Biodegradable organic matter in domestic wastewaters: comparison of selected fractionation techniques

S. Gillot and J.-M. Choubert

ABSTRACT

The first objective of this work was to evaluate the ability of the long-term BOD tests to provide the total biodegradable COD (BCOD) for domestic wastewaters. Results show that the method is repeatable (using two different volume samples, 97 and 164 mL) and that the fractions of BCOD determined were not statistically different from the one obtained by respirometry (at low S/X ratio). Respirometric tests were also repeatable. They were shown to be sensitive to the origin of the sludge. The results obtained are in the range of literature data. But they later indicated that long-term bioassays (>20 days) give higher biodegradable fractions than the other methods (BOD and respirometry). The second objective was to compare soluble fractions obtained with raw and pre-flocculated samples. Flocculated filtered COD is significantly lower than filtered COD, even if a pore size of 0.1 μm is used. The comparison to literature values shows that physicochemical RBCOD fractions are significantly higher than the ones obtained using bioassays. Comparison with the fractions used in calibrated models would help the choice of the more suitable method for modelling purposes.

Key words | biodegradability, domestic wastewater, RBCOD, respirometry, ultimate BOD

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INTRODUCTION

Assessing the biodegradability of the organic matter contained in wastewaters is of highly importance while designing and modelling wastewater treatment plants (WWTPs). If the chemical oxygen demand (COD) is the parameter that is traditionally used by practitioners, its fractionation into different classes of biodegradability (slowly biodegradable, rapidly biodegradable, inert soluble and particulate) is essential for modelling (Henze *et al.* 1987; Phillips *et al.* 2009), in order to predict among others the biological treatment efficiency, the oxygen demand and the sludge production.

Over the last 20 years, a number of procedures have been developed to allocate the different fractions of the organic matter contained in wastewaters. None of them has become a standard yet.

doi: 10.2166/wst.2010.341

To assess the total biodegradable COD (BCOD) fraction of a given wastewater, two types of biological assays have been proposed. They required:

- the monitoring of the oxygen consumed versus time during batch experiments, measured either by respirometry with a low Substrate to Biomass ratio (S/X) (Sperandio *et al.* 2001; Orhon & Okutman 2003; Yildiz *et al.* 2007), or by ultimate BOD tests with a high S/X ratio (Roeleveld & van Loosdrecht 2002);
- the follow-up of the COD evolution versus time (total and soluble) in continuously aerated batch reactors (Lesouef *et al.* 1992; Orhon *et al.* 1997; Stricker *et al.* 2003).

The alternative to a direct assessment of BCOD is the deduction of the particulate unbiodegradable fraction of

COD (X_U) by trial, using a simulation model to match observed and simulated values of mixed liquor volatile suspended solids (MLVSS) concentrations in a bioreactor (sludge production calibration). When data from the real plant are not accurate enough, especially concerning the sludge age, a bench-scale system (SBR reactor) can be run to evaluate this fraction (Melcer *et al.* 2003). BCOD is then deduced from this value, the influent total COD and the effluent soluble unbiodegradable COD as follows:

$$BCOD = COD_{TOT} - X_U - S_U \quad (1)$$

where S_U is the soluble unbiodegradable COD, usually considered equivalent to 90 to 100% of the soluble COD in the effluent for domestic wastewater (low loaded WWTPs).

The proposed procedures to determine BCOD highly differ in:

- the duration of the tests [few hours for respirometry, 10 days for ultimate BOD tests, 35 days for COD-monitoring in batch assays, and up to 50 days for sludge production calibration in a pilot plant (SBR)];
- the Substrate to Biomass ratio (S/X) used in the tests;
- data analysis: from simple mass balance (for practical application and design) to modelling (for scientific interpretation, identification of stoichiometric and kinetic parameters and model calibration).

Similarly, the readily biodegradable fraction of COD (RBCOD) can also be determined using different techniques:

- physicochemical methods suppose that the division between readily and slowly biodegradable COD can be based on physical characteristics: a link between the size of organic molecules and their biodegradability is thus assumed. Simple filtrations with different pore sizes have been proposed (Roeleveld & van Loosdrecht 2002), preceded or not by a flocculation step (Mamais *et al.* 1993);
- bioassay tests, based on a respirometric characterisation method where oxygen or nitrate utilisation rates (OUR and NUR, respectively) are recorded (Naidoo *et al.* 1998; Spanjers *et al.* 1998; Sperandio *et al.* 2001; Orhon & Okutman 2003).

The objective of the work presented here was to evaluate some of the techniques mentioned above, in order to answer two main questions:

- Is the ultimate BOD test able to provide the total biodegradable COD of a given wastewater (WW)? To this aim, the repeatability of the method, the WW volume required for the test, and the sensitivity of the results to the parameters used in the equations for data processing were investigated. The results obtained with this technique were compared to the ones obtained using respirometry (at low S/X ratio), both methods being applied to the same WW samples. Regarding respirometry, the repeatability and the impact of the sludge used to inoculate the bioassays were also analysed;
- Are soluble fractions of COD obtained using different physicochemical separation techniques close to each other? Filtration and flocculation and filtration methods (with two pore sizes), were compared. The aim of these measurements were mainly to verify if, as concluded by Roeleveld & van Loosdrecht (2002), the wastewater sample does not need to be pre-flocculated before filtration if a pore size of 0.1 μm is used.

The results obtained in this work were analysed mainly in view of a practical application. Therefore the operating conditions of the tests were investigated. Results–in terms of biodegradable COD fractions–are further compared to literature data.

MATERIAL AND METHODS

Wastewater and sludge samples

The tests were conducted on 11 grab samples of wastewater taken at the inlet of different municipal wastewater treatment plants mainly located in Ile de France. The total COD concentration (COD_{TOT}) of the samples obtained by standardised chemical analysis (ISO standards), are presented in Table 1, as well as the conditions of the tests performed.

Respirometric tests were carried out at low S/X ratios (< 0.2 mg COD (mg ML VSS)$^{-1}$), the wastewater being mixed with sludge samples withdrawn from the aeration tanks of the plants all operated under extended aeration.

Table 1 | Characteristics of the samples (wastewater and sludge) used for the ultimate BOD determination, the respirometric tests and the physicochemical methods

Series	Source of the WW sample	COD_{TOT} (mg/L)	Volume of WW used for the BOD tests (number of replicates)	Source of the sludge sample for respirometric tests (number of replicates)	Physicochemical methods applied (indices = pore size, μm)
1	Barbizon1	733	$V = 97$ mL (1)	Barbizon (1)	$f_{0.45}$, $f_{0.1}$, $ff_{0.45}$, $ff_{0.1}$
2	Antony2	*n.p.*	$V = 97$ mL (2) $V = 164$ mL (1)	Valenton (2)	$f_{0.45}$, $f_{0.1}$, $ff_{0.45}$, $ff_{0.1}$
3	Antony1	1,078	$V = 97$ mL (3)	Barbizon (2)	*n.p.*
4	Barbizon2	1,064	$V = 97$ mL (2) $V = 164$ mL (2)	Barbizon (1)	
5	Etrechy1	960	$V = 97$ mL (2) $V = 164$ mL (2)	Etrechy (1)	$f_{0.45}$ $ff_{0.45}$
6	Etrechy2	*n.p.*	$V = 97$ mL (2) $V = 164$ mL (1)	Etrechy (1) Barbizon (1)	$f_{0.45}$ $ff_{0.45}$
7	Boississe le Roi	619	$V = 97$ mL (2) $V = 164$ mL (2)	*n.p.*	*n.p.*
8	St Martin 1	350	$V = 97$ mL (2) $V = 164$ mL (2)	*n.p.*	*n.p.*
9	St Martin 2	380	$V = 97$ mL (2) $V = 164$ mL (2)	*n.p.*	*n.p.*
10	Milly la Forêt	801	$V = 97$ mL (3) $V = 164$ mL (3)	Milly La Forêt (1) Barbizon (1)	*n.p.*
11	Evieu	805	*n.p.*	*n.p.*	$f_{0.45}$, $f_{0.1}$, $ff_{0.45}$, $ff_{0.1}$

Note: *n.p.* = tests not performed; f = filtration; ff = flocculation prior to filtration.

Two tests were also performed using mixed liquor originated from a different wastewater treatment than the WW sample, in order to assess the impact of the sludge on the determined BCOD. This test is important to check if respirometry at low S/X ratio can be used to determine the BCOD of a specific WW in the cases no WWTP exists or operational problems are encountered in a specific plant.

Ultimate BOD-test

BOD measurements were performed using an OxiTop (WTW) pressure system (with ATU addition), applied to BOD-flasks of 0.5 L continuously mixed and maintained at 20°C. The tests were conducted during at least 8 days, with two different volumes of wastewater sample (97 and 164 mL) in order to be sure not to exceed the BOD measurable value of the apparatus. Replicate tests were performed (see Table 1). BOD_5 is the BOD measured after 5 days with this apparatus.

Following the method proposed by Roeleveld & van Loosdrecht (2002), the biodegradable COD fraction ($BCOD_{BOD}$) was determined from a long-term BOD-test where the BOD-course is measured as a function of time, as presented in Figure 1 (corresponding to one of the measurements performed for series 2, $V = 97$ mL).

The first order rate constant (k_{BOD}, d^{-1}) of the BOD data versus time is estimated from the measurements, and the ultimate BOD concentration (BOD_{tot}) is calculated as follows (Equation (2)):

$$BOD_{tot} = \frac{1}{(1 - e^{-k\,BOD \cdot t})} BOD(t) \qquad (2)$$

where $BOD(t)$ is the BOD value at t.

The biodegradable COD ($BCOD_{BOD}$) is obtained using Equation (3):

$$BCOD_{BOD} = \frac{1}{(1 - f_{BOD})} BOD_{tot} \qquad (3)$$

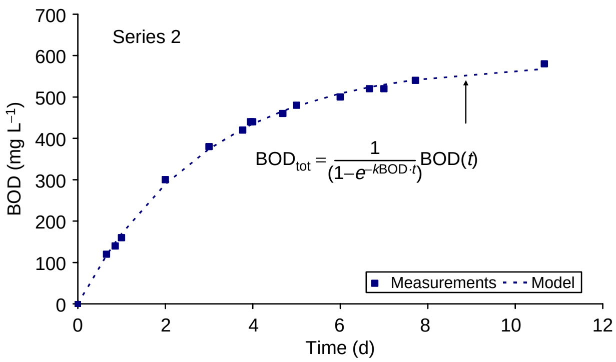

Figure 1 | Example of a BOD-course obtained for series 2 ($V = 97$ mL).

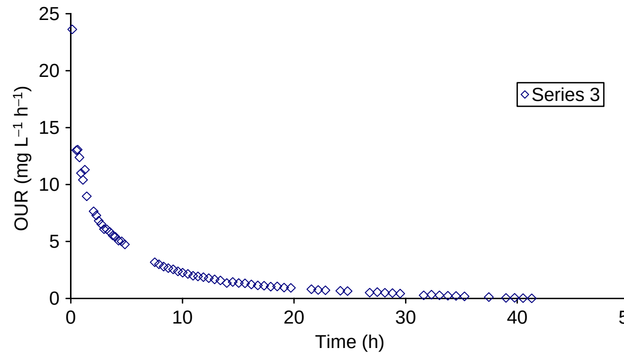

Figure 2 | Example of an OUR_{ex}-course obtained for series 3 ($S/X < 0.2$ g COD g MLVSS^{-1}).

where f_{BOD} (−) is a correction factor that accounts for the unbiodegradable endogenous residue created during the course of the experiment. The value of 0.15 proposed by Roeleveld & van Loosdrecht (2002) corresponds to the fraction of inert COD produced by biomass decay used in activated sludge models (Henze *et al.* 1987); it is constant as soon as the heterotrophic yield (Y_H) is constant (Dold 2007).

Respirometric measurements

The experimental set-up comprises a 5-L continuously mixed batch reactor maintained at 20°C, fully described in Lagarde *et al.* (2005). The aeration is intermittent to measure the oxygen uptake rate (OUR) in the reactor. The test consists in adding 2 L of wastewater to 3 L of aerated sludge (with ATU addition), so as to obtain low S/X ratios (<0.2 g COD g ML VSS^{-1}), as proposed by Sperandio *et al.* (2001). An example of the exogenous oxygen uptake rate (OUR_{ex}) obtained after deduction of the endogenous respiration rate to the total OUR is presented in Figure 2.

The biodegradable COD obtained by respirometry ($BCOD_{resp}$) is the total oxygen consumption during the test. It is determined by the area under the exogenous oxygen uptake rate curve, obtained from the OUR curve after deduction of the endogenous respiration rate:

$$BCOD_{resp} = \frac{\int OUR\,dt}{(1 - Y_H)} \frac{V_T}{V_{ww}} \quad (4)$$

where Y_H is the heterotrophic yield coefficient, assumed to be 0.67 g $COD_{biomass}$ (g $COD_{removed}$)$^{-1}$ in the experiments (municipal wastewater, aerobic conditions, Henze *et al.* 1987; Orhon *et al.* 1997; Sperandio *et al.* 1999; Cokgor *et al.* 2009); V_T and V_{WW} are the total volume of the respirometer and the volume of the wastewater sample added, respectively.

Series 2 and 3 have been duplicated to assess the repeatability of the procedure (see Table 1). The impact of the sludge origin used during the respirometric experiments was also assessed by tests performed with 2 sludge samples issued from different WWTP complemented with the same wastewater (series 2 + 3 and 7 + 8).

Physicochemical methods

COD measured after filtration (fCOD) and after filtration of pre-flocculated samples (ffCOD) were determined for a selection of the samples presented in Table 1 (series 1, 2, 5, 6 and 11). For the simple filtration, pore sizes of 0.45 and 0.1 μm were used. The flocculation step was performed on 500 mL of wastewater according to the following protocol: addition of 10 mL of $FeCl_3$ (7.5 g L^{-1}), addition of 1 mL NaOH (1 g L^{-1}) to adjust pH to 7, rapid mixing for 10 minutes followed by a settling period of 10 minutes.

RESULTS

Ultimate BOD-test: influence of selected operating conditions on $BCOD_{BOD}$

Results obtained from replicate BOD-tests (Table 1) are presented in Figure 3 for the 10 series.

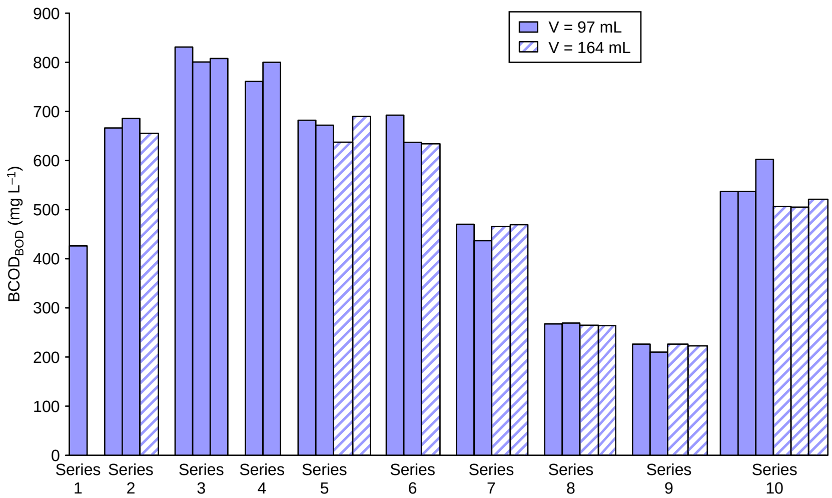

Figure 3 | Repeatability and impact of the initial sample volume on the BCOD values obtained from the BOD-tests.

Replicate measurements show that:

- the difference between BCOD values determined from duplicate tests (performed on the same WW with the same volume sample) is lower than 11%, with an average value of 4% (SD = 3%, $n = 21$). In the range of COD tested (from 350 to 1,078 mg L^{-1}) and for municipal wastewater, BOD-tests are considered as repeatable. In comparison a 20% accuracy is a common value for the measurement of BOD_5; (NF EN 1899-1 1998);
- the two sample volumes tested give average results close to each other, with a mean difference value of 3%. It can be concluded that no systematic difference has been observed between the two sample volumes.

The first order rate constant k_{BOD} determined using Equation (2) is on average 0.30 d^{-1} (SD = 0.06 d^{-1}, $n = 34$). These values are similar to the ones published by Roeleveld & van Loosdrecht (2002).

Respirometry: influence of selected operating conditions on $BCOD_{resp}$

The results of the respirometric tests performed on seven wastewater samples are summarised in Figure 4.

The repeatability of the respirometric method and the influence of the origin of the sludge (sludge impact) were assessed. The two duplicate tests give BCOD values that differ by 8% (series 2) and 10% (series 3), that represents around 50 mg COD L^{-1}. The difference is two times lower than the discrepancy observed on the data reported in the literature (Figure 6). When the sludge used in the test comes from a different WWTP than the wastewater sample, the results differ by +13% (series 6) and −15% (series 10). From these tests (limited in number), the difference between tests performed with acclimatised and unacclimatised sludge seem to be higher than the difference between duplicates, but still lower than 15%. This difference may also be due to the difficulty to assess the endogenous respiration rate when the test is completed.

BCOD values obtained from tests performed at low S/X ratios indeed depend on the level of the endogenous respiration of the sludge (OUR_{end}). In the protocol applied in this work, OUR_{end} was assessed before the addition of the wastewater sample to the sludge (Lagarde *et al.* 2005). The obtained value is deduced from the exogenous oxygen uptake rate obtained after wastewater addition, and the test is

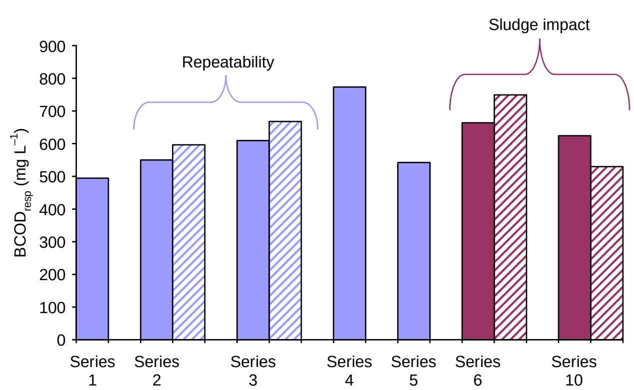

Figure 4 | Repeatability and sludge impact on the BCOD values obtained by respirometry.

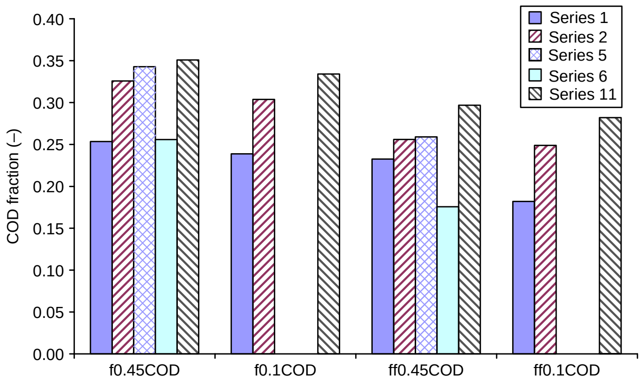

Figure 5 | Fractions of COD obtained by filtration (f) and flocculation/filtration (ff) for pore sizes of 0.1 and 0.45 μm.

completed when the OUR_{end} is recovered. However the endogenous respiration is always difficult to dissociate from the slowly biodegradable substrate removal, and represents therefore an important source of uncertainty. As an example, in series 2 an increase in OUR_{end} by 5% induces a decrease in the determined BCOD values by almost 10%.

Physicochemical methods: influence of pre-flocculation on filtrated COD

Values of COD fractions obtained after filtration of raw or pre-flocculated samples are reported in Figure 5 for the five samples analysed (see Table 1).

The flocculation step induces a significant decrease in the COD fraction passing through the filter: $ff_{0.45}$COD values are up to 16% lower than $f_{0.1}$COD values. These methods do not provide equivalent fractions contrary to the conclusion of Roeleveld & van Loosdrecht (2002). Deeper chemical analyses suggest that the compounds passing through the filter (pore size 0.1 μm) are mono and polysaccharides and amino acids, whereas these compounds are flocculated (Gorini *et al.* in press).

BCOD: comparison of ultimate BOD-test and respirometry

Table 2 recapitulates the different BCOD fractions obtained by the two methods applied. In order to determine the biodegradable part of the COD for a given sample, values obtained from the different duplicates have been averaged.

The ratio between BOD_5 and COD values obtained from the BOD-tests are comprised between 0.42 and 0.59 (average 0.47; SD = 0.07). These values are typical for municipal wastewater in Europe (Pons *et al.* 2004).

$BCOD_{BOD}$ fractions are comprised between 0.58 and 0.76, with an average value 0.69 (SD = 0.06, $n = 8$). This fraction corresponds to about 1.5 times the BOD_5

Table 2 | Biodegradability of the WW analysed by BOD-tests ($n = 8$) and by respirometry ($n = 5$)

			BOD-test		Respirometry		
Series	COD_{tot} (mg L^{-1})	BOD_5/COD_{TOT}	$BCOD_{BOD}$ (mg L^{-1})	f_{BCOD} (–)	$BCOD_{resp}$ (mg L^{-1})	f_{BCOD} (–)	Difference $BCOD_{resp}/BCOD_{BOD}$ (%)
1	733	0.42	426	0.58	494	0.67	16
2	–	–	573	–	669	–	17
3	1,078	0.59	813	0.75	639	0.59	−21
4	1,064	0.51	780	0.73	773	0.73	−1
5	960	0.46	670	0.70	542	0.56	−19
6	–	–	654	–	664	–	2
7	619	0.45	460	0.74	–	–	–
8	350	0.51	265	0.76	–	–	–
9	380	0.37	220	0.58	–	–	–
10	801	0.47	520	0.65	624	0.78	20
11	805	–	–	–	–	–	–
	Average = 0.47		Average = 0.69		Average = 0.67		
	SD = 0.07 ($n = 8$)		SD = 0.07 ($n = 8$)		SD = 0.09 ($n = 5$)		

Note: – = not determined; SD = standard deviation.

content, the ratio $BOD_5/BCOD_{BOD}$ being on average 0.66 (SD = 0.06, $n = 8$).

$BCOD_{resp}$ fractions are comprised between 0.56 and 0.78. The average value is 0.67 (SD = 0.09, $n = 5$).

DISCUSSION

BCOD: critical comparison of the evaluated techniques

Results obtained by respirometry differ from the ones obtained by long-term BOD by 1 to 21%. However, a Student-test performed on the differences between BCOD values obtained by the two methods showed that the differences between results obtained are not statistically different from 0 with a confidence level of 95%. It can be concluded that similar BCOD fractions are obtained using long-term BOD test or respirometry at low *S/X* ratio. Given the fact that BOD-tests are simpler to perform and that replicate tests are easily obtained, this method is recommended by the authors when assessing the total biodegradation COD of a specific wastewater. However, the duration of the test (minimum 8 days) could limit its application.

Flocculation/filtration versus simple filtration

Even if a small pore size is used (i.e. 0.1 μm), the filtered COD values are significantly higher than the ones obtained with a prior flocculation step. Considering an inert soluble fraction of 0.04 (fraction checked on few series–data not shown), resulting RBCOD-like fractions can therefore differ by up to 25%. Such results, even if not new, comfort the necessity to flocculate the sample for the analysis of the true soluble part of organic matter, in order to remove colloidal material susceptible to pass through the filter pores.

BCOD fractions: comparison with literature data

Data found in the literature for the total biodegradable COD fraction (f_{BCOD}) obtained for domestic wastewater (raw effluent) applying four different procedures are compared to the results of this study in Figure 6.

Values of f_{BCOD} obtained in this study are in the same range than the ones reported in literature for these techniques.

Even if simpler to carry out, the long-term BOD test seems to be less often used than respirometry to assess COD fractions. This could be explained by the fact that an

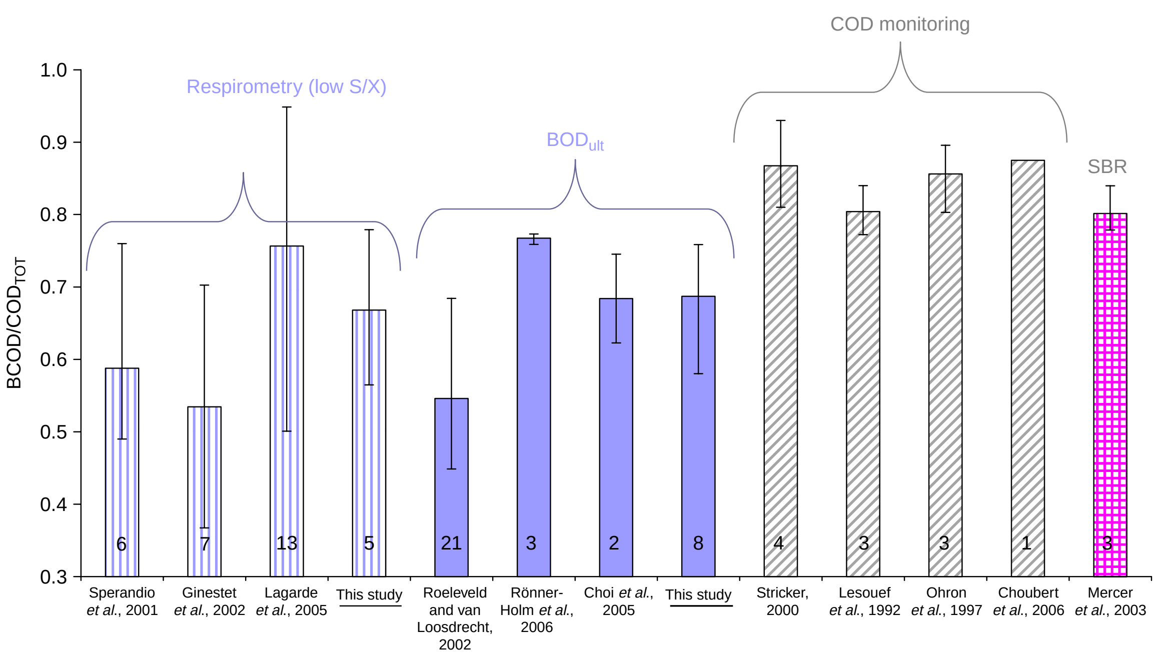

Figure 6 | Fraction of total biodegradable COD (f_{BCOD}) by different methods for raw domestic wastewaters (I = extreme values (minimum and maximum); figures correspond to the number of wastewaters analysed).

additional test is required to separate the rapidly biodegradable fraction (RBCOD) from the slowly biodegradable one, whereas respirometric measurements are theoretically able to provide all fractions within one test. In practice however, at least two experiments with different *S/X* ratios are required to assess the total, rapidly and slowly biodegradable fractions of COD in a WW sample (Sperandio *et al.* 2001). Finding *a priori* the optimal *S/X* ratio to characterize the wastewater through one test is indeed a time consuming task.

Reported fractions of BCOD obtained using short term bioassays [respirometry or ultimate BOD (BOD_{ult})] are on average lower (0.5 – 0.8) than the ones obtained through long-term tests in batch reactors (0.8 – 0.9). Values determined by Roeleveld & van Loosdrecht (2002) and Ginestet *et al.* (2002) are significantly low. This may be due to several sources: sewer characteristics, industrial contributions, nature (grab or composite) and conservation of the samples.

Part of the observed discrepancy within one series of data could certainly be attributed to the fact that the results reflect the biodegradability of different wastewaters, as the tests have been performed on samples from different WWTPs. However the difference due to the procedures and to their measurement conditions (*S/X* ratio, parameter recorded, duration, composite or grab samples) seem also to have an impact on the results, and long-term bioassays (COD monitoring, SBR) give higher fractions of BCOD.

As far as modelling is concerned, assessing the correct value of the unbiodegradable fraction of COD (X_U) is a pre-requisite task when starting calibrating a model. According to Melcer *et al.* (2003), the importance of this value fully justifies its determination (from specific measurements in a bench scale SBR if the data collected on the plant are not good enough). The procedure proposed by Roeleveld & van Loosdrecht (2002) is probably less accurate, as X_U is calculated from other measured fractions of COD and therefore integrates all other uncertainties. Nevertheless, the SBR method also shows limitations: as wastewater is stored at 4°C for a long period, the biodegradable fraction can be degraded during storage.

RBCOD fractions: comparison with literature data

Figure 7 shows values of the readily biodegradable COD (RBCOD) fractions reported in the literature (values from

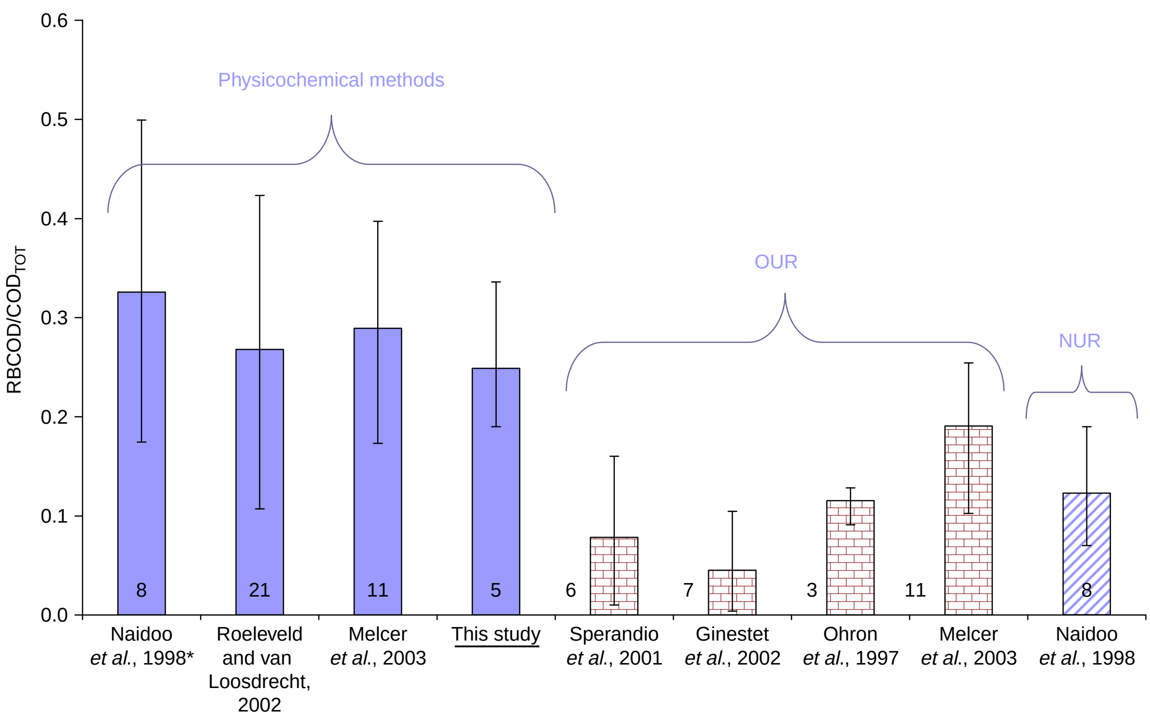

Figure 7 | Fraction of readily biodegradable COD (RBCOD) by different methods for raw domestic wastewaters (I = extreme values (minimum and maximum); figures correspond to the number of wastewaters analysed). *S_U not deduced—see text.

Naidoo *et al.* (1998) correspond to the ratio $COD_{ff0.45}$/ COD_{TOT} as no S_U values were reported for the data set). Values deduced from the methods employed in this study (from $COD_{ff,0.45}$ and assuming a S_U fraction of 0.04) are also reported in this graph; they are in accordance with literature data.

Such as for BCOD, RBCOD values seem to depend on the method employed. RBCOD fractions obtained by physicochemical techniques (0.25–0.29 excluding Naidoo *et al.* 1998, see above) are significantly higher than the ones deduced from OUR and NUR bioassays (0.05–0.19). This difference was also observed by Melcer *et al.* (2003) on the basis of tests carried out on the same wastewater samples. Because they require less sophisticated apparatus and skills and less time, physicochemical methods represent however attractive alternatives to biological tests.

Choice of wastewater characterisation techniques

When comparing different wastewaters in terms of biodegradable fractions, literature data and results obtained in this study suggest using a standardised protocol and above all the same methods. Simplest ones to carry out (in terms of required experimental set-up and time) may be suggested: the association of the ultimate BOD test for BCOD with flocculation and filtration method for RBCOD. This approach is closed to the one proposed by STOWA (Roeleveld & van Loosdtrecht 2002).

However in particular cases, for example when a significant industrial input exists, those methods are not adapted to allocate RBCOD to different species. Respirometric measurements will be required (see for example Coen *et al.* 1996 or Yildiz *et al.* 2007).

In terms of modelling, due to the difficulty to accurately measure COD fractions, in practice, measured fractions of influent characteristics are often considered as initial values, susceptible to be modified to fit simulation results to experimentally observed data during the calibration step of a plant model. Comparison of the results presented here with the fractions used in calibrated models would help the choice of the more suitable method for modelling purposes.

CONCLUSION

The main objective of this work was to confront characterisation results obtained with different methods to determine wastewater biodegradable fractions of COD. Specific measurements performed on 11 grab samples of domestic wastewater show that

- respirometry at low S/X ratios (<0.2 mg COD mg $MLVSS^{-1}$) provides total biodegradable fractions of COD that are not statistically different from the ones deduced from ultimate BOD tests;
- Operating conditions of the two tests were investigated: for municipal wastewater, BOD-tests are shown highly repeatable and no systematic difference has been observed between the two sample volumes used in the automatic BOD analyser (97 and 164 mL). Results of respirometric tests are less repeatable than the ones of BOD-test and are impacted by the origin of the mixed liquor sample.
- COD fractions measured after flocculation and filtration are 16% lower than values determined after a simple filtration, even if small pore sizes (i.e. 0.1 μm) are used.

While comparing different wastewaters, using systematically the same methods is required. Long-term BOD analysis complemented with COD measurements after flocculation is certainly the simplest protocol to carry out. Moreover replicate tests can easily be obtained. However the duration of the test (minimum 8 days for the BOD analysis) may represent a limiting factor.

Obtained results in terms of biodegradable fractions are similar to literature data. Moreover, comparison of published results has confirmed differences that may partly be attributed to the methods employed:

- fractions of BCOD obtained using short term bioassays are on average significantly lower than the ones obtained through long-term tests in batch reactors.
- RBCOD fractions obtained by physicochemical techniques are significantly higher than the ones deduced from biological short term tests.

Impact in terms of modelling may however be limited due to the fact that these fractions are often used as calibration parameters. The comparison with modelling results would therefore be of interest to further state on the different BCOD values obtained with other methods (long-term batch tests or SBR bench scale tests in particular).

ACKNOWLEDGEMENTS

The authors would like to thank people who have been involved in the 'MAITRISE-MO' project (funded by Cemagref), and in particular Fabrice Béline for the exchange on the experimental work and on the results. The authors thank the Cemagref technical staff for their assistance in data collection and chemical analysis.

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