Specific stormwater solutions to be tested within the Research Based Innovation Centre (SFI) Klima 2050

By Kamal Azrague, Gema Raspati, Tone Merete Muthanna, Julie Elisabeth Andersen and Hanna Kristine Haug Lindseth

Kamal Azrague is Senior Research Scientist at SINTEF Water and Environment. He holds a PhD in Chemistry (2005) from the University Paul Sabatier, Toulouse, France. *Gema Raspati* is Research Scientist at SINTEF Water and Environment. He holds a PhD in Environmental Engineering (2015) from NTNU, Trondheim, Norway. *Tone Merete Muthanna* is Associate Professor at the Department of Hydraulic and Environmental Engineering, NTNU. She holds a PhD in Environmental Engineering (2007) from NTNU, Trondheim, Norway. *Julie Elisabeth Andersen* is Civil Engineer at Rambøll. She carried out her master thesis on the present subject at the Department of Hydraulic and Environmental Engineering, NTNU. *Hanna Kristine Haug Lindseth* is presently master student at the Department of Hydraulic and Environmental Engineering, NTNU. She is carrying out her master thesis on the present subject.

This article summarises the presentation entitled "Specific stormwater solutions to be tested within the Research Based Innovation Centre (SFI) Klima 2050" held in Trondheim on the 16 February 2016 at the "Norsk vannforenings fagtreff – Stormwater management in Norway; how was it done before, how do we do it today, and what does the research say about the future?".

Introduction

Urban growth leads to an increase of stormwater volumes, peak flows and deterioration of water quality. For a long time, stormwater quantity was the focus and its contamination was considered negligible, though many investigations showed that stormwater pollution should be also managed (Saget et al. 1995). Indeed, as precipitation washes over land, transport of a variety of contaminants (e.g. metals, petroleum products, sediment, etc.) occurs leading to the deterioration of receiving water bodies.

The EU Water Framework Directive (WFD)

The EU Water Framework Directive (WFD) aims to achieve "good status" in terms of low levels of chemical pollutants as well as healthy ecosystems for all of Europe's surface waters (Meland, 2015). Therefore, mitigating peak runoff volumes as well as reducing pollution loads and concentrations are now considered important and are often mandatory both from a regulatory perspective and for the National Road Administrations (Meland, 2015). Development of more environmentally conscious approaches for stormwater management such as 'Sustainable (urban) drainage systems' (SUDS) is nowadays more profound. These approaches aim at re-establishing near natural water cycles and restoring the ecological condition of urban streams. Consequently, in many European countries, the trend is moving towards the implementation of SUDS and other advanced systems compared to basic sedimentation/detention ponds that are in use, especially in Scandinavian countries (Meland, 2015). Indeed, sedimentation pond, which is the conventional system that exploits the gravity to separate solid particles from water with typical removal of 60% of total suspended solids; 90% of settleable solids; and 30% of COD and BOD5; does not fulfil the WFD requirements. Thus, the aim of Klima 2050 is to investigate/develop new treatment technologies that are applicable for the Norwegian context and that could cope with the foreseen climate change.

Klima 2050 and treatment of runoff from airport runways

As initial activities within Klima 2050, the treatment of runoff from airport runways has been selected as a case study. Airports in Norway are facing real environmental challenges due to climate change. The greatest challenge is the increase of flight traffic, which with an unchanged winter climate will result in higher consumption of de-icing chemicals i.e. propylene glycol and potassium formate (Avinor, 2013). These chemicals infiltrate the soil surface along the runways when the melting of snow begins around April. It is important to ascertain that these chemicals do not contaminate the groundwater.

Filtration treatment systems are promising methods

Filtration treatment systems are considered as promising methods for reducing dissolved and particulate pollutants provided that the selected filter media has high adsorption capacity during the initial operation phase. In longer run, once the media is coated with biomass, the stormwater is then treated by biofiltration (also known as rain garden or bioretention), which provide water quality improvement and flow retention (e.g. Dietz, 2007). Alternatively, the filtration system can also be made modular and compact i.e. in form of filter cartridge. In such an arrangement filter cleaning by means of hydraulic backwash can be thought as an advantage to ensure longer filter operation.

To assess the applicability and performance of filtration system, lab-scale column tests were conducted using commercial media made of filtralite with grain sizes range from 0 to 2 mm. Hydraulic modelling and separation performance during filtration were used as means to evaluate the filter media. All media are able to remove 93-99% of suspended solids. The observed amount of suspended solids removed before the filters were fully clogged are within the recommended range of 1.2-5 kg/m^2. Removal of the de-icing chemicals depends on the filtration condition, i.e. filtration flowrate and initial concentration of the de-icing chemicals. During the experiments, removal of de-icing chemicals up to 88% was observed. Biodegradation seems to play an important role in removal of the soluble contaminants. The current experiments take into account biological processes in the filter and attempt to optimize the conditions (e.g. nutrient addition, change of operating temperatures, and variations of filtration rate) for better removal of the de-icing chemicals.

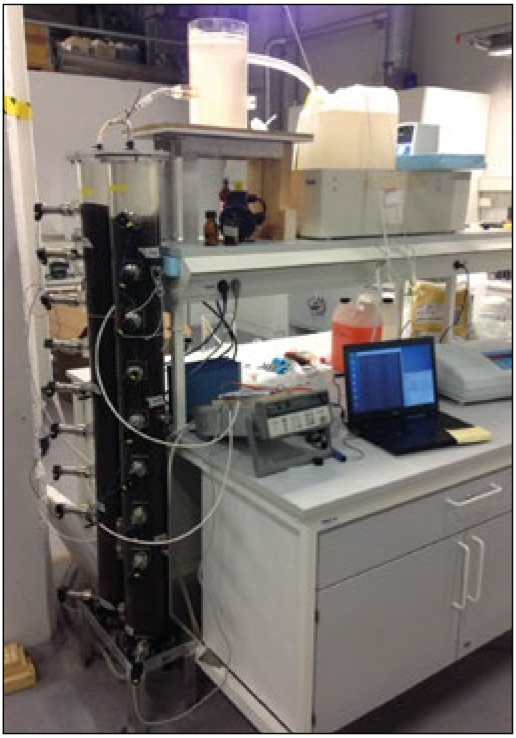

Figure 1. Digital picture of the media filter laboratory set-up.

References

Avinor (2013) Environmental report 2013.

Dietz, M.E. (2007) Low impact development practices: a review of current researchand recommendations for future directions. Water Air Soil Pollut. 186, 351–363.

Saget, A., Chebbo, G., and Desbordes, M. (1995) Urban discharges during wet weather: What volumes have to be treated? Water Science and Technology, 32(1), 225-232.

Meland, S. (2015) Status og vannhåndtering i Europa. Nordic Road Water – NORWAT under Teknologidagene, Veg og vannforurensning, Tirsdag 22. september og onsdag 23. september 2015.