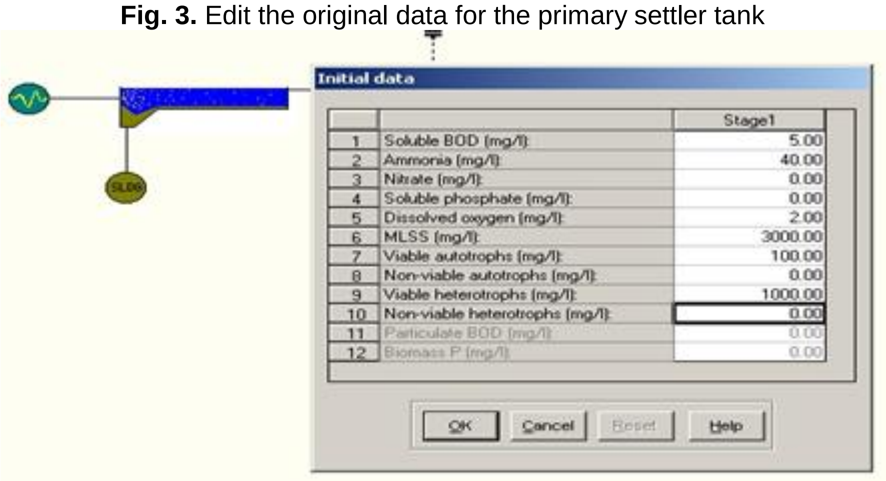
Data of influence are:
Average Flow-100 $m^3$/h
Average speeds for settling tanks-0.25 m/h
Retention time for Aeration Basin-8 hours

Work time-48 hours.
After this step, must edited data sets for each process (Fig. 3, Fig. 4, fig. 5).



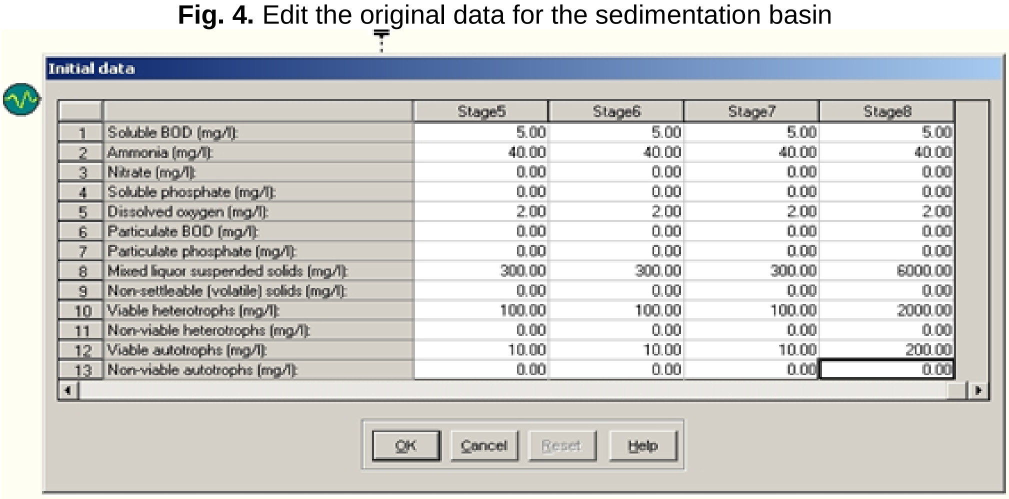

| | | Stage1 | Stage2 | Stage3 |
|---|---|---|---|---|
| 1 | Soluble BOD (mg/l): | 150.00 | 150.00 | 150.00 |
| 2 | Soluble inert COD (mg/l): | 0.00 | 0.00 | 0.00 |
| 3 | Ammonia (mg/l): | 40.00 | 40.00 | 40.00 |
| 4 | Nitrate (mg/l): | 0.00 | 0.00 | 0.00 |
| 5 | Soluble organic nitrogen (mg/l): | 0.00 | 0.00 | 0.00 |
| 6 | Soluble phosphate (mg/l): | 0.00 | 0.00 | 0.00 |
| 7 | Dissolved oxygen (mg/l): | 0.00 | 0.00 | 0.00 |
| 8 | BOD of volatile fatty acids (mg/l): | 0.00 | 0.00 | 0.00 |
| 9 | Settl. particulate BOD (mg/l): | 70.00 | 70.00 | 70.00 |
| 10 | Non-settl. partic. BOD (mg/l): | 30.00 | 30.00 | 30.00 |
| 11 | Settleable particulate inert COD (mg/l): | 0.00 | 0.00 | 0.00 |
| 12 | Nonsettleable particulate inert COD (mg/l): | 0.00 | 0.00 | 0.00 |
| 13 | Settl. volatile solids (mg/l): | 140.00 | 140.00 | 140.00 |
| 14 | Non-settl. volatile solids (mg/l): | 40.00 | 40.00 | 40.00 |
| 15 | Settl. non-volatile solids (mg/l): | 40.00 | 40.00 | 40.00 |
| 16 | Non-settl. non-volatile solids (mg/l): | 20.00 | 20.00 | 20.00 |
| 17 | Settl. partic. organic N (mg/l): | 0.00 | 0.00 | 0.00 |
| 18 | Non-settl. partic. organic N (mg/l): | 0.00 | 0.00 | 0.00 |
| 19 | Temperature (°C): | 15.00 | 15.00 | 15.00 |

**Fig. 3.** Edit the original data for the primary settler tank




| | | Stage1 |
|---|---|---|
| 1 | Soluble BOD (mg/l): | 5.00 |
| 2 | Ammonia (mg/l): | 40.00 |
| 3 | Nitrate (mg/l): | 0.00 |
| 4 | Soluble phosphate (mg/l): | 0.00 |
| 5 | Dissolved oxygen (mg/l): | 2.00 |
| 6 | MLSS (mg/l): | 3000.00 |
| 7 | Viable autotrophs (mg/l): | 100.00 |
| 8 | Non-viable autotrophs (mg/l): | 0.00 |
| 9 | Viable heterotrophs (mg/l): | 1000.00 |
| 10 | Non-viable heterotrophs (mg/l): | 0.00 |
| 11 | Particulate BOD (mg/l): | 0.00 |
| 12 | Biomass P (mg/l): | 0.00 |

**Fig. 4.** Edit the original data for the sedimentation basin



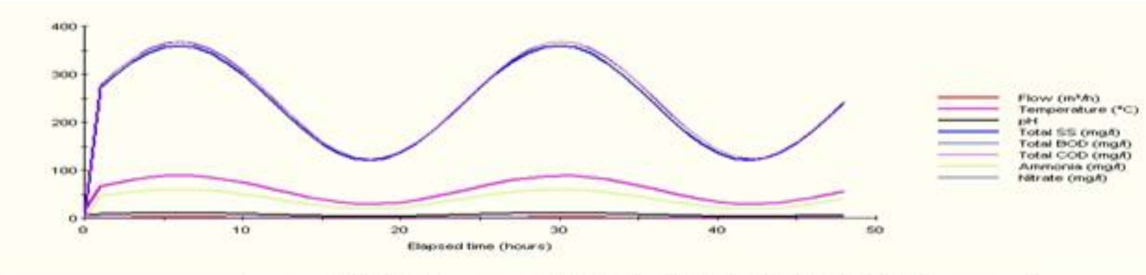

| | | Stage5 | Stage6 | Stage7 | Stage8 |
|---|---|---|---|---|---|
| 1 | Soluble BOD (mg/l): | 5.00 | 5.00 | 5.00 | 5.00 |
| 2 | Ammonia (mg/l): | 40.00 | 40.00 | 40.00 | 40.00 |
| 3 | Nitrate (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | Soluble phosphate (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | Dissolved oxygen (mg/l): | 2.00 | 2.00 | 2.00 | 2.00 |
| 6 | Particulate BOD (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | Particulate phosphate (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | Mixed liquor suspended solids (mg/l): | 300.00 | 300.00 | 300.00 | 6000.00 |
| 9 | Non-settleable (volatile) solids (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | Viable heterotrophs (mg/l): | 100.00 | 100.00 | 100.00 | 2000.00 |
| 11 | Non-viable heterotrophs (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | Viable autotrophs (mg/l): | 10.00 | 10.00 | 10.00 | 200.00 |
| 13 | Non-viable autotrophs (mg/l): | 0.00 | 0.00 | 0.00 | 0.00 |

**Fig. 5.** Edit the original data for the secondary settler tank

After editing data for each of the processes, simulation is running for 48 hours.

## 3. Results and interpretations

For the first selected items characteristic of wastewater received in the wastewater treatment plant, the graphical result is shown in Figure 6.

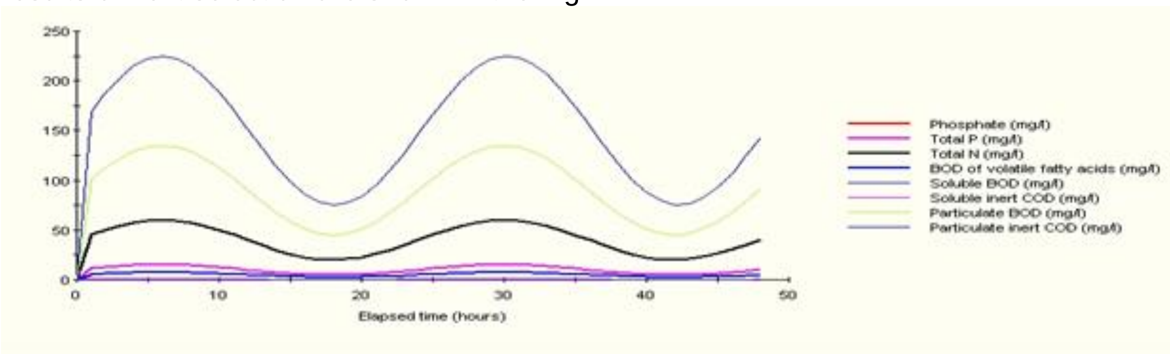



| | Flow (m^3/h) | Temperature (°C) | pH | Total SS (mg/l) | Total BOD (mg/l) | Total COD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.62 | 58.08 | 7.00 | 235.12 | 239.96 | 240.58 | 39.19 | 0.00 |
| Minimum | 0.00 | 15.00 | 3.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.94 | 88.50 | 10.50 | 360.00 | 367.50 | 368.44 | 60.00 | 0.00 |
| Standard deviation | 0.24 | 21.65 | 2.48 | 91.47 | 93.54 | 93.78 | 15.24 | 0.00 |
| Total mass (kg) | | | | 8.164 | 8.336 | 8.357 | 1.361 | 0.000 |
| Peak load (g/s) | | | | 0.094 | 0.096 | 0.097 | 0.016 | 0.000 |

**Fig. 6.** The results of first page selection of characteristics

One can notice the variations for the following elements: flow, temperature, pH, ammonia concentration, nitrate concentration, biochemical consumption of oxygen, total COD and particulate matter.

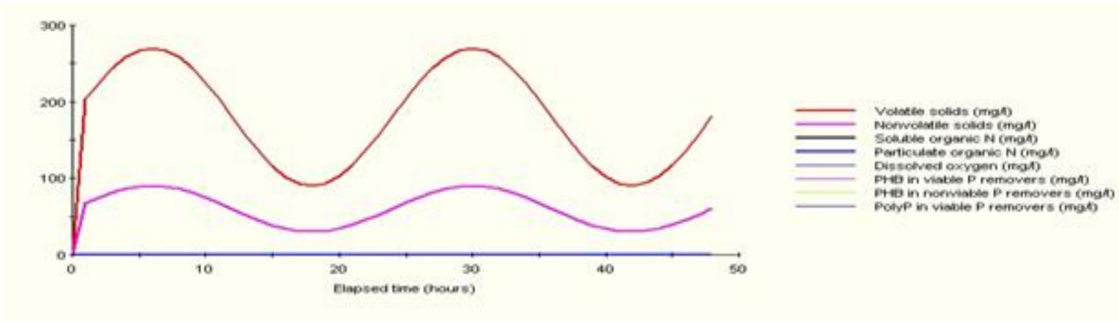
The results of next selection are shown in the Fig. 7.




| | Phosphate (mg/l) | Total P (mg/l) | Total N (mg/l) | BOD of volatile fatty | Soluble BOD (mg/l) | Soluble inert COD (mg/l) | Particulate BOD (mg/l) | Particulate inert COD |
|---|---|---|---|---|---|---|---|---|
| Mean | 9.80 | 9.80 | 39.19 | 4.90 | 146.89 | 0.62 | 88.17 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 15.00 | 15.00 | 60.00 | 7.50 | 225.00 | 0.94 | 135.00 | 0.00 |
| Standard deviation | 3.81 | 3.81 | 15.24 | 1.91 | 57.37 | 0.24 | 34.30 | 0.00 |
| Total mass (kg) | 0.340 | 0.340 | 1.361 | 0.170 | 5.104 | 0.021 | 3.062 | 0.000 |
| Peak load (g/s) | 0.004 | 0.004 | 0.016 | 0.002 | 0.059 | 0.000 | 0.035 | 0.000 |

**Fig. 7**. The results of second page selection of characteristics

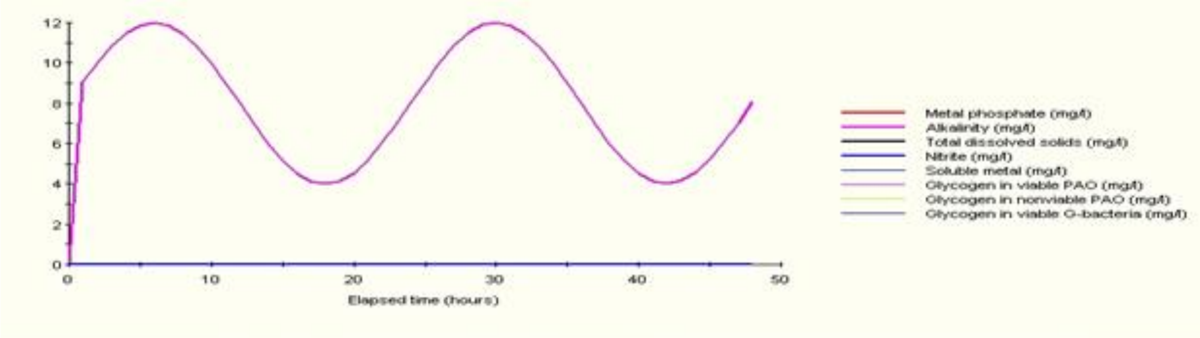
Graph 7 shows the variation in time of the following elements: phosphorus, total phosphate, total nitrogen, BOD from volatile fatty acids, soluble BOD, soluble inert COD, BOD particles, inert particle COD.




| | Volatile solids (mg/l) | Nonvolatile solids (mg/l) | Soluble organic N | Particulate organic N | Dissolved oxygen | PHB in viable P | PHB in nonviable P | PolyP in viable P |
|---|---|---|---|---|---|---|---|---|
| Mean | 176.34 | 58.78 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 270.00 | 90.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 68.60 | 22.87 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 6.123 | 2.041 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 0.071 | 0.024 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Fig. 8.** The results of third page selection of characteristics

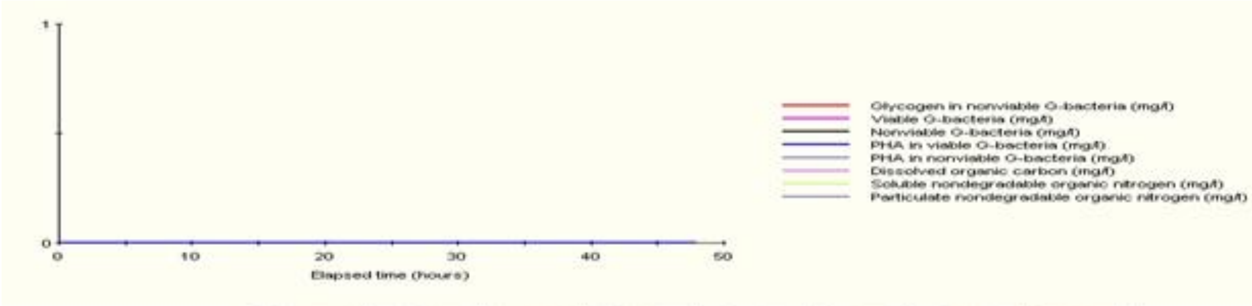
Graph 8 contains the following selected elements: volatile solids, uncoated solids, soluble organic nitrogen, organic nitrogen particles, dissolved oxygen, PHB in the viable elimination of phosphorus, PHB in the elimination of non-viable phosphorus, poly-phosphorus in eliminating Viable phosphorus (where PHB – polyhydroxybutyrate).




| | Metal phosphate | Alkalinity (mg/l) | Total dissolved | Nitrite (mg/l) | Soluble metal (mg/l) | Glycogen in viable PAO | Glycogen in nonviable | Glycogen in viable |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.00 | 7.84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.00 | 12.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 0.00 | 3.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 0.000 | 0.272 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Fig. 9.** The results of fourth page selection of characteristics

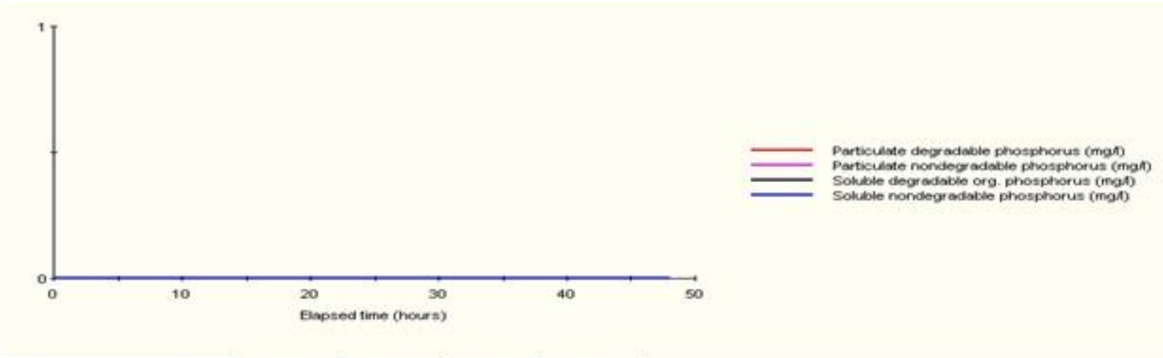
Graph 9 contains the following selected elements: poly-phosphorus in the unviable elimination of phosphorus, viable autotrophic, non-viable autotrophic, viable heterotrophic, non-viable heterotrophic, elimination of viable phosphorus, elimination of non-viable phosphorus, Metal hydroxide.




| | Glycogen in nonviable | Viable G-bacteria | Nonviable G-bacteria | PHA in viable | PHA in nonviable | Dissolved organic | Soluble nondegrada | Particulate nondegrada |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Fig. 10.** The results of five page selection of characteristics

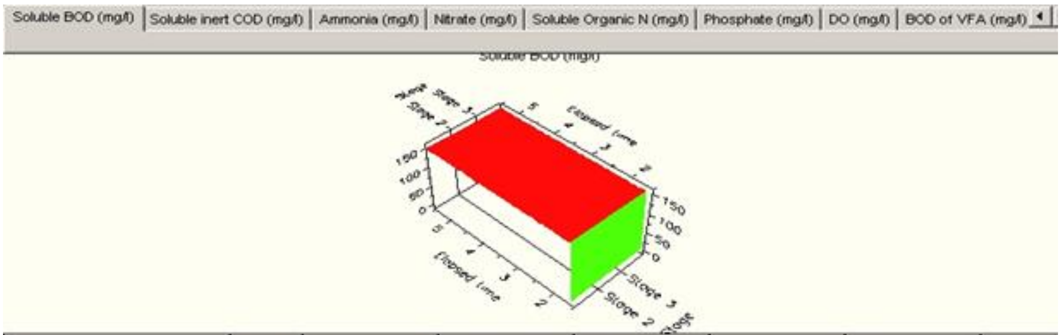
Graph 10 for the fifth page of selected items contains: Metal phosphate, alkalinity, total dissolved solids, nitrates, soluble metal, glycogen in PAO viable, glycogen in PAO unviable, glycogen in the viable bacteria-G.




| | Particulate degradable | Particulate nondegrada | Soluble degradable | Soluble nondegrada |
|---|---|---|---|---|
| Mean | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 0.000 | 0.000 | 0.000 | 0.000 |

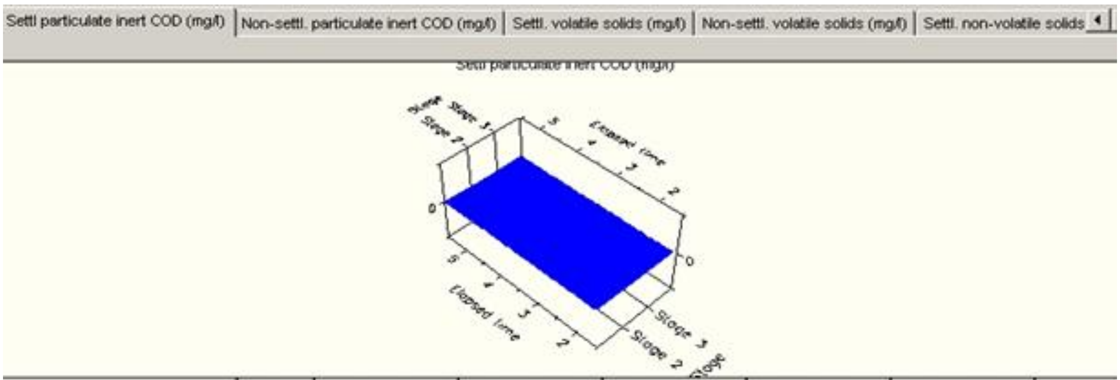
**Fig. 11.** The results of 6 page selection of characteristics

Graph 11 contains the following selected elements: degradable phosphorus particles, non-degradable phosphorus particles, degraded organic soluble phosphate, non-degradable soluble phosphate.
The 6 -11 graphs show the variation of the various elements along the 48 h during the course of the wastewater flow from the point of entry of the flow into the station to the primary settler tank.
After identifying the various characteristics of the influential fluid, the program goes further to the next element, the primary deckhead, where it analyses in time of 48h (time set for the duration of the simulation) variation of the characteristics of the fluid content in the settler tank.
Thus, the programme is primarily oriented after the initial conditions set before to determine the variation in time of soluble BOD, soluble inert code, ammonia content, nitrate content, phosphate content, etc., and the graphical results are playable in graphs 12 and 13.




| | Stage | Soluble BOD (mg/l) | Soluble inert COD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) | Soluble Organic N (mg/l) | Phosphat |
|---|---|---|---|---|---|---|---|
| Mean | 1 | 147.2 | 0.0 | 39.2 | 0.0 | 0.0 | 0.1 |
| | 2 | 146.9 | 0.0 | 39.2 | 0.0 | 0.0 | 0.0 |
| | 3 | 146.9 | 0.0 | 39.2 | 0.0 | 0.0 | 0.0 |
| Minimum | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Maximum | 1 | 150.5 | 0.0 | 40.1 | 0.0 | 0.0 | 0.2 |
| | 2 | 150.0 | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 150.0 | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 |

**Fig. 12.** The variation in time of effluent for primary tank



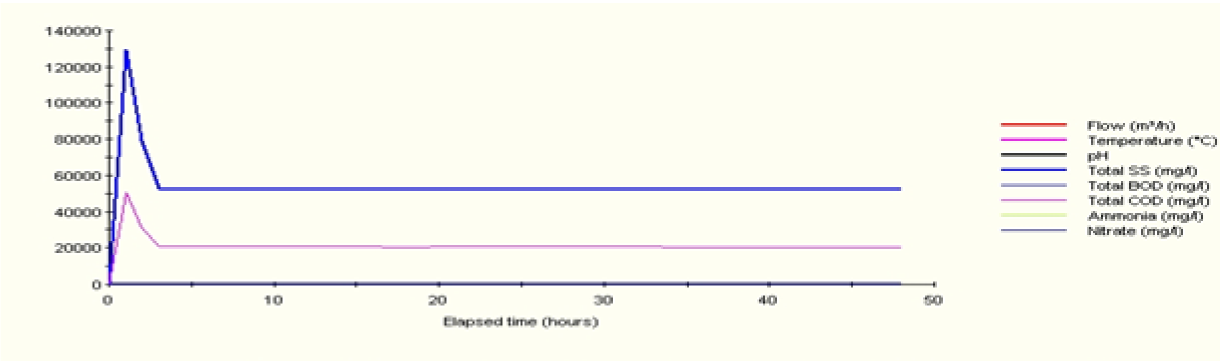

| | Stage | Settl particulate inert COD (mg/l) | Non-settl. particulate inert COD (mg/l) | Settl. volatile solids (mg/l) | Non-settl. volatile solids (mg/l) | Settl. non-volatile solids (mg/l) | Non-s. non-volatil (mg. |
|---|---|---|---|---|---|---|---|
| Mean | 1 | 0.0 | 0.0 | 33.5 | 39.3 | 9.6 | 19.6 |
| | 2 | 0.0 | 0.0 | 32.9 | 39.2 | 9.4 | 19.6 |
| | 3 | 0.0 | 0.0 | 32.9 | 39.2 | 9.4 | 19.6 |
| Minimum | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Maximum | 1 | 0.0 | 0.0 | 112.1 | 40.2 | 32.0 | 20.0 |
| | 2 | 0.0 | 0.0 | 112.1 | 40.0 | 32.0 | 20.0 |
| | 3 | 0.0 | 0.0 | 112.1 | 40.0 | 32.0 | 20.0 |

**Fig. 13.** Other characteristics of effluent for primary tank

After the program has run and determined the variation of the 3-stage characteristics of the fluid contained in the primary decanter, move on, when displaying the graphs of the various characteristics for the fluid between the primary settling tank and the first treatment pool of the active sludge.

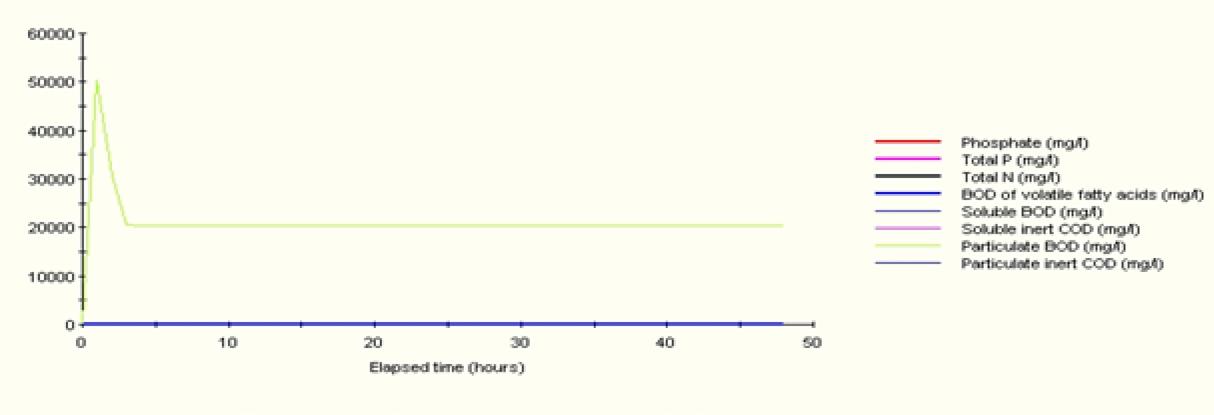
In the first hours we have a sudden increase in temperature and soluble substances from a minimum value of 0 to a maximum of 129559, 20mg/L and at a short interval of time a sudden decrease in value and maintaining it to a constant value throughout the remaining time. The pH is constant, and nitrates do not exist (Fig. 14).

Results from the analysis of the fluid flow between the primary decanter and the first active sludge treatment basin are presented in the following figures (Fig. 14, Fig. 15, Fig. 16, Fig. 17):



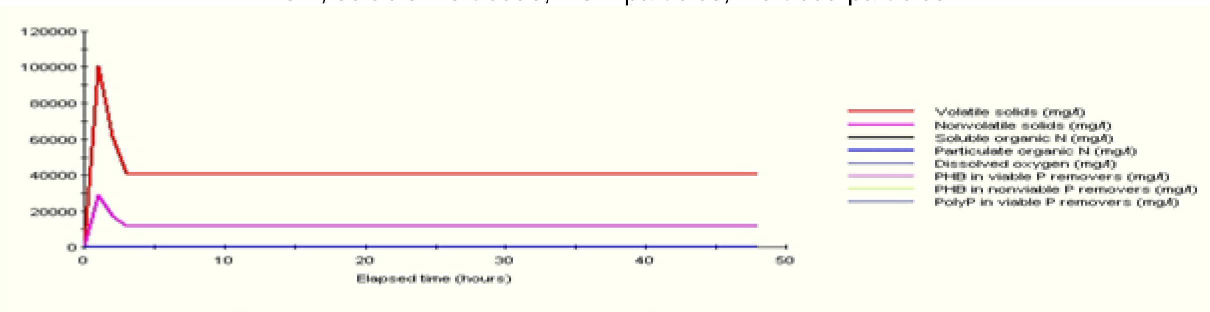

| | Flow (m³/h) | Temperature (°C) | pH | Total SS (mg/l) | Total BOD (mg/l) | Total COD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.15 | 58.08 | 7.00 | 53546.87 | 20890.13 | 20890.13 | 39.19 | 0.00 |
| Minimum | 0.00 | 15.00 | 7.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.85 | 88.50 | 7.00 | 129559.20 | 50549.63 | 50549.63 | 60.00 | 0.00 |
| Standard deviation | 0.21 | 21.85 | 0.00 | 13947.58 | 5446.22 | 5446.22 | 15.24 | 0.00 |
| Total mass (kg) | | | | 462.742 | 181.097 | 181.097 | 0.355 | 0.000 |
| Peak load (g/s) | | | | 25.587 | 9.983 | 9.983 | 0.013 | 0.000 |

**Fig. 14.** The variation of Total SS, Total BOD, Total COD, Ammonia and Nitrate



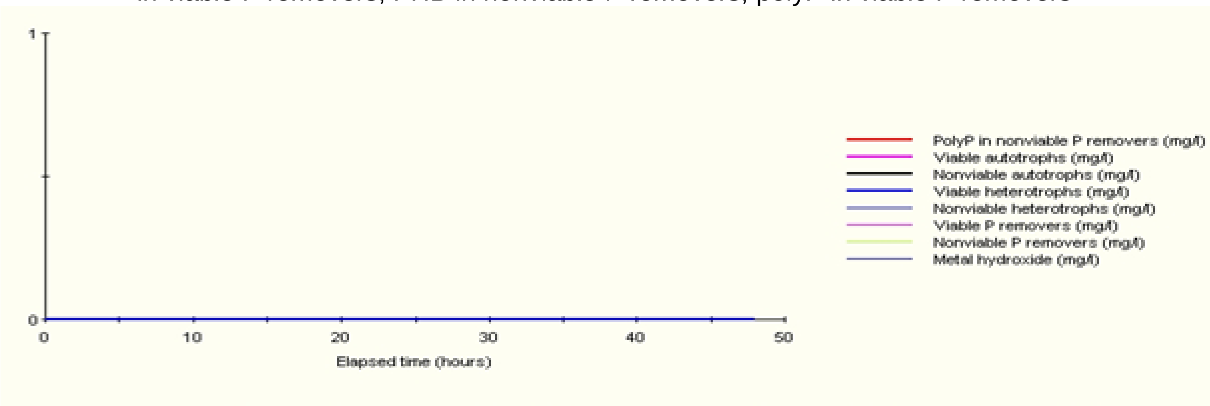

| | Phosphate (mg/l) | Total P (mg/l) | Total N (mg/l) | BOD of volatile fatty | Soluble BOD (mg/l) | Soluble inert COD (mg/l) | Particulate BOD (mg/l) | Particulate inert COD |
|---|---|---|---|---|---|---|---|---|
| Mean | 9.80 | 9.80 | 39.19 | 0.00 | 146.89 | 0.00 | 20743.24 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 15.00 | 15.00 | 60.00 | 0.00 | 225.00 | 0.00 | 50380.35 | 0.00 |
| Standard deviation | 3.81 | 3.81 | 15.24 | 0.00 | 57.37 | 0.00 | 5430.07 | 0.00 |
| Total mass (kg) | 0.089 | 0.089 | 0.355 | 0.000 | 1.330 | 0.000 | 179.767 | 0.000 |
| Peak load (g/s) | 0.003 | 0.003 | 0.013 | 0.000 | 0.048 | 0.000 | 9.950 | 0.000 |

**Fig. 15.** The variation of phosphate, phosphorus total, nitrogen total, BOD of volatile fatty acids, soluble BOD, soluble inert code, BOD particles, inert cod particles




| | Volatile solids (mg/l) | Nonvolatile solids (mg/l) | Soluble organic N | Particulate organic N | Dissolved oxygen | PHB in viable P | PHB in nonviable P | PolyP in viable P |
|---|---|---|---|---|---|---|---|---|
| Mean | 41616.89 | 11929.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 100760.70 | 28798.46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 10849.30 | 3098.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 359.802 | 102.940 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 19.900 | 5.688 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

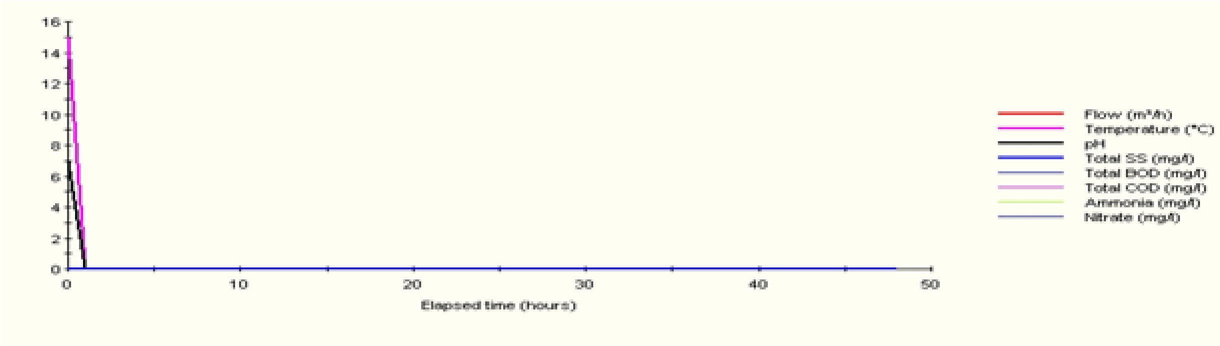
**Fig. 16.** The variation of volatile solids, nonvolatile solids, soluble organic N, particulate organic N, DO, PHB in viable P removers, PHB in nonviable P removers, polyP in viable P removers




| | PolyP in nonviable P | Viable autotrophs | Nonviable autotrophs | Viable heterotroph | Nonviable heterotroph | Viable P removers | Nonviable P removers | Metal hydroxide |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Fig. 17**. The variation of polyP in nonviable P removers, viable autotrophs, nonviable autotrophs, viable heterotrophs, nonviable heterotrophs, viable P removers, nonviable P removers, metal hydroxide

For the secondary settling tank the results are shown in Fig. 18 and Fig. 19:




| | Flow (m³/h) | Temperature (°C) | pH | Total SS (mg/l) | Total BOD (mg/l) | Total COD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.00 | 0.31 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minimum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum | 0.00 | 15.00 | 7.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Standard deviation | 0.00 | 2.14 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total mass (kg) | | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Peak load (g/s) | | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Fig. 18.** The variation of flow for secondary settling tank

As we can see, the analysis is done on 7 stages, where it is set for each element, a minimum value, a maximum value and the average of all values (Fig. 19).

Soluble BOD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) | Soluble phosphate (mg/l) | DO (mg/l) | Particulate BOD (mg/l) | Particulate phosphate (mg/l) | MLSS (m

| | Stage | Soluble BOD (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) | Soluble phosphate (mg/l) | DO (mg/l) | Particulat (mg |
|---|---|---|---|---|---|---|---|
| Mean | 1 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 2 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 3 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 4 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 5 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 6 | 4.9 | 39.1 | 0.1 | 0.0 | 2.0 | 0.0 |
| | 7 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 8 | 4.9 | 39.2 | 0.0 | 0.0 | 2.0 | 0.0 |
| Minimum | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Maximum | 1 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 2 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 3 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 4 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 5 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 6 | 5.0 | 40.0 | 0.1 | 0.0 | 2.0 | 0.0 |
| | 7 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |
| | 8 | 5.0 | 40.0 | 0.0 | 0.0 | 2.0 | 0.0 |

**Fig. 19**. The values for secondary settling tank

It is observed that soluble CBO resulted in an average value of 4.9 mg/l, an average value of 39.2 mg/L of Nitrates, and there was also a lack of nitrates and soluble phosphonates.
The program also analyzes for the aeration basin and the non-viable heterotrophic content, viable autotrophic and non-viable autotrophic (Fig. 20).

Non-viable heterotrophs (mg/l) | Viable autotrophs (mg/l) | Non-viable autotrophs (mg/l)

| | Stage | Non-viable heterotrophs (mg/l) | Viable autotrophs (mg/l) | Non-viable autotrophs (mg/l) |
|---|---|---|---|---|
| Mean | 1 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.1 | 0.0 |
| | 5 | 0.0 | 0.2 | 0.0 |
| | 6 | 0.0 | 0.3 | 0.0 |
| | 7 | 0.0 | 0.8 | 0.0 |
| | 8 | 0.0 | 233.8 | 0.0 |
| Minimum | 1 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 0.0 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 0.0 | 0.0 |
| Maximum | 1 | 0.0 | 0.0 | 0.0 |
| | 2 | 0.0 | 0.0 | 0.0 |
| | 3 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 1.7 | 0.0 |
| | 5 | 0.0 | 4.5 | 0.0 |
| | 6 | 0.0 | 7.4 | 0.0 |
| | 7 | 0.0 | 14.4 | 0.0 |
| | 8 | 0.0 | 240.2 | 0.0 |

**Fig. 20.** The non-viable heterotrophic content, viable autotrophic and non-viable autotrophic for aeration basin

It is noticed the total reduction of nitrogen content, soluble substances and COD code which leads to the conclusion that the wastewater is purged when it is discharged into the Emisar.

## 4. Conclusions

There is a high increase in the early hours of the simulation preceded by a sudden drop in short time after reaching the maximum, and then maintaining a constant value of the various elements.
The use of a specialized program for the follow-up of each process is beneficial both for the personnel who are in administration and use a clean wastewater treatment plant and for the emissary receiving the daily intake of treated water.
It is recommended to use the Stoat plant for the treatment station SEAU Mangalia because the simulation performed in this paper was clearly observed the difference between the values of each characteristics at the entrance to the treatment plant and the values of the characteristics In the final stages.
The same reasoning applies when dealing with treatment processes. The use of integrated models as a planning tool in the operational phases can be much more important to develop a more efficient complex use of the existing resources in the sewage system and the wastewater treatment station.

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