THE EARLY STAGES IN THE CSO CHARACTERISATION IN THE CITY OF SANTIAGO DE COMPOSTELA (SPAIN).

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ABSTRACT

Santiago de Compostela is a cosmopolitan European city whose population has burgeoned, especially during the last decade, ever since it became the seat of the Authonomic Government. For these reasons, in addition to its being one of the rainiest cities in Europe, the existing drainage system has become insufficient, and as a result, the main receiving system, the river Sar, is completely degraded and has turned into one of the most polluted in Galicia.
A control section has been set up at the outfall of the catchment studied, where suspended solids (SS) are being recorded with a floatable, mobile on-line monitoring device, due the high velocity of flow. A storm water sampler has been connected to the flow meter in order to define the pollutant loads that are carried by water during storm events. The aim of this research is to establish design criteria for storage and treatment facilities in order to minimise the frecuency of CSO events as well as to reduce pollutant concentrations.
The purpose of this essay is to estimate the SS loads in the wastewater during both dry weather and storm events. The results of early actividies are presented in adition to several correlations in the wastewater characterisation studies. Lastly, problems that arosed during the installation of the on-line monitoring system are discussed.

KEYWORDS

Urban drainage; suspended solids; dry weather, storm events; CSO characterisation, on-line monitoring.

INTRODUCTION

The aim of this paper is to present part of the global Project for Santiago de Compostela´s drainage system, based on high environmental criteria and hydrocomputerized tools in order to reduce the environmental impact of the drainage system on the receiving one. The current system consists of the urban sewer network, the two main sewers Sar and Sarela that lead to the wastewater treatment plant in Silvouta, and the rivers Sar and Sarela (tributary of the Sar) as the water receiving system. The urban catchment studied "El Ensanche" is shown in Figure 1.

In order to meet European quality objectives, we have drawn up a methodology based on continuous hydrological and quality modeling, to provide a hydrodynamic description of flows and pollutants in the system and lastly to offer the necessary procedures that will guarantee the above-mentioned quality standards.

The wastewater characterisation during both dry weather and storm events is the first activity to be carried out for the analysis of the pollutant flux during storm events. The objective is to acquire knowledge about the solid loads that are being routed as well as their composition (dissolved solids: fixed and volatile; suspended solids: fixed and volatile, settleable solids, etc.). We also aim to define the particle sizes and densities of the

routed solids especially during storm events in order to analyse the sedimentation process that will take place in the different stormwater impoundments possible for the control and treatment of CSO's.

Figure 1. The catchment "El Ensanche"

The purpose of this paper is to present the early stages in the stormwater characterisation of the subcatchment known as "El Ensanche" (Figure1) during both dry weather and storm events as well as the most relevant outcomes of this process.

THE PROBLEMS WITH SANTIAGO DE COMPOSTELA´S DRAINAGE SYSTEM

Santiago de Compostela is the capital of the Autonomous Community of Galicia. It has a population of about 100.000 which is still growing. As we mentioned above, the city lies between the rivers Sar and Sarela, the latter is an affluent of the former. The sewer network is totally combined except for the subcatchment of "Fontiñas" which has a separate system.
One of the problems of the existing drainage system is the frequent combined sewer overflows to the rivers Sar and Sarela due to heavy rainfall (1.500 mm/year), which means very high rates of pollutant discharges to the receiving system. The result is the degradation of the environment of the river Sar.

METHODOLOGY

Morphology of the catchment studied

The catchment studied, "El Ensanche", has a combined sewer system and serves nearly forty thousand people. The area covered is about forty five hectares, 100% developed and mainly used for residential purposes. The constructed area accounts for 68% of the total surface and the 32% remaining corresponds to streets and parking lots, so it is possible to assume that imperviousness is nearly 100%.

Installation of the control section

In order to analyse the behaviour of the pilot catchment, a control section that registers flow and pollutant measurements has been installed. The final goal is to record the hydrographs and pollutographs of the combined sewer system at the outfall of the catchment during storm events.

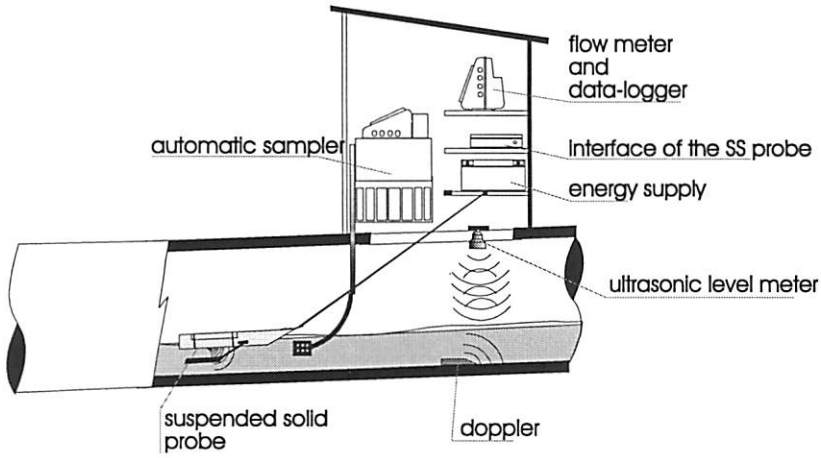

Figure 2. Sketch of the instrumentation at the control section.

The instrumentation at the control section can be seen in Figure 2. An automatic sampling device with special stormwater programming (variable intervals provide a good representation of the early stages of a storm, ex. 30 min.) has been set up and connected to a flow meter (cross section-velocity). The flow meter is programmed to send an alert signal to the automatic sampler when the flow reaches a predetermined level.

Suspended solids are recorded with a floatable, mobile on-line monitoring device. The purpose of this mobile device is to eliminate turbulence that could interfere with the recorded values because of the high

velocity of the flow (3-5 m/sec). A light-scattered probe with a 90° scattered angle that utilises the double-beam pulsed-infrared light method is used to emit an analogical signal which is proportional to the suspended solid concentration.

Wastewater characterisation campaignes

Two diferent types of wastewater characterisation campaignes have been developed: (1) dry-weather campaigns and (2) wet-weather (storm events) campaigns. The information obtained should be used to calibrate the suspended solid probe as well as to analyse the possibility of installing a conductivity probe, whose measurements may be compared with those of the SS probe.

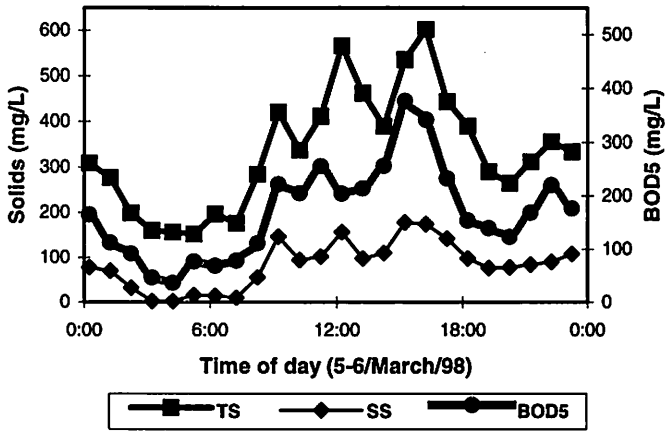

Figure 3. Daily variations of solids and BOD5.

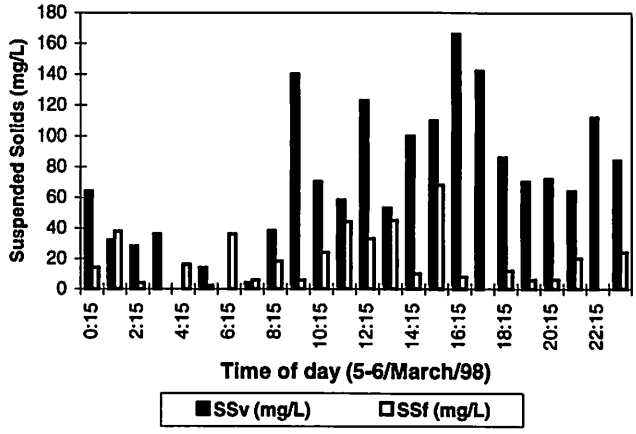

Figure 4. Daily variations of SSv and SSf

The laboratory analisys carried out on watewaters in dry conditions show good correlations between DS-conductivity, TS-turbidity and non settleable solids-turbidity. Low values registered for some probes obtained during the night are noteworthy: SS are under 10 mg/l. This phenomenon can be explained by the high rates of infiltration into the network.

Registers of the probe have been correlated with measurements of measured solids and it has been observed that the probe did not have the sensitivity needed to register changes in concentration. There is a clear trend which is consistent with the variation in concentration, however a great dispersion has been observed. Besides the problems associated with the sensitivity of the probe itself, whose range is 0-2500 mg/l, the interference produced by air bubbles may disturb the measurements. The bouyant sistem used will be improved when installing a pump and a tank to measure wastewater properties.

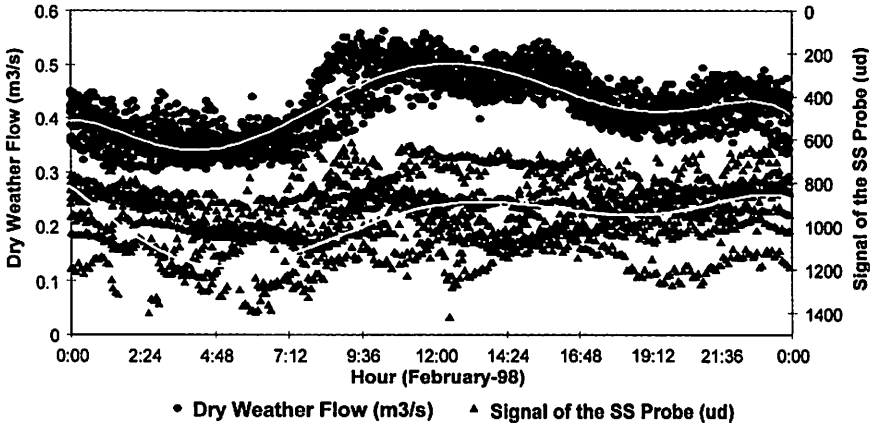

Figure 5. Daily variation of recorded flow and SS probe signal.

Several storm events have been characterised. The results of one of these events is shown in Figure 5. During the first storm event (3.6 mm/h), solid removal was very important (preceding dry weather:two weeks and a half); the 2nd storm event caused a dilution in the wastewater, while the third storm event (7.2 mm/h) caused another major washoff in the city. Figure 7 shows that during storm events, SS rates are higher than SD rates. During the second washoff, this phenomenon is repeated even more noticeably.

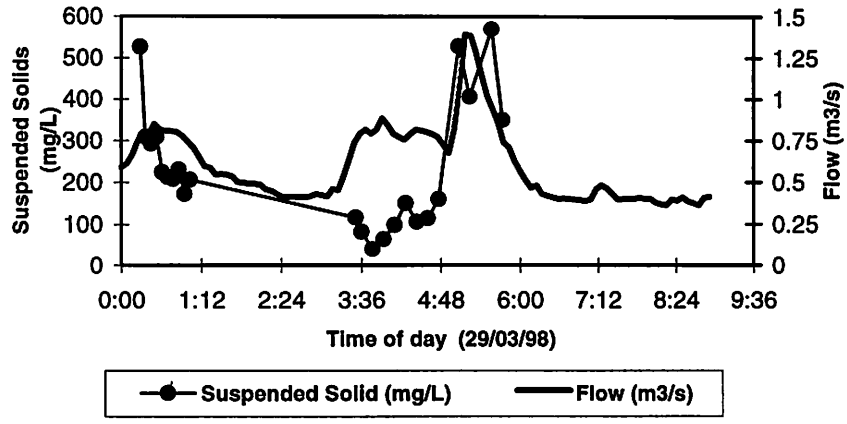

Figure 6. Recorded CSO event.

There was a poor correlation between laboratory measurements of SS concentrations and the corresponding signals of the SS probe, probably due to the air-bubbles of turbulence at the control section.The correlations found between DS-conductivity, TS-turbidity and non settleable solids-turbidity in the laboratory analysis of wastewaters during dry weather, will permit the simplfication of the characterisation of CSO.

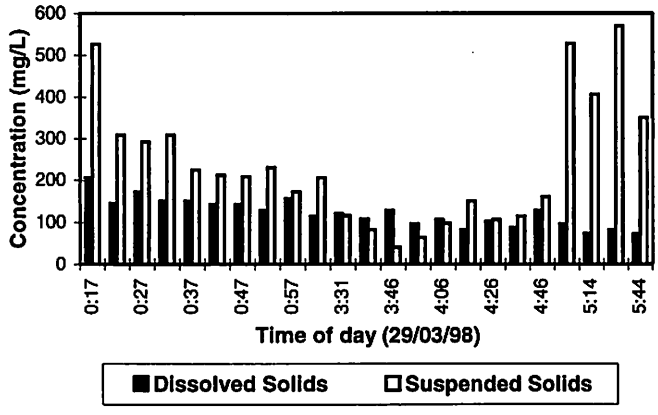

Figure 7. DS-SS rates during the CSO event

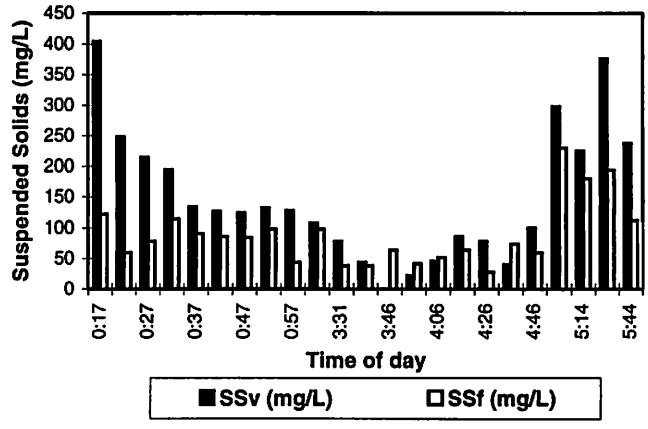

Figure 8. SSv - SSf rates during the CSO event

CONCLUSIONS

The main conclusions of this study are:

- During storm events, a clear variation between SS and DS rates can be observed. SS rates increase when the rainfall intensity has the capacity to wash off the dust and dirt from the catchment surface.
- The on-line monitoring system of SS, a double-beam pulsed-infrared light probe, did not show the required quality in the reported information. A possible factor that may explain this lack of correlation between the probe signals and the corresponding laboratory measurements of SS concentrations, are the air-bubbles in the hydraulic turbulence. This is why the correlation found during dry weather is higher and a clear trend can be observed.
- As a result of the above, it would seem more appropriate to install a by-pass system, external to the conduit's flow, for recording of SS measurements. Other probes as well (DO, Cond., T) will also be installed in this external device due to the high wastewater velocities at the control section.

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