Household Raw Wastewater Characterisation: quality, quantity and load of 15 facilities

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Context

On-site sanitation facilities must be adapted to the pollution emitted by households of diverse occupancy rates. A study has been undertaken to understand the composition of raw wastewater at the household level.

The aim of this project is to study variations of daily flows, concentrations and daily loads in order to optimise design guidelines of on-site wastewater treatment devices.

Material and methods

The pollution emitted by a household is difficult to measure because of legal (access to a private property) and technical limitations (heterogeneity of the influent). However, influents from 15 households were monitored for several years (302 24h-samples).

- 2 sampling methods: i) automatic flow composite samples from a pumping station and ii) storage of raw wastewater (Figure 1) and homogenization before sampling (Figure 2). See Table 1, sampling method (ii) is underlined.
- 6 physicochemical parameters analysed : TSS, COD, BOD_5, NH_4^+-N, TKN and TP. BOD_5 is the only parameter presented here.

Table 1. Description of households

Household	Adult + Child	Number of sample
F1	1 + 0	34
F2	2 + 0	10
F3	2 + 0	17
F4	2 + 0	18
F5	2 + 0	14
F6	2 + 1	26
F7	2 + 1	14
F8	2 + 2	8
F9	2 + 2	35
F10	2 + 3	25
F11	2 + 4	30
F12	2 + 4	29
F13	3 + 1	21
F14	3 + 1	7
F15	3 + 2	14
Total		**302**

Figure 1. Daily storage

Figure 2. Homogenization and sampling

Daily flow and concentration per household

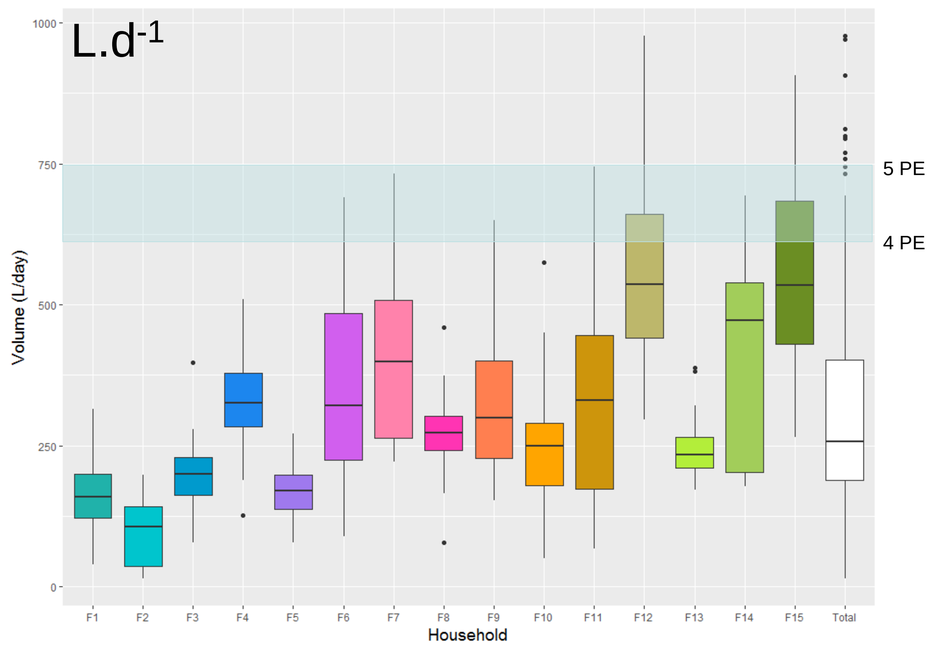

Figure 3. Daily flow per household

Table 2. Daily flow and BOD_5 concentration

Raw wastewater	Flow ($L.d^{-1}$)	BOD_5 ($mg.L^{-1}$)
Mean	311	514
Median	**257**	**412**
Minimum	14	37
Maximum	977	3380
RSD*	59%	75%
Nb of data	291	226

*Relative Standard Deviation

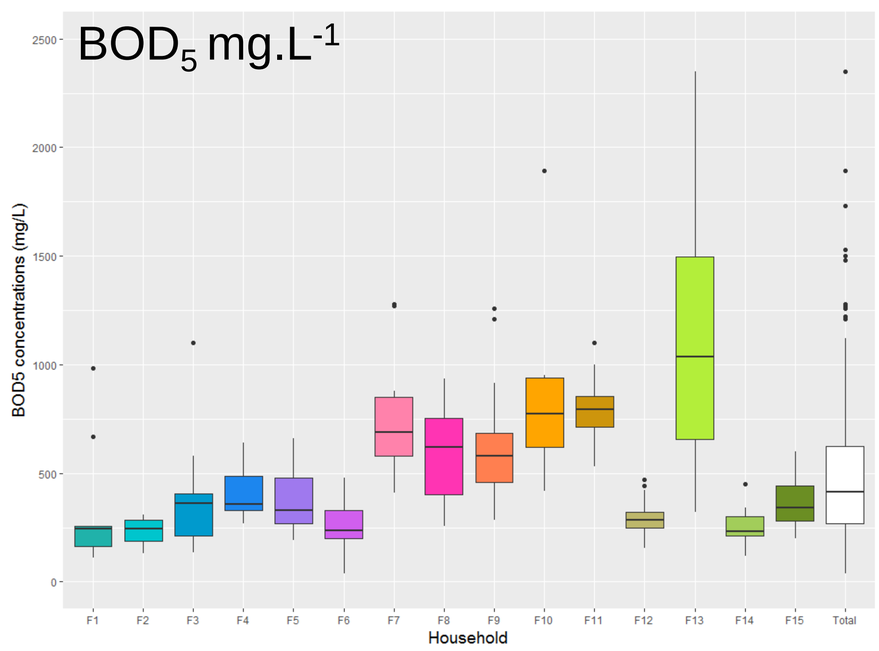

Figure 4. BOD5 concentration per household

- Median daily flow per household: 106 (F2) to 536 $L.d^{-1}$ (F12)
- Range of variation per household (RSD) : 23% (F13) to 69% (F2)

The median daily flow of the total dataset is 260 $L.d^{-1}$ which is well below design guidelines used : 600-700 $L.d^{-1}$ for a household of 4 – 5 people (highlighted in Figure 3).

- Median BOD_5 concentration per household: 230 (F14) to 1035 $mg.L^{-1}$ (F13)
- Range of variation per household (RSD) : 22% (F11) to 87% (F1)

RSD per household for concentration and volume are similar.

BOD_5 Organic load per household

- Median daily load per household: 24 (F2) to 280 $g.d^{-1}$ (F7)
- Range of variation per household (RSD) : 32% (F15) to 127% (F1)

The median daily load of the total dataset is 140 $g.d^{-1}$ which is below design guidelines used : 240 – 300 $gBOD_5.d^{-1}$ for a household of 4 - 5 PE (highlighted in Figure 5).

The on-site treatment systems must be designed to account for the highly varying loading observed.

Table 3. BOD_5 daily loads

Raw wastewater	BOD_5 ($g.d^{-1}$)
Mean	155
Median	**140**
Minimum	3
Maximum	938
RSD*	79%
Nb of data	223

*Relative Standard Deviation

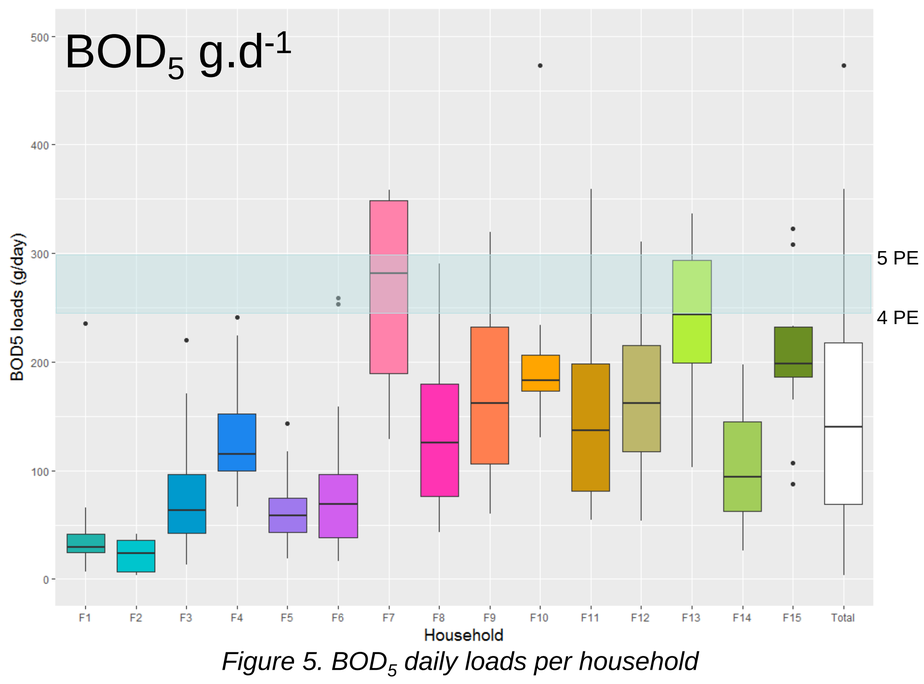

Figure 5. BOD_5 daily loads per household

Conclusions and perspectives

This observation of very large variations in flow, concentration and also, in organic load at the household scale confirms the validity of the question concerning the most adapted design basis for onsite wastewater treatment systems.

Hydraulic and organic loads are not directly related to the household occupancy rate. A complementary analysis of the loads expressed in $g.capita^{-1}.day^{-1}$ shall be conducted and compared to international standards (PE).

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