Characterisation and biological treatability of "Izmit industrial and domestic wastewater treatment plant" wastewaters

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Abstract

We investigated the conventional characterisation and biological treatability of wastewaters of the "Izmit Industrial and Domestic Wastewater Treatment Plant". Respirometric procedures were carried out for the experimental assessment of organic contents of wastewater. The mean value of total COD was 1201 mg·l^{-1} and varied within a wide range of 580 to 1822 mg·l^{-1} for the 14 different influents. The soluble COD concentrations were evaluated to vary in the range of 168 to1061 mg·l^{-1}, with a mean value of 615 mg·l^{-1}. The readily biodegradable organic substance, S_S is between 0.03 to 0.24% of the influent total COD. The BOD_5/total COD ratio in the influent was calculated as 0.20 to be a mean value. The evaluation of this result, wastewater was not suitable for biological treatment. But, the results of COD fractionation studies indicate that the organic content of wastewater is mostly biodegradable (84-92%). Therefore, conventional wastewater characterisation does not enable for a reliable design of biological treatment processes.

Keywords: Conventional characterisation, COD fractionation, biological treatability, oxygen uptake rate.

Nomenclature

COD	chemical oxygen demand (mg·l^{-1})
BOD	biological oxygen demand (mg·l^{-1})
SS	suspended solids (mg·l^{-1})
VSS	volatile suspended solids (mg·l^{-1})
TKN	total kjedhal nitrogen (mg·l^{-1})
OUR	oxygen uptake rate (mg·l^{-1})
ΔO	the difference between total respiration and respiration due to hydrolysed substrate and endogenous metabolism (mgO_2 l^{-1})
C_T	total COD of wastewater (mg·l^{-1})
C_S	total biodegradable COD of wastewater (mg·l^{-1})
S_I	soluble inert COD of wastewater (mg·l^{-1})
S_S	readily biodegradable COD of wastewater (mg·l^{-1})
S_H	rapidly hydrolysable COD of wastewater (mg·l^{-1})
S_T	total soluble COD of wastewater (mg·l^{-1})
X_I	particulate inert COD of wastewater (mg·l^{-1})
X_S	slowly biodegradable COD of wastewater (mg·l^{-1})
Y_H	heterotrophic yield coefficient [mg cell COD (mg COD)$^{-1}$]

Introduction

Characterisation of wastewater and activated sludge has been used for control and optimisation of existing processes, and development of new processes. COD as a basis for organic matter measurements has replaced BOD as the primary parameter in wastewater. The important aspect of organic matter characterisation is the fractionation due to its rate of degradation (Henze, 1992). COD may be used as a direct parameter to yield the stoichiometric equivalent of carbonaceous substrate, with the provision that its biodegradable fraction is ascertained. This fraction reflects the appropriate electron balance between substrate, biomass and the electron acceptor (Orhon et al., 1999b). COD fractionation involves identification of inert and biodegradable COD together with readily biodegradable and slowly biodegradable fractions. The inert fraction may be further subdivided into soluble inert COD (S_I) and particulate inert COD (X_I). S_I in the influent bypasses the system without affecting the biochemical reactions in the reactor, whereas the X_I is entrapped, accumulates in the activated sludge and leave the system through the sludge wastage stream (Orhon and Ubay Çokgör, 1997).

The experimental assessment of inert soluble and particulate COD of different wastewaters under aerobic and anaerobic conditions has been discussed previously in the literature (Ekama et al., 1986; Germirli et al., 1991; Orhon et al., 1994; Orhon et al., 1999; Ince et al., 1998).

In the literature, various respirometric methods have been proposed for estimating the readily and slowly biodegradable COD fractions. (Ekama et al., 1986; Henze et al., 1987; Xu and Hasselblad, 1996; Kappeler and Gujer, 1992; Mathiue and Etienne, 2000).

Spanjers et al. (1996), indicated that respirometry is a powerful alternative tool for assessing the condition of activated sludge systems because the oxygen utilisation rate can be monitored easily.

The "Izmit Industrial and Domestic Wastewater Treatment Plant" (IIDWTP) is a plant where raw domestic wastewaters and pretreated industrial wastewaters of various sectors such as tyre, drug, chemistry, yeast industries which have been discharged to collectors are treated biologically. Design of an activated sludge process has a significant importance with respect to high treatment efficiencies and constructional and operational costs of plants. The purpose of this study was to investigate the conventional characterisation and biological treatability of wastewaters of IIDWTP.

Materials and methods

The respirometric procedure for the assessment of the readily biodegradable COD consisted of running 1.5 l batch reactors. The

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