CORRELATION BETWEEN BOD, COD AND TOC

M. RAMANAND BHAT, ROOPALI, S. HIREMATH AND VINAYAK R. KULKARNI

C/O Mr. N,V, Shet, Kumudini Nivas, Gandhinagar Last Stop Road
Gandhinagar, DHARWAD- 4, India

ABSTRACT

For a refinery processing heavy crude coorelation was tried between BOd, COd and TOC. For BOD V. TOC preferable and for BOD V. COD cubic equation gives better equation.

INTRODUCTION

The objective of this paper is to correlate BOD (Biochemical Oxygen Demand) with COD (Chemical Oxygen Demand) and TOC (Total Organic Carbon). So that, knowing wether COD or TOC , one can estimate BOD. This study is limited to wastewater from a refinery processing heavy crudes.

Estimation of Total Organic Carbon (TOC) and Chemical Oxygen Demand (COD) is a matter of 3-4 hours. However, the analysis of BOD of effluent water takes about 3-5 days after sampling. Hence, treatment that is required for the waste water will not be possible, if BOD data are not available.

Hence, to facilitate quicker estimation of BOD, the correlations relating BOD with TOC/COD are generated for a wastewater from a specific refinery. BOD of a wastewater stream can be read out from the graphs showing fitted curves or from the generated equations.

Experimental Procedure

The treated effluent was tested for BOD, COD and TOC. Intially, the pH of the treated effluent sample was brought to 7.0, which was then tested for BOD , COD and TOC. These values of BOD, COD and TOC were collected

and sample readings have been tabulated in Table 1.

Using these values, the different curves possible such as exponential, quadratic and cubic wer fitted using method of least squares.

RESULT AND DISCUSSION

Sl No.	TOC	BOD	COD
1.	13.79	3.6	21
2.	16.35	6.0	31
3.	21.86	8.5	32
4.	16.86	9.5	48
5.	12.79	9.5	56
6.	31.67	9.8	92
7.	9.36	5.1	132
8.	11.97	5.2	108

Table-1 Showing some representative measured values of TOC, BOD and COD.
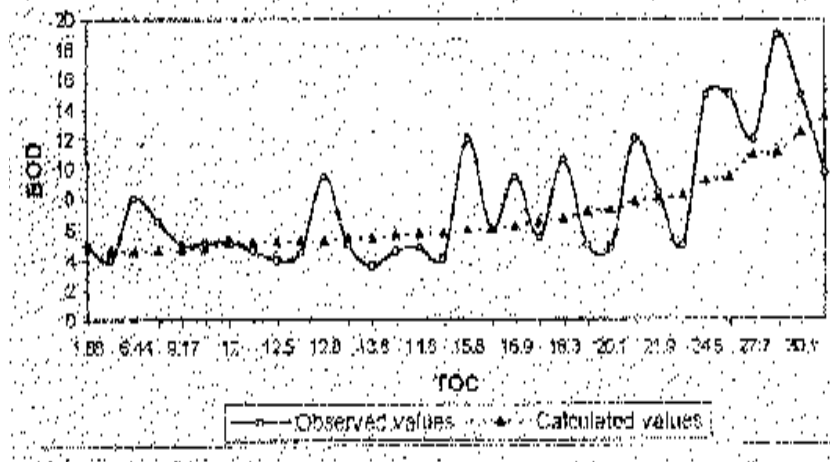
(A) Cubic Fit -

Fig. - 1

Third order polynomial equation is fitted for the observed behaviour of BOD as a function of TOC.

$$BOD = 2/154 \times 10^{-5}(TOC)^3 + 0.012299\,(TOC)^2 - 0.1399\,(TOC) + 4.986$$
Also,
The average error in predicting the BOD is 12.938%
The standard deviation observed is 5.211%
The best fit is observed in between the TOC range of 9.17 and 21.86 with the average% error of 5.07% and SD of 3.78%.
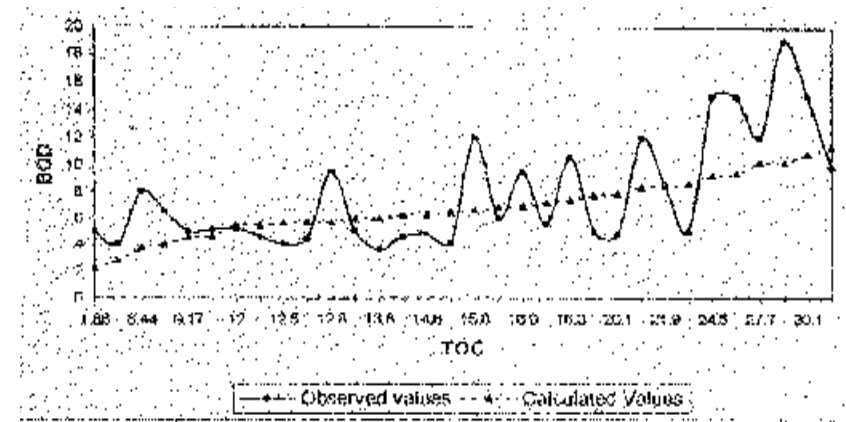
(B) Quadratic Fit

Fig. - 2

$$BOD = -0.000364\,(TOC)^2 + 0.316\,(TOC) + 1.6887$$
Also
The average error in predicting the BOD is 22.75%
The standard deviation observed is 6.776%
The graph shows deviation in entire range but, equal devation is observed in the range of 12.51 to 24.54 of TOC.
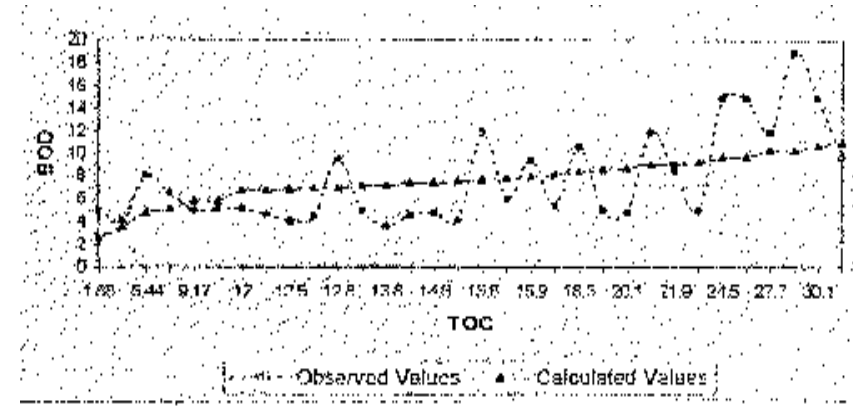
(C) Exponential Fit

Fig. - 3

Exponential equation is fitted for the observed behaviour of BOD as a function of TOC.
$$BOD = 1.813(TOC)^{0.4244}$$
The following points can be noted from the above graph.
The average error in predicting the BOD is 11.524%
The standard deviation observed is 6.44%

The graph shows equal deviation in entire range of TOC.

Observations

It can be inferred that, the third order polynomial gives less error but has more deviation compared to exponential equation. Hence it is recommended to use exponential due to equal deviations through out the entire range.
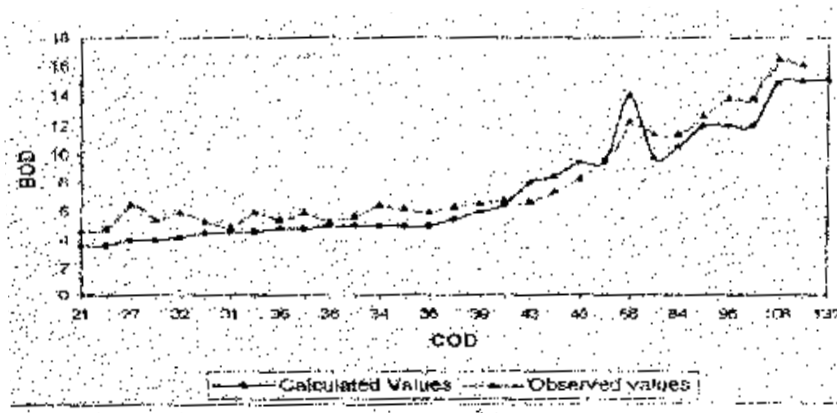Exponential equation: $BOD = 1.813 (TOC)^{0.4244}$

(A) Exponential Fit

Fig. - 4

Exponential equation is fitted for the observed behaviour of BOD as a function of COD.

$BOD = 0.386 (COD)^{0.7645}$
The following points can be noted from the abvove graph.
The average error in predicting the BOD is 5.27%
The standard deviation observed is 5.89%
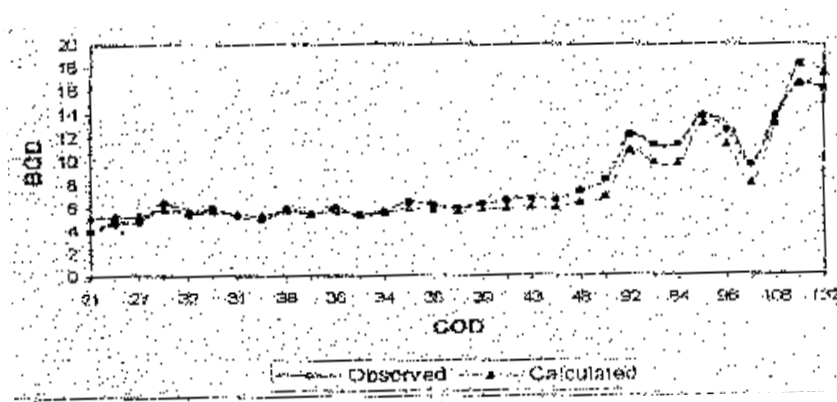The graph shows equal deviation in entire range of COD.

Fig. - 5

(B) Cubic Fit

Cubic equation is fitted for the observed behaviour of BOD as a function of COD

$BOD = 3.376E – 7 (COD)^3 + 6.82E{-}4 (COD)^2 + 3.96E{-}4 (COD) + 4.822$

The following points can be noted from the above graph.
The average error in predicting the BOD is 0.27%
The standard deviation observed is 3.99%.
The fit almost gives accurate values of BOD over entire range of COD.

Observations

From the above we can conclude that the Cubic equation has minimum SD and less error.

Cubic Equation :

$BOD = 3.376E{-} 7 (COD)^3 + 6.82E{-} 4 (COD)^2 + 3.96E {-}4 (COD) + 4.822$.

CONCLUSIONS

For correlating BOD with TOC and COD we can employ any of the above equations (wither Cubic or Quadratic or exponential).
But on comparing the erros of each equations, we can conclude that :
For BOD versus TOC, exponential equation is preferable because of lesser errors.
For BOD versus COD, cubic equation gives better estimation.