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DEFINITION OF STATISTICS, CORRECTED AND CLASSICAL DEGREE OF EFFICIENCY WASTEWATER TREATMENT

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ABSTRACT
In order to mathematically described and easy way to determine the representative degree of efficiency of the wastewater treatment on the plan were carried out the necessary measurements of quality parameters of wastewater, based on which the regression model over COD defined statistically corrected to the level of effectiveness of treatment. The classical degree of efficiency is defined directly from the measured values of COD. Statistics defines the certificate of adequacy of regression models and adjusted to get equally t-test. This paper contains a graphic representation of spatial functions of statistical dependence, corrected and classic efficiency of purification on the plants for wastewater treatment cities.
Keywords: degree of purification efficiency, classical and statistically adjusted level of purification, wastewater parameters

1. INTRODUCTION
On the basis of quality characteristics of wastewater, which is tracked by monitoring the plants for treatment before and after the process of biochemical treatment is defined as the degree of purification of the classic by individual indicators of water quality. Selection process and purification technologies first depends on the origin and characteristics of wastewater, the planned improvements and the required quality of the discharged water and purified water, or the degree of purification, which is necessary to achieve compliance regulations. In order to define the degree of statistical efficiency of treatment is necessary to make the measurement of quality parameters of wastewater to treatment plants before and after processing. The existing classical degree of purification involves the relationship of pollution to separate the input of pollution. It can be defined for each parameter separately. Based on 31 measurements of input-output parameters of the quality of wastewater at four plants, is defined by statistical analysis statistical level of purifying through a representative parameter chemical oxygen demand (COD). Testing the adequacy of regression models will be made of input output parameters for all 4 plants-level statistical effectiveness of treatment. After that will be conducted Student t-test where they will assess the significance of regression parameters that define the COD for the significant parameters-adjusted level of effectiveness of treatment. The degree of wastewater treatment is determined by the quality parameters of wastewater before and after processing. This dependency can be expressed mathematically and describe the levels of dependence and rank the impact of wastewater quality parameters. The interest of this paper is to present and lead to an appropriate statistical dependence, statistic, corrected and classic level of efficiency of wastewater treatment at four plants that operate on the territory of Bosnia and Herzegovina to full functionality.

2. DEFINING THE CLASSIC, STATISTICS AND CORRECTED THE EFFICIENCY PURIFICATION AND THEIR MUTUAL RELATION

The success of the process, determined by measuring the size of which indicate the quality of treated wastewater at the exit, as well as water quality, which leads to the entrance facility for treatment. Relation between these parameters, at the entrance and exit process in order to obtain data on the same level of success of implementation, is called the degree of efficiency of waste water. The classical degree of efficiency wastewater treatment is defined by equation 1.

$$\eta_{COD} = \frac{COD_{ri}}{COD_{in}} = \frac{COD_{in} - COD_{ou}}{COD_{in}} = 1 - \frac{COD_{ou}}{COD_{in}} 100\ \% \qquad \ldots(1)$$

Where is: η_{COD} - The degree of COD removal efficiency; COD_{ri} - The amount of COD removed during processing; COD_{in} - The amount of COD measured at the entrance to the plant for waste water treatment, COD_{ou} - The amount of COD measured at the exit of the plant, prior to discharge into the watercourse. In assessing the adequacy of regression equation is used F-test, where the degree of freedom (df_{REG} and df_{REZ}) and the threshold of significance $\alpha = 0.05$ is needed to satisfy the condition given by equation 2.

$$F_{CAL} > F_{TAB} \qquad \ldots (2)$$

For a specified threshold of significance $\alpha = 0.05$ and degrees of freedom $df_{REG} = 5$, $= 25\ df_{REZ}$ taken table look-up value of F = 2.60, and the computational value of F0 = 3.3165, and is therefore filled with the greatest condition ($F_{CAL} = 3\ ,\ 3165$) ($F_{TAB} = 2.60$) - Consequently, the simple linear regression model COD is adequate. This was confirmed for all regression models reentrant COD-output parameters were analyzed at 4 plants. Thus defined COD statistical model inputs shown by equation 3.

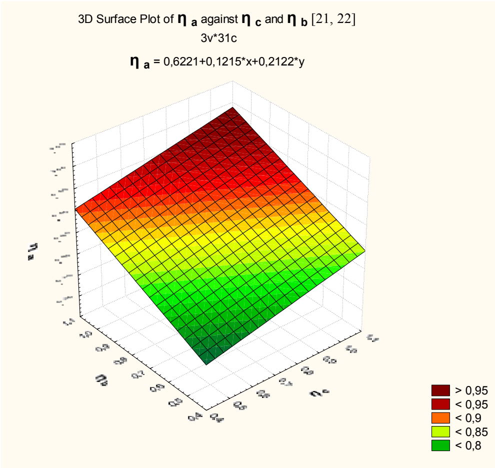
$$COD_{S,\ in} = -1657{,}69 + 0{,}64459\ SM_{in} + 0{,}8548\ N_{in} - 0{,}063\ Q + 125{,}796\ P_{in} + 281{,}5037\ pH_{in} \qquad \ldots (3)$$

Statistical level of effectiveness of treatment (the same way for all four plants) expressed by chemical oxygen demand (COD), the ratio of the removed COD and the amount COD_{in}, which was measured at the entrance to the wastewater treatment plant for waste water as an analytical expression in function of other quality parameters of wastewater is shown in the Table 1.

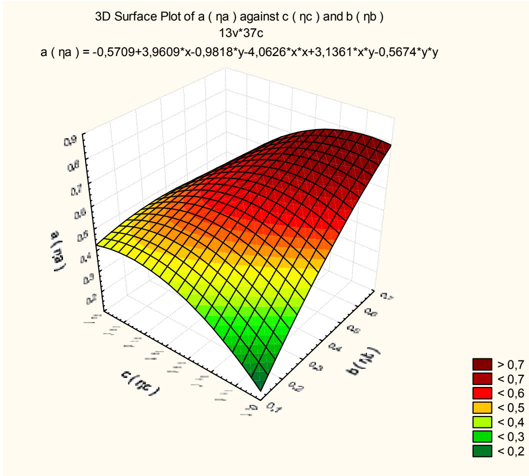
Figure 1 (a, b, c, d) given the equation and spatial statistical functions, corrected and standard level of efficiency for the 4 analyzed plant for wastewater treatment, where a represents a statistically η_a, η_b b (y) adjusted until the η_c c (x) refers to the classical degree of efficacy of treatment.

Table 1. Review the efficiency of the statistical treatment.

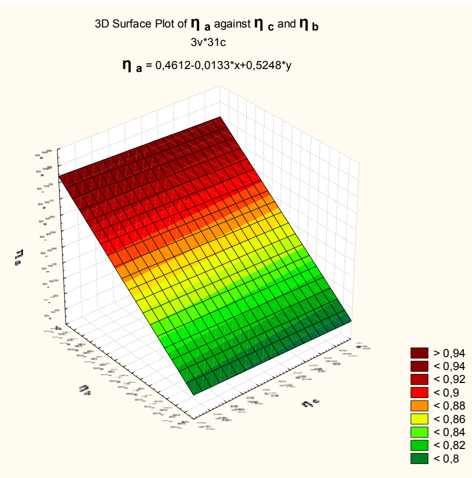
Aerobic biochemical plant for wastewater treatment with activated sludge	The mathematical model of the efficiency of purification
PWT - S	$\eta_{POWT-S} = 1 - \frac{(-331{,}708 + 0{,}2146\,SM_{out} + 1{,}2083\,N_{out} + 49{,}434\,P_{out} + 0{,}0064\,Q + 44{,}8635\,pH_{ou})}{-1657{,}69 + 0{,}64459\,SM_{in} + 0{,}8548\,N_{in}1\ 0{,}063\,Q + 125{,}796\,P_{in} + 281{,}5037\,pH_{in}}$
PWT - LJ	$\eta_{PWT-LJ} = 1 - \frac{(328{,}15 + 2{,}35SM_{ou} + 0{,}098\,Q - 0{,}1155\,BPK_{5ou} - 50{,}4\,pH_{ou} - 0{,}135\,P_{ou} + 0{,}3292N_{iz} + 0{,}973T_{ou})}{-252{,}49 + 1{,}304BPK_{5in} + 0{,}977SM_{in} + 0{,}128\,Q - 2{,}95\,P_{in} - 1{,}404\,T_{in} + 23{,}35pH_{in} - 1{,}49N_{in}}$
PWT- T	$\eta_{PWT-T} = 1 - \frac{(38{,}497 + 2,\ o79\ SM_{ou} - 0{,}1213EP_{ou} - 0{,}1511\ SM^2_{ou} + 0{,}004SM_{ou}\ EP_{ou} + 0{,}002EP^2_{ou}}{(-\ 0{,}0028\ EP^2_{in} + 4{,}244\ EP_{in} - 1286{,}9)}$
PWT - G	$\eta_{PWT-G} = 1 - \frac{(64{,}3 + 2{,}32\ BPK_{5ou} + 0{,}805\ P_{ou} - 10{,}59\ pH_{ou} + 1{,}42\ T_{ou} + 0{,}0019\ Q - 0{,}179\ SM_{ou} - 0{,}93\ N_{ou})}{-\ 456{,}5 + 36{,}07\ P_{in} + 0{,}503\ SM_{in} + 0{,}499\ BPK5_{in} + 5{,}86\ T_{in} - 0{,}0025\ Q + 42{,}71\ pH_{in} + 2{,}91\ N_{in}}$



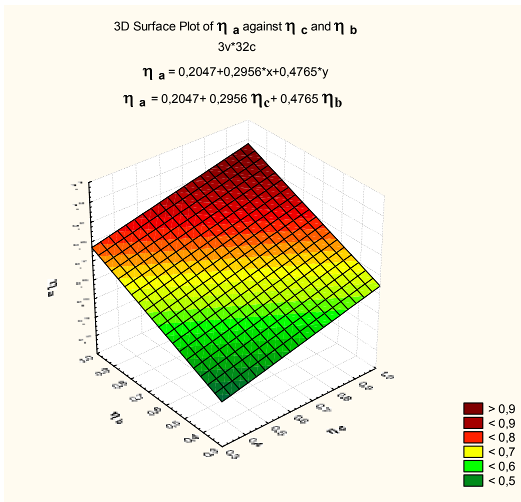
a) Plant in Srebrenik (PWT-S)



b) Plant in Ljubuški (PWT-LJ)



c) Plant in Trebinje (PWT-T)



d) Plant in Gradačac (PWT-G)

Figure 1. Statistical degre of efficiency wastewater treatment in a function of η_b *i* η_c *degree.*

3. CONCLUSION

According to these graphs, for any value of the efficiency of purification, obtained for a smaller number of (significant) parameter expressed mathematically as corrected, and classic level of purification, can be read at a value more representative, more efficient, more accurate and reliable level of efficiency of wastewater treatment plants cities. Knowing the classic level of purification efficiency is expressed directly through the measured COD and significantly shorter procedure defined adjusted over significant degree of purification of process parameters for data measurement and conditions of the facility, it can statistically determine the degree of purification efficiency of the spatial function, that is the equation that connects these three stages of treatment. In this way, eliminate unnecessary measurement of certain parameters, decreases total time of measurement, which brings significant savings on consumption of chemicals for the analysis of waste water and energy consumption and the involvement of human resources.

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