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MATHEMATICAL MODEL OF CHEMICAL OXYGEN DEMAND IN FUNCTION OTHER WASTEWATER PARAMETERS

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ABSTRACT
In order to mathematichal described relation between parameters of wastewater quality, on the facilites for wastewater treatment, the necessary measurement of mentioned parameters has been performed. Results of measurement are shown by tabs and to submit regression analaysis of interdependent individual parameters. Also, it will be given correlation of chemical oxygen consumption as function of other wastewater parameters. Paper consist graph of regression date, as well as, results of variance analaysis. At the end of this papers will be presented mathematical model of chemical oxygen consumption for 31 performed the measurement and given model adequacy verification by Fisher test.
Keywords: chemical oxygen demand; regression equation; parameters of wastewater;

1. INTRODUCTION
In order to achievement of measurement dates which are used for calculation of requisite process parameters, it is essential to perform correctly preparation of test samples. Also, it is very important for connection of input-output dates and the design of facilities for waste water treatment. Sampling is automatic performed in the same period of time on the plant for waste water treatment in Gradačac city. During of the sampling, it was looked after about correctly of way usage the device for the sampling *[1]*. The samples of waste water were sampled after have been passed through the crude girder:

- Sampling was carried out 31 times,
- From the hourly currently samples were formed the 24-hourly compositional samples;
- In the compositional samples is defined the next parameters :
    - pH value (whose change is very a little, so it can be taken as constant value),
    - BOD_5- biological consumption of oxygen, mg O_2/l,
    - COD- chemical oxygen consumption , mg O_2/l,
    - Total amount of particle suspension (SS), mg/l,
    - Temperature of water ^{0}C,
    - Total of Nitrogen N, mg/l,
    - Total of Phosphor P, mg/l,
    - Flow Q (m^3/h)*[2]*.

Table 2. shows parameters of row waste water as, chemical oxygen consumption (COD biological consumption of oxygen (BOD_5), Total amount of particle suspension (SS), Temperature of water, their

pH values, flow Q, and Total value of Nitrogen and Phosphor, which are measured 31 days in the same time.
In statistical analysis, regression and correlation are apply together for the solving dependence among observed parameters as well as determination of interaction efficiency. In this paper has been used statistical systems – frameworks of Microsoft Excel – as well as regression analysis.

2. CORRELATION COEFFICIENT

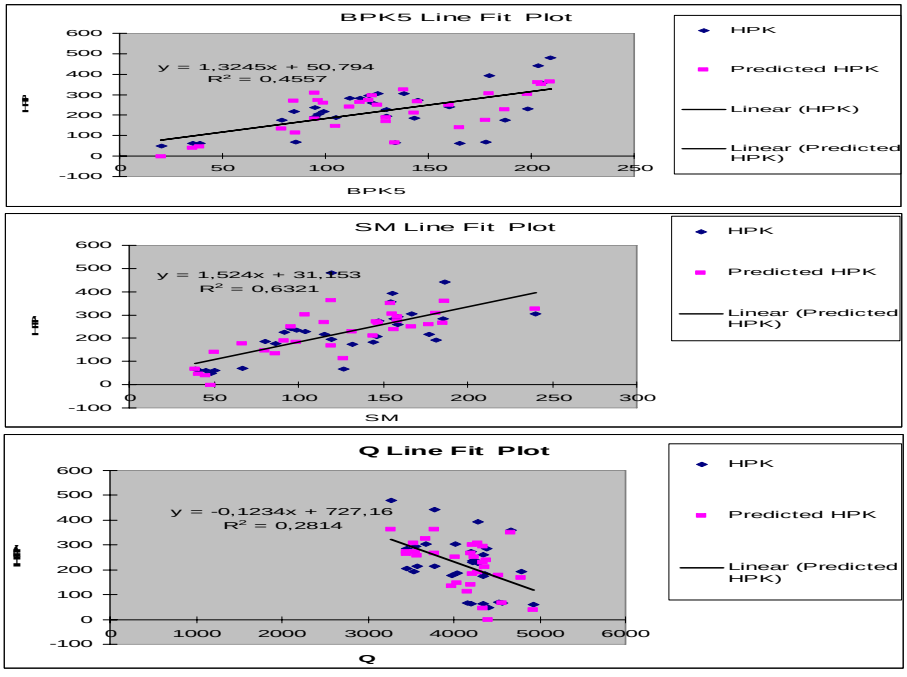
In Table 1 data is the correlation coefficient matrix for data quality of waste water.

Table 1. Correlation coefficient matrix quality of wastewater

	Q	*BOD_5*	*pH*	*SS*	*N*	*P*	*T*	*COD*
Q	1							
BOD_5	-0,05404	1						
pH wastewater	0,570408	-0,24923	1					
SS	-0,53443	0,307356	-0,52201	1				
Total N	0,4209	0,299278	0,417987	-0,05767	1			
Total P	-0,48284	0,585512	-0,49754	0,657098	0,084848	1		
Temperature	-0,85238	0,048166	-0,74441	0,603352	-0,60045	0,495351	1	
COD	-0,45779	0,582534	-0,43893	0,686077	0,11494	0,816729	0,472613	1
Rank variable	x_5	x_3	x_6	x_2	x_7	x_1	x_4	y

3. GRAPHIC DATA PROCESSING REGRESSION

Analytical regression results of the analysis with seven variables are shown through regression diagram (Figure 1).



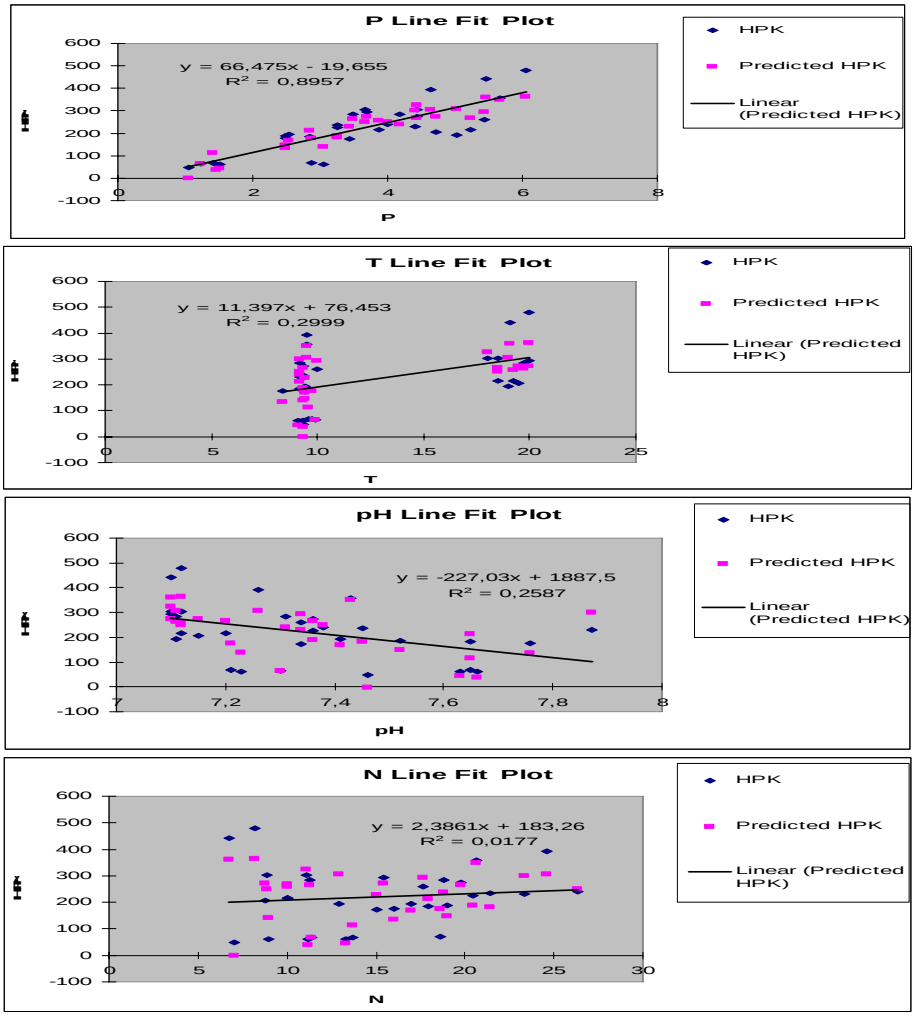


Figure 1. Diagram regression-dependence COD certain parameters of the process

4. PARAMETERS OF LINEAR REGRESSION

After the analytical calculations for reasons of comprehensibility, according to the table ANOVA Results of processing data for reimbursement, given the view coefficient for the regression of all parameters that will serve as a basis for a final view regression equation [3]. Be sure to be here and can see how certain parameters of the process depending on the sign of the coefficient values and influence on the chemical oxygen consumption (COD) (Table 2).

Table 2. The parameters of linear regression

No	Index included variable	b_0 Free article	b_1 BOD_5	b_2 SS	b_3 Q	b_4 P	b_5 T	b_6 pH	b_7 N
1	X_1, X_2 ,X_3, X_4, X_5, X_6	-403,981	39,521	0,5867	0,5311	2,3325	-0,01097	48,6131	-
2	X_1, X_2 ,X_3, X_4, X_5, X_6, X_7	-456,507	36,07	0,5033	0,49967	5,8667	-0,00258	42,718	2,9107

5. RESULTS ANALYSIS OF VARIANCE

From the analysis presented in Table 3. can determine which regression equation will be the optimum that can gain insight into the amount of squares and the size of standard errors. From the table to see that the data under the first and second column are differences between the regression and residual sums of squares at least you talk about better quality of regressions, especially the residual amount in case 2nd.

Table 3. The results of analysis variance

No	Index included variable	Regression sum of squares	Residual sum of squares	Coefficient of Determination	Correlation coefficient	Standard error
1	$X_1, X_2, X_3, X_4, X_5, X_6$	281025,4	100291,3	0,736987	0,858479	64,64367
2	$X_1, X_2, X_3, X_4, X_5, X_6, X_7$	283965,3	97351,37	0,744697	0,862958	65,05896

6. REGRESION EQUATION

During the evaluation of adequacy regression equation is used F-test, where the degree of freedom ($df_{REG,}$ and df_{RES}) and the threshold of seriousness $\alpha = 0.05$ is needed to meet the requirement [4]:

$$F_{CAL} > F_{TAB}$$

Threshold for alleged pregnancy $\alpha = 0.05$ and the degree of freedom $df_{REG} = 7$, $df_{RES} = 23$, occurs table value determined through interpolation F = 2.455, and the computational value of $F_{CAL} = 9.584139$, and is therefore above condition ($F_{CAL} = 9.584139$)> ($F_{TAB} = 2.455$) is fulfilled. For this, as well as from the table 3. as an adequate regression equation can take can take the equation that integrates y = f (x1, x2, x3, x4, x5, x6, x7) marked as 1.

$$COD = -456{,}507 + 36{,}0757\,P + 0{,}5033\,SS + 0{,}4996\,BOD_5 + 5{,}8667\,T - 0{,}0025\,Q + 42{,}7182\,pH + 2{,}91\,N$$

7. CONCLUSION

Regression equation x. shows that with increasing P, BOD_5, pH value (x_6), SS, N (x_7) and T , COD increases, while the increase of flow Q (x_5), HPK at the entrance decreases. Monitoring of waste water at the entrance to the facility in „Gradačac“, leading the account of the quality effluent, and mutual respect of certain parameters, the quality of waste water, which were available in this work, a very small test period, it was shown that using the statistical package Excel, can complement previous theoretical (with the increase of BPK and Nutrient N and P increases COD) and experimental findings. Be sure to make for a better quality analysis was required, selected, and process data for a longer period of time, which would be installing continuous monitoring of waste water at the entrance of water into the plant for treatment of water Gradačac city. What would be very interesting, for amendment of this work is, the implementation of the statistical process for indicators of quality of waste water to exit from the plant, and would thus be able to connect mathematical input-output parameters, and affirmed the degree of removal of certain pollutants from wastewater .

8. REFERENCES

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