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STORMWATER TREATMENT PLANT CONCEPTION

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The practice of urban stormwater management has until recently focused only on drainage and flood control. Yet more concern should be taken to reduce pollution loads on water recipients by implementing source control management, on-site treatment and building stormwater pollution control facilities. Overview and basic principals of stormwater quality management are presented in the article. Summary presents the results for the evaluation of stormwater pollution removal.

Introduction

Growing cities and urbanization cause larger runoff volumes, increased pollution and have negative effects on the environment. A number of research reports showed the deterioration tendency of water recipients even after construction of wastewater treatment [1, 6]. Urban stormwater runoff is recognized as a major source of the pollution of the receiving water [2, 4]. Runoff is flushing organic and inorganic matters, soluble and suspended solids, nutrients, metals, bacteria and litter from urbanized areas to water recipients. Runoff brings pollution loads to recipients and causes problems to water quality, life environment for water habitants, and restricts stream use for recreation [3, 5].

Stormwater management practice

The basic objectives of stormwater management are improvement of water quality in drainage watershed, reduction in runoff volumes and enhanced beneficial use of the receiving water bodies. Stormwater management strategy could be divided into two main groups:

- stormwater pollution reduction;
- runoff volume reduction.

Volume and pattern of rainfall do not depend on our wishes, and we cannot regulate or make influence on them. Yet we could more or less regulate the rainfall transformation process in urban areas. It could be done by proper design of watershed, minimization of directly connected impervious area, introduction of infiltration practice and other best management practice (BMP) methods [1, 5, 6]. Stormwater pollution depends on a number of factors; the most important are: atmospheric pollution, rainfall characteristics, pedestrian and traffic intensity, road mainten-

ance, patterns and functions of the watershed, dry period. The following three basic objectives could be involved to improve stormwater pollution reduction:

- source control;
- on-site treatment;
- end-of-pipe techniques.

Source control strategy should ensure that pollution never reaches the surface of the Earth. Source control efficiency has strong relationships with public education on the proper use and disposal of household chemicals, litter, paints, solvents, motor oil, pesticides, herbicides, fertilizers, antifreezes, etc. Focus turns to the process of the land development and redevelopment, such as detection and elimination of illicit discharges of wastewater into separate storm sewers, street sweeping, leaf pickup, efficient street de-icing programs, accidental spill control, and the enforcement of clear violations of ordinances designed to prevent the deposition of pollutants on the urban landscape [2, 4].

An on-site stormwater treatment facility in general means reduction of runoff volume. Such facilities could serve small sites of about two to four hectares of paved catchment area. On-site facilities also include the use of minimized directly connected impervious area. However, this practice could be implemented in newly developing and redeveloping areas. It relies on non-traditional layout of urban streets, parking lots and buildings, and uses grass buffers, roadside grass swales instead of curd and gutter, porous pavement, percolation trench and infiltration basins.

End-of-pipe techniques are generally recognized as some kind of stormwater treatment facilities, such as dry ponds, dry extended ponds, wet ponds, shallow marsh systems, wetlands, sand filters and others [3, 5, 7]. Findings presented in the article are related with the end-of pipe techniques.

Assumptions for Pollution reduction concept

From a literature review, research experience and statistical evaluation of rainfall data the following conclusions can be made:

1. Precipitation is the driving force that mobilizes and transports pollutants from urban territory to receiving water. Rainfall intensity and runoff pollution have a strong relationship.

2. Intensive rainfalls cause a bigger runoff, which washes away larger amount of pollutants. The concentration of stormwater pollution varies during the rain, also the average concentration of the rain event and the quantity of emissions produced during a single rain vary greatly.

3. The biggest parts of stormwater contaminants are bounded with small particles of suspended solids. Therefore, removal of suspended solids from stormwater is the main issue. If suspended solids are removed, a big part of other contaminants, such as heavy metals, organics and oil, will be removed as well.

4. Adsorption, chemical reaction and biological treatment could remove dissolved solids, metals and nutrients. The most powerful treatment is natural self-cleaning. We can only make appropriate conditions for improving self-cleaning activity.

Case study

In order to achieve comprehensive efficiency of stormwater treatment all the above mentioned pollutant removal mechanisms, such as physical, chemical and biological treatment mechanisms, should be applied. Wet ponds can potentially operate all of these mechanisms [1, 5]. Principal layout of constructed wet pond pilot plant is presented in Figure.

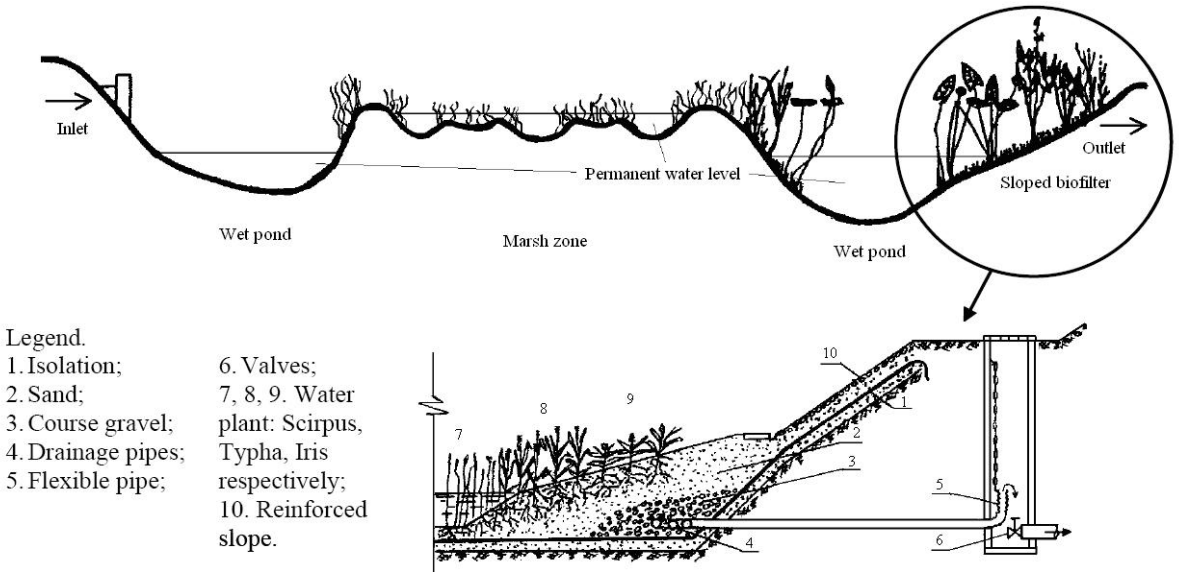

Figure – *Constructed wet pond design conception*

At the beginning of treatment a pond should be constructed. It accumulates big volumes of runoff, equalizes pollution concentrations, traps coarse sediments, reduces incoming velocities, and helps to distribute runoff evenly over the marsh. After preliminary settling stormwater enters to shallow/high marsh system (wetland). The physical, chemical and biological stormwater treatment mechanisms take place here due to plant activity, slow flow, hydraulic conductivity, water depth and other factors. After the marsh systems stormwater enters second wet pond for final polishing. Water from wet pond flows to effluent through the biological filter constructed on the blanks of pond and planted with water plants.

Water samples were taken manually or by automatic sampler. During the studies stormwater pollution level was indicated: SS vary from 25 to 882 mg/l (median – 165 mg/l), BOD_5 – 5,5-22 mg/l (median – 14 mg/l); COD – 24-184 mg/l (median – 80 mg/l); oil 0,4-3,1 mg/l (median – 0,7 mg/l); total phosphorus 0,02–0,36mg/l (median – 0,06 mg/l); total nitrogen 0,1-2,8 (median – 0,6 mg/l).

The overall treatment efficiency of constructed wet pond is very good. Effluent concentrations are much lower than the requirements for stormwater discharge to water bodies. Average effluent concentration was: 4,8 mg/l of SS, 0,48 mg/l of oil, 0,8 mg/l of BOD, 28 mg/l of COD, 0,32 mg/l of total nitrogen, 0,03 mg/l of total phosphorus. Properly designed wet ponds with wetlands could be useful facilities for downstream stormwater pollution control.

Conclusion

1. Stormwater from urban areas carrying significant source of pollution to receiving waters causes thread to the environment. Implementation of different best management practices can reduce the negative effects. The choice of method (source control, on-site treatment or end-of-pipe techniques) depends on site-specific conditions.

2. In many countries there is an increasing trend in construction of the stormwater treatment facilities, such as ponds, wetlands, infiltration basins, filter strips. However, clear guidelines for design and operation of stormwater treatment facilities still need to be established.

3. Wet ponds in association with wetlands are one of the most promising stormwater pollution reduction facilities where physical, chemical and biological

treatment mechanisms are applied. Nevertheless, before stormwater enters the wetland a proper pre-treatment should be performed.

4. Stormwater treatment efficiency was tested in the pilot plant. The final polishing of stormwater in the sloped biological filter was added to conventional wet pond layout. The obtained results showed good treatment efficiency and significant reduction of stormwater pollutants loads.

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ОСОБЕННОСТИ СОРБЦИОННОЙ ОЧИСТКИ НЕФТЕСОДЕРЖАЩИХ ПОВЕРХНОСТНЫХ СТОКОВ

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Studies on applying for clearing of a surface sink of petroleum of graphitic sorbent «Livsor-S" have shown his high performance, due to high magnitude of adhesive properties, developed surface of macropores retaining pool hydrocarbons in amounts, in some times superior mass of the sorbent.

Введение

При всем многообразии известных методов строительство очистных сооружений требует отчуждения больших площадей и соответствующих капитальных затрат. Особенно в условиях тесной городской застройки, даже располагая необходимыми материальными средствами, не всегда представляется возможность разместить на соответствующей территории эффективно работающие очистные сооружения. Поэтому основной тенденцией в настоящее время является внедрение интенсивных технологий, которые позволят уменьшить размеры площадей под очистные сооружения и повысить качество очистки воды.