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To cite this version:
C. Gonzalez-Merchan, S. Barraud, S. Le Coustumer, T.D. Fletcher. Monitoring of clogging evolution in the infiltration system. Novatech 2010 - 7ème Conférence internationale sur les techniques et stratégies durables pour la gestion des eaux urbaines par temps de pluie / 7th International Conference on sustainable techniques and strategies for urban water management, Jun 2010, Lyon, France. pp.1-10. hal-03296715

HAL Id: hal-03296715
https://hal.science/hal-03296715
Submitted on 22 Jul 2021

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Monitoring of clogging evolution in the infiltration system

Suivi de l’évolution de colmatage dans les ouvrages d'infiltration

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RÉSUMÉ

L'infiltration est aujourd'hui largement utilisée dans la gestion des eaux pluviales en milieu urbain. Malgré ses avantages, son efficacité sur le long terme pose encore question. Parmi ces questions figure celle du colmatage. Pour traiter ce problème, des observations de terrain ont été menées de manière à évaluer l'évolution du colmatage au cours du temps à l'aide de mesures de la résistance hydraulique. L'observation a été menée sur un bassin d'infiltration suivi en continu sur 6 ans environ de janvier 2004 à octobre 2009. Après une rénovation (le fond du bassin a été curé), la résistance hydraulique a décru substantiellement (de 24 h à 6 h) et est progressivement remontée (10 h) jusqu'à ce que le bassin soit envahi de végétation spontanée. Dès lors la résistance hydraulique est restée approximativement constante, ce qui montre le potentiel important de la végétalisation des ouvrages. Si les valeurs moyennes annuelles sont restées à un niveau constant, les variabilités événementielles sont importantes (CV de 26 % à 48 %) sans que l'on puisse les expliquer statistiquement par des facteurs suivis en continu comme les volumes d'eau, les charges en MES ou en DCO, le nombre ou la durée de périodes pluvieuses antécédentes, l’énergie solaire reçue ou la température de l’air. Si la corrélation sur les variables normalisées par unité de temps donne de bien meilleurs résultats, elles n'expliquent cependant pas la totalité des variations.

MOTS CLÉS

Colmatage, Eaux pluviales, Infiltration

ABSTRACT

Infiltration is nowadays widely used to manage stormwater in cities and their suburbs. Despite their advantages questions remain about the long-term performance of these systems. One of them is their potential for clogging. To address this problem, a field study was undertaken to assess the evolution of clogging over time by means of hydraulic resistance measurements. The experiment was carried out on an infiltration basin continuously monitored during about 6 years from January 2004 to October 2009. After a renovation (the basin was scrapped and sediment removed) the hydraulic resistance decreased substantially (from 24 h to 6 h) and progressively increased again (up to 10h) until the growth of spontaneous vegetation. Until that time, clogging did not increase any longer illustrating the fact that vegetation is an interesting factor to reduce clogging evolution. If annual mean values remained constant, the variation from one event to another presented high variability (CV from 26% to 48%). However, this variability is not adequately explained by factors such as amount of water, amount of TSS, COD, number or duration of rain periods prior to the evaluation of a hydraulic resistance value, solar energy or air temperature. The correlation between the variation of the hydraulic resistance per time unit and the same factors also per time unit gives much better results but is not sufficient to explain the whole variation.

KEYWORDS

Clogging, Stormwater, Infiltration
INTRODUCTION

Infiltration is nowadays widely used to manage stormwater in cities and their suburbs. This practice is an interesting option that tends to reduce water volumes and runoff peak flows in downstream networks or water courses, contributes to groundwater recharge and limits pollution discharges to surface waters.

However, questions remain about the long-term performance of these systems. One of them is their potential for clogging. Field studies such as Schuh (1990), Lindsey et al. (1992), Waarmars et al. (1999), Gautier et al. (1999), or Le Coustumer & Barraud (2007) have shown that clogging of stormwater infiltration systems was an issue of primary importance that may lead to more frequent pondings or overflows, reduced treatment capacity when equipped with bypass devices, and aesthetic problems.

If clogging is attested and the overall phenomena well known (combination of mechanical, biological and chemical processes), the evolution over time and the dominant factors of its development have still to be studied especially on real infiltration systems. For that purpose, long time series and observations of clogging and variables supposed to play a major role are necessary.

The aim of the paper is to present the results obtained in this context. The research is based on the monitoring of an infiltration basin (Django Reinhardt - France) from the 1st January 2004 to 22nd October 2009. The main objective is to study both the evolution of a clogging indicator (estimated by the hydraulic resistance) and the relationship between this evolution and factors supposed to play a role in the variation of clogging (i.e. the water volume, the amount of sediment brought to the system, estimated by TSS load, organic composition of inflow estimated by COD load brought to the system, and climatic factors estimated in a first approach by air temperature and solar energy).

1 EXPERIMENTAL SITE, METHOD AND MONITORING SYSTEM

1.1 Description of the site

The Django Reinhardt detention-infiltration basin is one of the OTHU monitored sites (OTHU being a Field Observatory on Urban Hydrology, www.othu.org). It is located in Chassieu (69) in the Eastern suburbs of Lyon, France.

The catchment of the system is an industrial area (185 ha) densely urbanized (about 75 % of imperviousness) with a flat topography (mean slope of about 0.004). It is drained by a stormwater separate system. However intermittently, the pipe network collects “clean” water (or supposed to be clean) coming from cooling of industrial processes.

The detention-infiltration system which extends over 2 ha is composed of two compartments (Figure 1 and 2) i) a detention / settling basin and ii) an infiltration basin, of about 1 ha each. The volumes of the two compartments are respectively 32 000 m$^3$ and 61 000 m$^3$. The stormwater flows successively through: i) the detention and settling basin, ii) a flow control device, iii) a 60 cm circular connection pipe and iv) the infiltration basin. The detention and settling basin is also equipped with an overflow structure in case of exceptional storm events.

The infiltration occurs through quaternary fluvial and glacial deposits. The aquifer has a mean hydraulic conductivity of 7 to 9 × 10$^{-7}$ m/s (Burgéap, 1995). The soil beneath the infiltration basin is composed mainly of coarse material: 30 % of pebbles (diameter d > 20 mm), 45 % of gravels (20 mm > d > 2 mm), 20 % of coarse sand (2 mm > d > 0.2 mm) and 5 % of fine sand (0.20 mm > d > 0.08 mm). Samples taken every meter had shown that there is a good homogeneity of the soil at the metric scale as deep as 26 m. The groundwater level is 13 m below the bottom of the infiltration basin (Barraud et al., 2002). The bottom of the basin was designed to be bare.

The basin has been functioning for more than thirty years. It has been rehabilitated in 2002 and totally scraped in April 2004 (sediments and the topsoil completely removed). From the end of 2006 to the beginning of 2007, the bare bottom of the basin has been progressively overgrown with spontaneous vegetation.
1.2 Method

Estimation of clogging evolution

One method to assess clogging of an infiltration basin is to evaluate the global hydraulic resistance $R$ which proved to be valuable as reported in (Gautier et al., 1999). The hydraulic resistance is identified in the Bouver’s model as the time the water takes for a unit infiltration amount to move through the clogging layer at unit head loss (Bouwer, 1969). In this model, Bouwer states that:

- if the clogged layer has a very small hydraulic conductivity compared to the underlying soil, the underlying soil stays unsaturated throughout infiltration. This is only possible if the underlying soil is not extremely dry and if the groundwater level is deep enough to avoid contact between the basin bed and the capillary fringe which is the case for the experimental site Django Reinhardt during rain periods. In such a case, flow in the underlying soil is assumed to be due to gravity alone and the hydraulic gradient is equal to one.

- Because the unsaturated flow beneath the infiltration basin is assumed to be only due to gravity, the water pressure head is uniform between the clogged layer and the capillary fringe. In unsaturated porous media, the hydraulic conductivity and the pressure head are related by a sigmoid-shaped function and for uniform granular material, the relation is a step function with a center water pressure head $h_{cr}$.

Therefore the Darcy’s law can be applied as follows:

$$\nu = K_c \frac{h + e - h_{cr}}{e} = K_c \frac{h - h_{cr}}{e} = \frac{h - h_{cr}}{R}$$

where $\nu$ is the infiltration rate (m/s), $e$ the thickness of the clogged layer (m), $h_{cr}$ the water pressure head (m), $h$ the water depth in the basin (m), $K_c$ the hydraulic conductivity of the clogged layer (m/s) and $R$ the hydraulic resistance (in s) representing the thickness divided by the hydraulic conductivity of the clogged layer.
The $R$ parameter can be calibrated for each rain event. For that purpose, infiltration flow rate has to be evaluated. It can be determined from the measurements of the volume stored in the basin, the inflow rate and the continuity equation:

$$\frac{dV(t)}{dt} = Q_e(t) - Q_{inf}(t)$$

where $t$ is the time, $V(t)$ is the volume stored in the basin determined with water depth measurements, $Q_e(t)$ the inflow rate in the basin, and $Q_{inf}(t)$ the infiltration flow.

Water depth and inflow in the Django Reinhardt basin are measured continuously as indicated further in the presentation of the monitoring system. The volume can be evaluated by a storage equation $V=f(h)$ established with a topographic survey.

The hydraulic resistance is then calibrated by minimizing the sum of the square differences between measured infiltration flow rates and the Bouwer infiltration flow:

$$C = \sum_{i=1}^{n} (Q_{inf,i} - Q_{Bouwer,i})^2 = \sum_{i=1}^{n} Q_{inf,i}^2 + \frac{S_i(h_i - h_{cr})}{R}\left(1 - \frac{h_i - h_{cr}}{R}\right)$$

with $n$ the number of time steps for a event, $R$ the parameter to be calibrated, $Q_{inf}$ the infiltration flow measured, $S_i$ the infiltration surface, $h_i$ the water depth in the basin and $h_{cr}$ the water pressure head in the unsaturated porous medium which was taken equal to -10 cm according to previous calibrations (Le Coustumer, 2008)

In order to compare the resistances between one event to another, each calibrated single-storm value of $R$ is corrected according to water temperature and normalized to 20°C. The uncertainty of each $R$ value is then calculated using the Monte Carlo Method described in Le Coustumer (2008).

So the procedure needs i) to monitor continuously the water temperature, the flow and the water depth and ii) have a digital terrain model to estimate the storage equation $V=f(h)$ and the relationship Infiltration surface vs. water depth.

**Evaluation of the different parameters supposed to play a role in clogging evolution**

The parameters supposed to play a role in the variation of clogging were: the water quantity (water volume), sediment brought to the system estimated by TSS load, organic composition estimated by COD load brought to the system, and climatic factors estimated in a first approach by air temperature and solar energy.

The volume is assessed by the continuous measurement of water inflow.

The mass of TSS and COD is derived from the measurement of turbidity. A relationship between TSS or COD concentrations and turbidity has been built using the Williamson method (Bertrand-Krajewski, 2004). This method takes into account uncertainties of turbidity measurement and TSS or COD concentration. Based on this relationship and on continuous measurement of turbidity, TSS mass for each rain event and for each dry weather period can be computed. Uncertainties on mass and volume are calculated for each event using the uncertainty propagation formula as applied in (Le Coustumer, 2008). At this stage, the procedure needs to identify dry and rain periods all along the times series. The division into dry and rain periods has been carried out by using rainfall series, variation of flow and specific conductance at the entry point of the infiltration system. Even though rigorous data verification methodology was applied to validate the flow and turbidity series, in some periods data have not been reported because of monitoring equipment failure and maintenance. In that case, we developed a methodology to fill the gaps in the series using both expert rules and modeling.

Air temperature and solar energy came from the local meteorological data base with a one hour time step. Two types of correlation were then tried on the period from the 1st April 2004 to 2nd February 2009.
The first correlation analysis (Correlation A) was conducted between the hydraulic resistance (coming from the calibration of a R-value) and the following variables:

- AVOL (m$^3$): total volume of water brought to the infiltration basin from the renovation in 2004 (basin scrapped) until the calibration of a R-value;
- # Rain (-): total number of rain events observed from the renovation in 2004 until the calibration of a R-value
  - Rain-P (s): total of rain periods from the renovation in 2004 until the calibration of a R-value,
- ATSS (kg): accumulated mass of sediments brought to the system from the renovation in 2004 until the calibration of a R-value.
- ACOD (kg): accumulated mass of COD brought to the system from the renovation in 2004 until the calibration of a R-value.
- SOL-EN (J/cm$^2$): solar energy from the renovation in 2004 until the calibration of a R-value

As the R-value calibrations are not regularly evaluated over time, a second correlation analysis (Correlation B) was carried between the ratio $\Delta R/\Delta t$ (variation of R between two calibrations by time unit) and the following variables:

- $\Delta$VOL/$\Delta t$: variation of the water volume brought to the basin between two calibrations of R values by time unit;
- $\Delta$T-P/$\Delta t$: total rain duration between two calibrations of R values by time unit;
- $\Delta$ # Rain/$\Delta t$: rainfall number between two calibrations of R values by time unit;
- $\Delta$TSS/$\Delta t$: mass of sediments brought to the system between two calibrations of R values by time unit;
- $\Delta$COD-Kg/$\Delta t$: mass of COD brought to the system between two calibrations of R values by time unit;
- $\Delta$T°C/$\Delta t$: difference between the peak and the minimum of air temperature between two calibrations of R values by time unit;
- $\Delta$Sol-En/$\Delta t$: total solar energy between two calibrations of R values by time unit.

1.3 Monitoring system

The monitoring system is the following one.

- For the characterization of inflows, water flow rate, specific conductance, turbidity and water temperature are continuously measured with a two minute time step. The flow metering and the turbidity measurements are doubled in order i) to reduce the probability of simultaneous failures, ii) to achieve a better assessment of uncertainties and iii) to achieve a better reliability of data through a rigorous data validation methodology. The scheme the monitoring system installed at the inlet of the basin is presented in Figure 4.

- For the characterization of the hydraulic behavior of the infiltration basin, the continuous measurement of 4 water depths at 4 different points of the basin is carried out with a two minute time step too (Figure 5). The curves determining the infiltration surface vs. water depth and the water volume stored in the system vs. water depth are assessed by using a digital terrain model.

More detailed information on the characteristics of the monitoring system can be found in Barraud et al. (2002) and Bertrand-Krajewski et al. (2008).
2 RESULTS AND DISCUSSION

2.1 Evolution of clogging over time

The results are summarized in table 1, the evolution of the hydraulic resistance $R$ is plotted in Figure 6. The boxplots in Figure 7 show the annual variation of $R$.

<table>
<thead>
<tr>
<th></th>
<th>2004 (before scraped)</th>
<th>2004-2005 (after scraped)</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009*</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$ (-)</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>4</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>$R_{\text{min}}$ (h)</td>
<td>15 - 29</td>
<td>5 - 6</td>
<td>6 - 15</td>
<td>5 - 9</td>
<td>6 - 16</td>
<td>7 - 12</td>
</tr>
<tr>
<td>$R_{\text{max}}$ (h)</td>
<td>23.4</td>
<td>5.7</td>
<td>9.7</td>
<td>9</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>$R$ (h)</td>
<td>26</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>$R_{50}$ (h)</td>
<td>26</td>
<td>26</td>
<td>41</td>
<td>25</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>$u(R)$ (%)</td>
<td>35</td>
<td>26</td>
<td>41</td>
<td>25</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>$\text{CV}%$</td>
<td>26</td>
<td>6.5</td>
<td>26</td>
<td>31</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>$V$ (m$^3$)</td>
<td>118 821 ± 29 919</td>
<td>670 371 ± 51 139</td>
<td>511 315 ± 33 105</td>
<td>554 756 ± 4 145</td>
<td>509 806 ± 18 615</td>
<td>518 134 ± 10 057</td>
</tr>
<tr>
<td>Mass TSS (kg)</td>
<td>9 201 ± 2 263</td>
<td>43 942 ± 7 405</td>
<td>14 263 ± 763</td>
<td>23 229 ± 1 786</td>
<td>31 069 ± 4 933</td>
<td>35 487 ± 2 265</td>
</tr>
<tr>
<td>Mass COD (Kg)</td>
<td>4511 ± 2 073</td>
<td>38 235 ± 5 552</td>
<td>23 806 ± 1 368</td>
<td>32 130 ± 1 601</td>
<td>52 046 ± 7 534</td>
<td>55 378 ± 3 793</td>
</tr>
</tbody>
</table>

* From January 2009 to October 2009

Tableau 1. Number ($n$) of hydraulic resistances calibrated in the year, Minimum value ($R_{\text{min}}$), maximum value ($R_{\text{max}}$), Mean value ($\overline{R}$) and median hydraulic resistance ($R_{50}$), relative uncertainties ($u(R)$), Coefficient of variation of the annual hydraulic resistance ($\text{CV}$), annual water volume ($V$), Annual TSS mass and Annual COD mass brought to the system.
Figure 6. Temporal evolution of hydraulic resistance.
The dashed line on the left delimits 2 periods (before and after the renovation of the basin).
The area in grey indicates the beginning of the development of spontaneous vegetation. Since that period the basin was overgrown with vegetation.

After renovation, the hydraulic resistance of the basin has decreased substantially from a mean value of 23.4 h (CV of 26% - n=5) down to a mean value of 5.7h (CV= 6.5% - n=3)

In 2005, only one R was calibrated and was of the same order of magnitude as in 2004 after the renovation of the basin.

If we compare the hydraulic resistance before renovation and the values obtained in 2004 after renovation together with 2005, there is a significant statistical difference (p-value = 0.003).

In 2006, the hydraulic resistance increases from 5.7 h in 2004/2005 (CV=6.5% - n=3) up to 9.7 h (CV = 26% - n=9) with a significant statistical difference (p-value= 0.0025).

From 2006 to 2009, the hydraulic resistance did not change a lot in terms of mean annual value. All the values compared to one another in this period are not statistically different (p-value>0.05). However the variation of R within a year can be important (CV ranging from 25 to 37%).
Between January 2007 and July 2008 five R were calibrated (19 months). In this period the mean hydraulic resistance is 6.4h (CV = 24%-n = 5). This mean value has a significant statistical difference with previous mean hydraulic resistance (p-value<0.05). As we already noticed from the end of 2006 to the beginning of 2007, the vegetation has developed (figure 8) and can explain that the overall hydraulic resistance remains approximately constant despite an important increase of water volume in 2007 and 2008. As reported in the literature (e.g. Citeau, 2006; Le Coustumer 2008), laboratory experiments have shown that some types of vegetation can reduce clogging phenomena and restore initial hydraulic performance thanks to the characteristics of the roots.

![Figure 8. Picture of the basin before and after the development of the vegetation](image)

We can also notice the significant amount of sediment brought to the system over the period (6 years) which is approximately equal to 150 t ± 19 t representing a thickness of the clogging layer of about 9 mm (i.e. about 1.5 mm/year) even if the spatial distribution of the thickness is not homogeneous over the basin. Le Coustumer (2008) identified similar values for the 3.5 first years.

The amount of COD load is quite significant too (i.e. ≈201 t ± 20 t over the 6 years).

### 2.2 Influence of the different parameters

The results of the first correlation analysis (Correlation A related to the evolution of R) are given in Table 2 and of the second correlation analysis (Correlation B related to the evolution of ΔR per time unit) is shown in table 3.

<table>
<thead>
<tr>
<th>Variables</th>
<th>AVOL (m³)</th>
<th>ATSS (kg)</th>
<th>ACOD (kg)</th>
<th>Rain-P (s)</th>
<th># Rain (-)</th>
<th>SOL-EN (J/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R(h)</td>
<td>0.32</td>
<td>0.29</td>
<td>0.29</td>
<td>0.32</td>
<td>0.29</td>
<td>0.33</td>
</tr>
<tr>
<td>AVOL (m³)</td>
<td>1.00</td>
<td>0.99</td>
<td>0.98</td>
<td>1.00</td>
<td>0.97</td>
<td>1.00</td>
</tr>
<tr>
<td>ATSS (Kg)</td>
<td>1.00</td>
<td>1.00</td>
<td>0.99</td>
<td>0.97</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>ACOD (Kg)</td>
<td></td>
<td>1.00</td>
<td>0.99</td>
<td>0.98</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>Rain-P (s)</td>
<td></td>
<td>1.00</td>
<td>0.98</td>
<td>0.98</td>
<td>0.97</td>
<td>0.99</td>
</tr>
<tr>
<td># Rain (-)</td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.98</td>
<td>0.97</td>
<td>0.95</td>
</tr>
<tr>
<td>SOL-EN (J/cm²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

| R² | 0.11 | 0.15 | 0.15 | 0.12 | 0.15 | 0.09 |

| R² | 0.17 |

*Values in bold indicate that the correlation coefficient is statistically different from 0 with a significance level alpha=0.05*

Table 2. Correlation matrix and determination coefficient between R and the other variables (Correlation A)

The results show that no correlation can be found neither with the total amount of water, nor with the accumulated sediment brought to the system, nor with the organic amount, nor with the rhythm of the rainfalls nor with the solar energy.
### Table 3. Correlation matrix and determination coefficient between $\Delta R/\Delta t$ and the other variables (Correlation B)

<table>
<thead>
<tr>
<th>Variables</th>
<th>$\Delta R/\Delta t$</th>
<th>$\Delta V/\Delta t$</th>
<th>$\Delta TSS/\Delta t$</th>
<th>$\Delta COD/\Delta t$</th>
<th>$\Delta T-P/\Delta t$</th>
<th>$\Delta # Rain/\Delta t$</th>
<th>$\Delta T°C/\Delta t$</th>
<th>$\Delta S E n/\Delta t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta R/\Delta t$</td>
<td>1</td>
<td>0.671</td>
<td>-0.069</td>
<td>0.329</td>
<td>0.641</td>
<td>0.487</td>
<td>0.138</td>
<td>-0.134</td>
</tr>
<tr>
<td>$\Delta V/\Delta t$</td>
<td>1</td>
<td>0.259</td>
<td>0.447</td>
<td>0.914</td>
<td>0.758</td>
<td>0.441</td>
<td>0.041</td>
<td>-0.165</td>
</tr>
<tr>
<td>$\Delta TSS/\Delta t$</td>
<td>1</td>
<td>0.483</td>
<td>-0.051</td>
<td>0.242</td>
<td>0.443</td>
<td>0.443</td>
<td>0.005</td>
<td>-0.350</td>
</tr>
<tr>
<td>$\Delta COD/\Delta t$</td>
<td>1</td>
<td>0.347</td>
<td>0.370</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
<td>0.11</td>
<td>-0.288</td>
</tr>
<tr>
<td>$\Delta T-P/\Delta t$</td>
<td>1</td>
<td>0.773</td>
<td>0.409</td>
<td>0.443</td>
<td>0.443</td>
<td>0.443</td>
<td>0.024</td>
<td>-0.065</td>
</tr>
<tr>
<td>$\Delta # Rain/\Delta t$</td>
<td>1</td>
<td>0.681</td>
<td>0.512</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
<td>-0.382</td>
</tr>
<tr>
<td>$\Delta T°C/\Delta t$</td>
<td>1</td>
<td>0.773</td>
<td>0.409</td>
<td>0.443</td>
<td>0.443</td>
<td>0.443</td>
<td>0.443</td>
<td>0.382</td>
</tr>
<tr>
<td>$\Delta S E n/\Delta t$</td>
<td>1</td>
<td>0.681</td>
<td>0.512</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
<td>0.723</td>
</tr>
</tbody>
</table>

$R^2$ indicates that 68% of the hydraulic resistance variability is explained by the variables studied. This correlation (correlation B) is more satisfactory than the previous one. One can notice that the best explanatory variables are related to the amount of water per time unit ($R^2=0.45$), the duration of rain periods per time unit ($R^2=0.41$) and the number of rain periods per unit time ($R^2=0.24$). Even if this correlation is much better than the previous one, the variables used do not completely explain the variation of the clogging evolution. Other factors were explored like the seasons but unsuccessfully because the characteristics of the seasons observed on the whole period were not very representative of typical seasons.

### 3 CONCLUSIONS

This study shows the evolution of an infiltration system through the evolution of hydraulic resistance calibrated with the Bouwer’s model. Between April 2004 (after renovation) and the end of 2006 the infiltration basin shows a significant evolution, but since 2007 it seems that clogging does not increase any longer. The development of vegetation being the most important event in the life of the basin, it suggests that vegetation growth could be the reason why clogging remains approximately constant.

If annual mean values remains constant from one year to another, the variation from one event to another presents high variability (CV from 26% to 48%) which is not adequately explained by factors such as amount of water, amount of TSS, COD, number or duration of rain periods prior to the evaluation of a hydraulic resistance value. The correlation between the variation of the hydraulic resistance per time unit and the above factors also per time unit gives better results but is not sufficient to explain the whole variation.

### ACKNOWLEDGEMENTS

The authors thank the Rhône Alpes Région for the PhD scholarship, OTHU (Field Observatory in Urban Hydrology) for scientific support, the Greater Lyon Community, ANR (ECOPLUIES) and DRAST project for financing this research.
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