Novatech 2004: Synthesis of 3 years of scientific and technical advances in urban water management

Novatech 2004 : Synthèse de trois années de progrès scientifiques et techniques dans la gestion urbaine des eaux pluviales

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In few years, water has become one of the main stakes of the XXIst century and its protection and management sustainability are now central in the political debates. Over the year 2003, international year of water, many events had been celebrated and many statements were made on the subject. Classical techniques, developed since the XIXth century are now questioned and the research of new solutions, that would better respect environment and better preserve water resources are now an international major concern.

This statement is in particular true for urban water management which status is changing in industrial countries as well as in developing countries. For years, this problem had been considered as a simple civil engineering technique that only consisted in building some pipes. It is now becoming one of the most important points of urban planning and water bodies management.

Organised in Lyon every three years since 1992, Novatech conferences have pointed out this evolution and might have contributed to its development. This event gathers international experts as well as a lot of operational actors of the field. Coming from very various parts of the world, they can exchange on the difficulties they meet but also on the solutions implemented.

Once more, this new edition of Novatech has given the opportunity to make the state of the art of the main breakthroughs relative to sustainable techniques and strategies in urban water management.

Among the about 200 papers presented in the proceedings, many relevant ideas come out and is the frame of this synthesis:

- the need of a global approach of urban problems combined with water management (water supply, management of waste water, stormwater and “natural” water bodies) and the need to take into account stormwater management in the very early stages in urban planning and development;

- the maturity of new techniques for stormwater or combined sewer pollution treatment and for economical source control solutions;
- a substantial effort to obtain and organise objective data on stormwater quality and on devices efficiency.

1 THE NEED OF A GLOBAL APPROACH OF URBAN PROBLEMS COMBINED WITH WATER MANAGEMENT

Many papers often presented by developer contractors and landscape architects (Varcin Calix A. & Maytraud T. ; Abran T. *et al.;* Valkman R. & Lems P. ; Esser D. *et al.;* Piel C. & Maytraud T.), dealt with interesting experiences on global strategies of stormwater management linked with urban planning and design. The main objective was to integrate flood control, water quality, human activities and habitat enhancement. A special concern for an integration in their environment of the large stormwater detention basins, built in the 70's is also being developed. (Tassin B. *et al*.).

Through the different applications, watershed scale efficiency for a global approach for the protection of streams is highlighted (Urbonas B.R. & Doerfer J.T., Vlier J.).

Many works have pointed out the importance of combined sewer overflows on the degradation of streams physico-chemical and ecological quality.

Some of those works dealt with the comprehension of the phenomena and on the development of models that simulate a certain number of them (Battaglia Ph. *et al*., Bedjou A. & Cherrared M., Calomino F. *et al*., Kominkova D. *et al*.). The paper of Kominkova D. *et al*. illustrates the advances realised in the relation implemented between CSO and streams ecological quality.

Another lesson is that the combination of models (sewer networks – treatment plant – river) is increasingly used. Thanks to this combination, overflows impacts can be simulated and this tool starts to be used for decision-making support in the optimisation of drainage systems (Benedetti L. *et al*., Hoppe H. *et al*., Lawrence A. I. *et al*., Mannina G. *et al.*). This integrated approach is nowadays one of the guideline of regulation and for example in Europe, for the implementation of the Water Framework Directive (Achleitner S. *et al*.). During the discussion, it appeared that a good integrated model does not necessarily emerge from the combination of excellent specific models. Specific approaches, taking into account the complexity of the interactions are necessary.

The combination of models is an interesting solution in hydraulic studies because it is a way to represent the complexity of phenomena implying urban floods (Chen S.H. *et al*.).

Some authors questioned the positive role that drainage systems could have to drain surfaces when there is an urban flood. Rivard G. *et al*. and Karpf C. & Krebs P. presented communications demonstrating that sewer network could contribute to lower groundwater table or to facilitate water draining off in case of stream flood.

The lack of watertightness of sewer networks can then play a positive role!

A particular aspect that has been also debated is the choice between the different drainage strategies. The article of Brombach H. *et al*. re-opens the debate on the choice between combined and separate sewer systems. Authors ran a long-term simulation on a synthetic urban watershed where one or the other sewer system was supposed to be implemented and compared the resulting effluents. Biting debates, following the presentation, seem to conclude on a consensus: a combined system, with as little as possible stormwater connections, could be the best solution.

In a field closed to the previous one, Richard Ashley highlighted the fact that an environmental approach of drainage that would stop taking into account the sanitary issues, would be a risk for the countries considered as developed or industrialised.

Many papers dealt with stormwater management in developing countries. Most authors defended the necessity of a global and systematic approach of wastewater, stormwater and drinking water supply management, developing several key ideas, which are also widely accepted:

- Sanitary issues are a priority,
- Citizens involvement is one of the key of the success,
- Monitoring tools such as observatories (Wondimu A.) and adapted planning and design tools such as manuals are necessary (Silveira A.L.L. & Goldenfum J.A.).

Beyond these general ideas that seem to be well conceptualised now, the article of Alderlieste M.C. & Langeveld J.G. presents a particularly innovative solution, well adapted to local characteristics.

Concerning drainage management, more specifically, we note a real evolution of stormwater source control techniques, but also of wastewater that demonstrates that there is maturity in the techniques and among the professionals of this field:

- Many papers dealt with water management of large individual connections. The research of solutions is also driven, whatever the continent, in a sustainable management approach, as shown in the examples of Auckland in New Zealand (McQuillan M. & Menzies M.), of Córdoba in Argentina (Bertoni J. C. *et al*.) and in France (Vuathier J. *et al*.);
- Solutions are also analysed with wastewater at-source control during wet weather (Rossi L. *et al.*);
- Finally, on regulation aspects, we can see that this maturity starts to be effective, with the national recommendations for source control management (in Belgium, Vaes G. *et al.* or in France).

Sormwater harvesting and re-use is a promising solution in many arid or developing countries. In particular, an increasing interest can be noted for roof-top rainwater harvesting associated with the possibilities of simple physico-chimical in situ treatments to produce drinkable water in developing countries. This is illustrated by the presentation of two case studies driven in India (Sharma S. K.) and in Congo (Lumbwe Gwaadigo B. & Ndembo Longo J.).

Stormwater re-use seems to be more difficult in Europe, in particular because of regulation obstacles. Nevertheless, researches are driven to better evaluate systems performances. Bernard De Gouvello presented a synthesis of the lessons from 2 years of experimentation on several buildings in France.

During Novatech 2004, more technological themes were also addressed. There were for example many papers on sewer systems real time control management, which is the sign of a renewed interest for this kind of solution.

Two reasons seem to justify this renewed interest:

- On one side, RTC objectives are diversifying and integrate more and more oftenthe protection of receiving waters during wet weather;
- On the other side, tools performances have increased and make now possible a more reliable management of the whole chain.

New results have been obtained concerning the joint use of radar and rain gauges networks to analyse a priori and a posteriori depths of rainfall. (Faure D. *et al.*; Einfalt T. *et al.*).

Nevertheless, many local authorities only develop partial applications of real time control systems. Global real time control management is mainly being analysed in terms of potentiality. The main difficulty remains to connect the different elements of the chain and to make it reliable. This question is developed in the article of Masahiro M. *et al*.

As a conclusion of this paragraph, it is interesting to note that many actors start to feel concerned by the evaluation of isolated devices performance, but also by the global efficiency of the system at a territory scale. This is particularly clear in the works driven in the framework of the European research programme, Daywater (Förster M. *et al*).

In the same way, it can be noted that decision-making support systems are being developed in various directions:

- They progressively integrate the system complexity, including its economical dimensions;
- They are central in administrators preoccupations and are more and more operational (Baptista M. *et al.*; Artina S. *et al.*);

They try to take into account the whole life cycle of devices and to position decision makers in a context of sustainable development (Dechesne M. *et al*).

Support to decision making is very important in terms of rehabilitation of sewer networks. This question is the subject of a French national research programme (programme RERAU, see Le Gauffre P. *et al*) and of a European one (programme CARE-S, see Matos M. R. *et al*, Sægrov S. & Schilling W.). Communications on that subject dealt in particular with sewer inspections optimisation (Le Le Gauffe P. *et al*, Bertin F. & Maglionico M.) and with the finalisation of indicators and the development of computer tools for support to decision-making (Matos M. R. *et al*, Sægrov S. & Schilling W.).

2 MATURITY ACHIEVEMENT FOR MANY TECHNIQUES

Many new results on different techniques, not always new but analysed differently or updated, were presented during the 3-days conference. In this synthesis, results are grouped following 6 technical fields:

- Stormwater infiltration techniques,
- Porous pavements and reservoir structures,
- CSOs,
- Stormwater treatment facilities,
- Networks maintenance techniques,
- Inlet facilities.

2.1 Stormwater infiltration

Stormwater infiltration techniques are being quickly developed all over the world. This development drives many researchers to feel concerned by the risks of soils and groundwater tables contamination. Logically, many papers dealt with micro-pollutants mobility and in particular, with toxic metals mobility.

Researches on this aspect are used to be made in laboratories (columns, batch) or with numerical modelling. One of the main advances of the conferences was the presentation of several experiences realised in-situ. From this point of view, the special session dedicated to the OTHU project (Field Observatory for Urban Water Management) was particularly important.

The article of Barraud S. *et al*. presents statistical analysis on persistent soil pollution under stormwater infiltration basins. It suggests then the possibility to set up long-term mass balances This possibility is reinforced by the advances made in modelling science, advances illustrated by the article of Zimmermann J. *et a.l* that simulates the transfer of pollutants on a long-term period (50 years) under infiltration devices.

Concerning the future of the pollutants, many analyses dealt with metals mobility between different phases (Béchet B. *et al*., Durand C. *et al*.).

Concerning phenomenological aspects, the most relevant result is the improvement of knowledge on the role of biological parameters (microorganisms and macro-fauna) in pollutants transfer (Bedell J. P. *et al*.). This role has been pointed out in the unsatured zone (Muris M. *et al*.), as well as in the satured zone (Mermillod-Blondin F. *et al*..

Concerning devices conception, the article of Lassabatère L. *et al.* explains the role of geotextiles in the pollutants trapping in infiltration basins.

2.2 Porous pavements and reservoir structures

Advances on the comprehension of porous pavements and reservoir structures are always improving. It is now possible to make recommendations to improve pollutants trapping and in particular oil degrading (Fach S. & Geiger W.F., Newman A. P. *et al*.).

Another innovating idea presented at Novatech concerns the use of recycled materials to built pavements. Finally, reservoir structures application fields become more important, for example in sub-tropical areas (Acioli L. A. *et al*.) and in their combination with permeable surfaces (Newton D. B. *et al*.).

2.3 Pollution control at CSO's

CSO's design is changing and facilities are more and more considered as real treatment devices.

During the conference, many papers dealt with facilities designing with the objective to optimise pollutants trapping in CSO's or in joined devices: baffle plates, vortex-solids separator, clarification tank or screen for visible pollutants trapping (as for example: Cigana J.F. & Couture M.; Luyckx G. *et al.*).

2.4 Stormwater treatment devices

Many communications were dealing with the use of passive biological treatment devices (reed bed filters, wetlands, vegetalisation strips) for stormwater treatment.

The main two results are:

- The confirmation of the prominent role of physical phenomena (settling) and the positive role of vegetation to facilitate settling;
- And questions still not resolved on chemical phenomena contribution (metals absoption); all the authors agree to consider that researches on the field have to continue (Barrett M. *et al*., Esser D. *et al*.).

On the opposite, few papers dealt with the improvement of devices strictly using physical or physico-chemical techniques and it seems that researches in the field are at the moment not very active. Nevertheless, the works of Wood J. *et al*. confirmed

that the combination between lamellar settling and flocculants increases settling capacity.

Many works presented complementary data on the pollution removal efficiency of settling devices (Kraeutler L. & Despreaux M., Milano V. *et al.,* Neary V. S. *et al*.).

Thanks to data mutualisation in strong and consistent computer databases (Strecker E. *et al*.; Tassin B. *et al*.) objective information is now available to make relevant statistics on devices efficiency.

2.5 Sewer solids management

Many communications were dealing with technical advances on sewer solids management. In particular:

- The paper of Bertrand-Krajewski J.-L. *et al.* deals with the study and modelling of an hydrass flushing gate. This work aims to the comprehension of the hydraulic operation of the system and confirms its efficiency for sewer solids management.
- The article of Sakrabani R. *et al*. that proposes an innovative methodology to take into account sewer solids biodegradability in CSO's management.

Finally, it seems that sediments transport and settling could play a positive role too. Therefore, the paper of Blackwood D. J. *et al*. highlights the interaction between sedimentation in sewer sections and exfiltration rates, because of to the quick clogging of cracks due to the deposit of suspended particles.

2.6 Inlets grates and urban flooding

A complete session was dedicated to the role of inlet grates. It shows the increasing awareness relative to the fact that some urban floods are due to the inlets grates inefficiency in absorbing flows (Despotovic J. *et al*.).

As a result, the consequences stated by researchers are double:

- On one side, it is necessary to improve inlet disposals; two papers proposed innovative technical solutions (Despotovic J. *et al.;* Gómez M. & Mur M.J.)
- On the other side, it is possible to use inlets to optimise the distribution of waters between minor network (underground sewer network) and the major network (road surface network) (O'Loughlin G. & Anderson G.).

3 CSO'S ASSESSMENT

Questions on CSO's assessment methods are still numerous and have been brought up by many local authorities.

Quite different approaches have been proposed that are often based on the combination between metrology and modelling. For the pollution fluxes evaluation, it can be noted that local authorities still not use models very often, maybe because they do not trust them and because there are implementation difficulties.

Many authors have confirmed the importance of models calibration and validation and uncertainty evaluation seems to be an emerging concern. Numerous researchers have developed this aspect and new results have been obtained:

- On uncertainty associated to the choice of models (Ahyerre M. et al.);
- On uncertainty associated to calibration methods (Zobrist C. et al.);
- On uncertainty associated to entrance data and methodology study (Mourad M. et al.; Cherrared M. & Chocat B. ; Neumann M. B. et al.) ;
- Finally, on numerical methods for uncertainty evaluation (Kanso A. et al.).

The correct assessment of effluents supposes to be able to assess the outflows of each device. Many communications dealt with CSO's measurements.

Two working tracks are proposed: i) the use of models in order to optimise the choice of sensors position in devices (Vazquez J. et al., Lipeme Kouyi G. et al.), approach also tested in networks (Larrarte F. et al.) and ii) the use of new sensors (camera for instance, Khorchani M. & Blanpain O.).

CFD tools start to be used too. In this issue, the paper of Vazquez J. et al proposes for example to use a 3 dimension model of the device in order to set up, and then to validate a 1-dimension model, that can be integrated into classical simulation softwares.

Another aspect deals with knowledge improvement on wastewater pollutants. New experiences, to get new data on runoff pollution, have been then presented. They dealt with traditional pollutants (Crabtree B. et al), "emerging" pollutants, such as pesticides (Ruban V. et al), or on pollutants produced during the devices building phase. Li J. & Pyatt L. showed that this phase can compromise the future behaviour of devices.

The article of Eriksson E. et al. presents a synthesis bibliography study on micro-pollutants that could potentially be present in stormwater and that, consequently reduce the possibilities to re-use stormwater.

The present major stake seems to organise all these data in reliable and homogeneous databases. Several papers have developed this question that seems to be more and more important in the United States (Strecker E. et al.), in France (Kanso A. et al.), as well as in Germany recently.

The same problem exists for the validation of models simulating pollutants transport in sewer systems (Langeveld J. G. et al.).

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