Characterising different sources of grey water for reuse in hotel facilities

Natasa Atanasova[*,1], Gianluigi Buttiglieri[**], Joaquim Comas[*,**], Manel Poch[*], Ignasi R. Roda[*,**]

* LEQUiA, Institute of the Environment, University of Girona, E-17071 Girona, Spain
** ICRA, Catalan Institute for Water Research, Parc Científic Tecnològic de la UdG. 17003 Girona, Spain
[1] corresponding author: Natasa Atanasova; natasa.atanasova@udg.edu

Abstract
Grey water (all domestic water flows except from toilets) is an important alternative water source, particularly in dry Mediterranean areas. Characterisation of grey water is important step towards proper selection and design of treatment technology prior to its reuse. In this paper we present an experiment for characterisation of synthetic grey water based on real water sampling at hotel facility. Two types of GW, showers and laundry, were characterised for modelling purposes. Results present some differences to what is typically reported in literature showing higher fraction of easily biodegradable matter for GW, which only includes water from showers and hand washing basins.

Keywords
grey water, grey water characterisation, membrane bioreactor, water reuse

INTRODUCTION

Separating and reusing grey water (water from showers, hand washing basins, laundry and kitchen) not only represents additional water source, but also a way towards sustainable urban water systems. There are several obstacles toward more extensive implementation of GW systems, most important being: gaps in current legislation regarding GW, existing infrastructure, and variable nature of the composition of the GW causing difficulties in selection of appropriate treatment technologies and reuse systems. Literature reports values of COD between 13-550 mg/l, BOD5 90-360 mg/l total nitrogen 0.6-74 mg/L and total phosphorous 4-14 mg/l (Erikson et al, 2002). These differences come from different types of GW and different use of detergents, soaps and other personal care products. In this paper we focus on characterising biodegradability of GW from hotel facilities for modelling purposes. Biodegradability was evaluated in a pilot membrane bioreactor (MBR) for both (1) synthetic GW at lab-scale and (2) real GW at the hotel premises.

MATERIALS AND METHODS

Hotel Samba (Lloret de Mar, Spain) is a large 3 star resort with 441 air conditioned rooms, green areas and exterior pools, conference rooms, bar and restaurant. To reduce water consumption, grey water is separated and reused for toilet flushing. Two sampling campaigns of GW have been performed in the high season and in the low season. Based on the results from the sampling campaigns synthetic GW recipes were used to feed a pilot MBR during three months and observe the biodegradation capacity. Measurements of COD, BOD, TSS, N and P species were taken at the input, output and in the reactor. The reactor was operated with parameters shown in Fig 1. COD fractions were determined based on the measurements at the inflow (_inf) and outflow (_eff) as follows:

- Inert soluble COD (S_I) = *0.9*COD_eff;*
- Readily biodegradable COD (S_S) = *BOD5_inf –S_I- BOD5_eff*
- Slowly biodegradable (X_S) = BOD_{20} - *S_S*;
- Inert particulate matter (X_I) = *COD_inf –S_I – X_S- S_S*

Input flow	37.5 L/d
Purge flow	0 L/d
Airflow	2.16 m^3/h
Cycles	10 minutes permeate (20L/h); 1 minute relaxation
Flux	20 LMH
Net flux	17.1 LMH
HRT	4.16 d

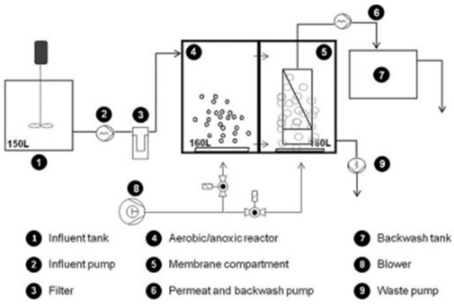

Figure 1: Scheme and operational parameters of the lab-scale MBR (150 L) for synthetic GW

RESULTS

Using the methodology described above we obtained COD fractions of the GW as presented in Table 1. There is a difference between rapidly biodegradable part for the GW from showers and hand washing basins and the GW from laundry, the latter being lower by 19%. Compared to literature, both types of GW, but particularly the GW from the showers have bigger fraction of easily biodegradable COD. Results are being used for model-based optimization of the MBR at the hotel.

Table 1: Characterisation of synthetic GW and comparison to literature values

	SAMBA hotel-shower	SAMBA hotel-laundry	Grey (Hocaoglu et al., 2010)	Domestic (Tas et al., 2009)	Black (Hocaoglu et al., 2010)
Total COD, CT, mg/ L	179.5	168.3	275	450	1145
Biodegradable COD, CS/CT , %	95	94	93.5	77.3	95.1
Readily biodegradable COD, S_S/CT, %	51	32	29.3	22.2	14.7
Slowly biodegradable COD, X_S/CT, %	44	62	64.2	29.3	50.7
Soluble inert COD, S_I/CT , %	4	8.3	5	7.1	3.7
Particulate inert COD, X_I/CT , %	1	1	1.5	15.6	1.1

CONCLUSION

GW systems offer a good opportunity for alternative water sources, however designing such systems still includes many uncertainties, such as the variable nature of the GW composition. Experiments were performed for synthetic and real GW from hotel facilities by using an MBR pilot at lab scale for synthetic GW and at the hotel, for real GW. Results show different biodegradability from what is typically found in literature, due to separation of GW from showers and laundry. Results are being used to feed a model for optimization of the operation of the MBR at the hotel.

REFERENCES

Eriksson, E., Auffarth, K., Henze, M. and Ledin, A. (2002). Characteristics of grey wastewater. *Urban Water*, **4(1)**, 85.

Hocaoglu S.M., G. Insel, E. Ubay Cokgor, A. Baban, D. Orhon. (2010) COD fractionation and biodegradation kinetics of segregated domestic wastewater: black and grey water fractions, J. Chem. Technol. Biotechnol. 85, 1241–1249.

Tas D.O., Karahan O., Insel G., Ovez S., Orhon D and Spanjers H. (2009) Biodegradability and denitrification potential of settleable chemical oxygen demand in domestic wastewater. Water Environ Res 81:715–727.