

**DOMESTIC WASTEWATER CHARACTERISTICS IN FRENCH RURAL AREAS:
CONCENTRATIONS AND RATIOS FOR TREATMENT PLANT UNDER 2000 POPULATION
EQUIVALENT (120KG OF BOD₅ A DAY).**

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Abstract

Wastewater treatment plants designed to treat pollution loads smaller than 120 Kg of BOD₅ per day (i.e. 2 000 Population Equivalent) are highly represented in France. This study defines mean concentrations, ratios and variation range of wastewater for communities under 2 000 PE in capacity. Analysed parameters are BOD₅, COD, TSS, TKN, NH₄-N, NGL and TP. Data collection contains 10 275 measurements of integrated 24-Hours water quality measurements on wastewater quality at the treatment plants entrances. Calculated average concentrations and lower values of variation range agree with literature data. Total Phosphorus is an exception, its average value is low compared to previous studies, even recent ones due to lowering use of phosphate based detergents.

Upper values of variation range are relatively high when compared to the higher values of literature data. These upper values are typical of concentrated incoming effluents observed in treatment plants connected to short and recent (infiltration and rainwater free) sewerage networks. For example the COD mean concentration is 646 mg/l, with a variation range from 122 to 1341 mg/l. Typical ratios values agree with the literature except for the COD/BOD₅ ratio showing a high average value of 2.62 which stresses that high biodegradability is not a characteristic of urban wastewater in rural areas. The upper values for typical parameters variation range obtained and the high average COD/BOD₅ values question the usual criteria used for wastewater treatment plants design and sizing, as well as concentration ranges for which plants builders usually guaranty treatment plant performances.

Key words: Domestic wastewater characteristics, concentrations, ratios, variation range, rural areas

Introduction

Wastewater treatment plants designed to treat pollution loads smaller than 120 Kg of BOD₅ per day (i.e. 2000 Population Equivalent) are highly represented in France: a total 15 550 plants of this size range was assessed in 2008 by the French Environment Ministry. Knowledge of mean concentrations, ratios and variation range of chemical parameters used to describe wastewater quality is crucial for

ensuring suited design and sizing of treatment facilities in these generally rural contexts. This study defines mean concentrations, ratios and variation range of wastewater for communities under 2 000 PE in capacity. Analysed parameters are BOD₅, COD, TSS, KN, NH₄-N, NGL and TP.

Methods

Data collected and analysed are results of integrated 24-Hours water quality measurements on wastewater quality at the treatment plants entrances. First, 10 924 incomplete were removed and 157 aberrant values were sorted out using the statistical Chauvenet criteria. Sorted out values were mostly maxima values, out of usual wastewater concentrations ranges. Median values were almost not affected by sorting and final data collection contains 10 275 measurements taken from 4 national hydrological watersheds standing for more than 60% of the French metropolitan territory.

Results and discussion

Calculated average concentrations agree with literature data (Table 1). Only the Total Phosphorus parameter is an exception: its average value is low compared to previous studies, even recent ones (Deronzier and Choubert, 2004). This is in accordance with the progressive decline in Phosphorus concentration since the 1990s linked with lowering use of phosphate based detergents.

Upper values of variation range are relatively high when compared to the higher values of literature data while remaining in the same order or magnitude. These upper values are typical of concentrated incoming effluents observed in treatment plants connected to short and recent (infiltration and rainwater free) sewerage networks. Variations range for each parameter agree with the literature for their lower values.

Table 1. Mean value and variation range for BOD₅, COD, TSS, KN, NH₄-N, NGL and TP

	BOD₅	COD	TSS	KN	NH₄-N	NGL	TP	
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
Average	265.0	645.7	288.1	67.3	54.9	72.6	9.4	
Variation range	Upper value	570.0	1341.3	696.0	123.1	98.3	122.6	18.4
	Lower value	39.0	122.0	53.0	14.1	12.0	20.2	2.0
Number of values	10 275	10 275	10 256	9 416	4 266	1 861	9 185	

Typical ratios values agree with the literature except for the COD/BOD₅ ratio showing a high average value of 2.62 (Table 2). This result stresses that high biodegradability is not a characteristic of urban wastewater in rural areas.

Table 2. Mean value and variation range for studied parameters ratios

	COD/BOD₅	KN/COD	TP/COD	TSS/COD	BOD₅/KN	BOD₅/TP	NH₄-N/KN
Average	2.62	0.12	0.02	0.46	3.88	28.53	0.74
Variation							
Upper value	3.93	0.18	0.03	0.79	6.50	47.01	0.97
Lower value	1.83	0.06	0.01	0.23	1.90	12.60	0.50
Number of values	10 275	9 416	9 184	10 256	9 416	9 184	4 244

Results were compared with existing literature. Trends related to treatment plants capacity and geographical areas (national hydrographical watersheds studied: Artois-Picardie, Adour-Garonne, Loire-Bretagne and Rhin-Meuse) are then analysed and discussed. Average concentrations are similar when analysed in 500 PE blocks. Geographically the Rhin-Meuse watershed is the only exception, distinguished by very low mean concentrations along with very high rates of hydraulic loads measured in the treatment facilities. Organic load analysis shows more than 40% of measurements relating to under loaded wastewater treatment plants. Hydraulic load analysis shows that a majority of these measurements took place in overloaded treatment facilities, especially in the Rhin-Meuse water basin.

Conclusions

The high upper values for typical parameters variations range obtained and the high average COD/ BOD₅ values have critical consequences: indeed, when inlet concentrations are strong, wastewater treatment facilities must show very high removal yields in order for the outlet effluent to comply with regulatory requirements. This study results question the usual criteria used for wastewater treatment plants design and sizing, as well as concentration ranges for which plants builders usually guaranty treatment plant performances.

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