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Can BOD_5 be Estimated Without any Dilution and Manometric Methods?

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ABSTRACT

Existing Biochemical Oxygen Demand (BOD) test methods cannot provide any relationship with other water quality parameters such as ammonia-nitrogen (NH_3-N), total phosphorus (TP), pH, and chemical oxygen demand (COD). This communication presents a noble way to do this.

Key words: Ammonia-Nitrogen, Total Phosphorus, pH, Chemical Oxygen Demand.

INTRODUCTION

In water quality analysis, the biochemical oxygen demand (BOD) is one of the recommended tests for polluted river systems and wastewaters. BOD gives the qualitative and quantitative concept of the status of organic matter activity in the river system or wastewater (Brookman, 1997, Henze *et al.,* 2001, Dogan *et al*., 2009). There are a number of methods available for the determination of BOD. These include the dilution method and the manometric method. The dilution method requires the determination of the level of dissolved oxygen in the water sample while the manometric method does not. The manometric method is more suitable for carbonaceous BOD estimation. Also, the manometric method provides a continuous display of results compared to the dilution method. The standard requirement for the BOD estimation as prescribed by the Royal Commission on Sewage Disposal shows that the standard way to report is the reading of BOD on the fifth day. Therefore, the five-day biochemical oxygen demand (BOD_5) gives the most effective outcome of dissolve oxygen activity of the polluted river or wastewater under consideration. Either dilution or manometric method requires the initial estimation of the value of BOD and the fifth day value. An empirical determination based on the standard temperature of 20°C is applied to obtain the final BOD_5.

In water quality modelling, the prediction, sensitivity and scenario analysis of water quality conditions are vital for the monitoring, assessment and planning for river and wastewater systems management. Existing laboratory protocols as in the case of BOD do not provide any relationship that relates BOD to other water quality parameters

such as ammonia-nitrogen (NH_3-N), total phosphorus (TP), chemical oxygen demand (COD) and pH. Therefore in order to relate BOD to these other water quality parameters, statistical methods were used to develop useful expressions to estimate BOD_5 with the typical known values of NH_3-N, COD, TP and pH. For detailed record of the statistical procedure used, please refer to Kabo-bah (2012). This means that for a rapid test and also an indication of the relationship between BOD_5 and COD, pH, TP and NH_3-N, the following expressions can be used (equations 1-3; measurements in mg/L).

$$BOD_5 = 93.1452e{-}01 + 12.6097e{-}03 * [COD][NH_3{-}N] + 65.7477e{-}01 * TP \quad ...(1)$$

$$BOD_5 = 12.6157e00 + 14.2552e{-}03 * [COD][NH_3{-}N] + 35.0377e{-}01 * pH \quad ...(2)$$

$$BOD_5 = 12.5032e00 + 14.5457e{-}03 * [COD][NH_3{-}N] \quad ...(3)$$

They were successfully tested with polluted river and wastewater samples in parts of China. The expressions have a prediction error of 26-37%. These errors are largely due to the empirical and the statistical nature under which expressions were developed. However, examining the long delays in obtaining BOD_5 measurements, sampling errors and man-handling of water samples during collection, and the urgent need for developing relationships between BOD_5 and other water quality parameters; these expressions provide a noble way of a rapid test kit for BOD_5 modelling. In the management of activated sludge systems such as wastewater treatment plants, the calibration of these expressions could go a long way to reduce the cost involved in laboratory analysis. It is therefore the hope of this new finding that, water quality modelling, monitoring and planning would be enhanced, though it may not replace conventional methods such as dilution and manometric methods for BOD determination. Nevertheless, BOD_5 can be estimated for water samples using the expressions described here.

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