WATER QUALITY AND WASTE WATER TREATMENT IN LITHUANIA

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Introduction

Lithuania's Water bodies were mostly polluted in the last years of the Soviet period (1985-89). At that time there was going on intensive industrial and agricultural production though out-of-date and high energy consuming technologies were used and large quantities of different pollutants were discharged in the environment and especially into water bodies. After independence in 1990 as industrial as agricultural production began rapidly to reduce as a result of production reorganization and lost of large markets in the ex-Soviet Union countries. According to assessment of some specialists the total production output in 1997 made up only 55-65% of the production output in 1989. According to our investigations water consumption for the domestic needs remained almost the same, though it tends to decrease as a result of following reasons: improving water use control installing watermeters, rise of water prices, decrease of inhabitants purchasing power. Therefore, during recent years the pollution with municipal waste water decreased insignificantly as the network of sewage system was gradually widened, whereas the biological and even mechanical waste water treatment facilities were developed inadmissible slowly (J.Dubra, 1995).

Restitution and privatization of agricultural land in rural areas created additional problems in waste water management. In the Soviet times Lithuanian village developed according to town model: central settlement, production center and other units. Inhabitants from separate farmsteads almost under compulsion were moved to settlements. Central water supply and wastewater removal systems were used in these settlements, often these systems do not worked efficiently. After independence in 1990 a reverse process started - people started to move back to separate farmsteads. And often separate farmsteads turn into small centers for meat and milk production. For these centers need of small water treatment facilities is rapidly increasing and the main problem is financing possibilities. Our department collects and studies data about designing and construction of waste water treatment equipment, their technologies and suitability for sewage purification in separate farmsteads or small rural settlements. Six sites with characteristic waste water treatment technologies (ground-plant filters, aerotanks of periodic operation, anaerobic biofilters, disk biofilters) have been selected in different regions of Lithuania to investigate waste water treatment efficiency (A.Kusta and other 1997).

About 80% of the Lithuania's area belongs to the catchment area of the River Nemunas. All waters of this area flow to the Kurđiu Lagoon and after to the Baltic Sea. That's why water quality of the Kurdiu Lagoon and the River Nemunas is an integrated indicator of water contamination in Lithuania. Analyzing water quality data in the River Nemunas and Kursiu Lagoon one can notice the tendency of pollution reduction, this is more characteristic for the mineral nitrogen content which decreased in the River Nemunas below Kaunas from 1,8 mg/l in 1992 to 1,0 mg/l in 1997 and in the Lower Nemunas from 1,6 mg/l to 0,8 mg/l respectively. There was observed reduction and of another pollution parameters. The main reason of this tendency is production output reduction, more severe water pollution control and responsibility for pollution, inhabitants ecological education and assistance from developed countries carrying out environmental projects in Lithuania.

Materials and methods

As it was mentioned earlier, at present in Lithuania development of individual farmsteads are going on and small centers for agricultural production processing are founded often in these farmsteads. Waste water treatment from these centers is rather great problem. It is important that waste water treatment facilities worked reliably and their maintenance were simple and low cost. Ground-plant filters are often applied to treat small quantities of waste water as local low cost materials are used for their construction and their maintenance is quite cheap, reliable and simple (G.Geler 1996, P.Wyss 1996). Ground - plant filters with study possibilities are installed in three sites. Detailed investigations of their performance efficiency are carried out in one of them - in Ţasliai secondary school waste water treatment system (Kaidiadoriai district).

This waste water treatment system operates since autumn 1995. Its schematic longitudinal section is presented in the fig. 1.

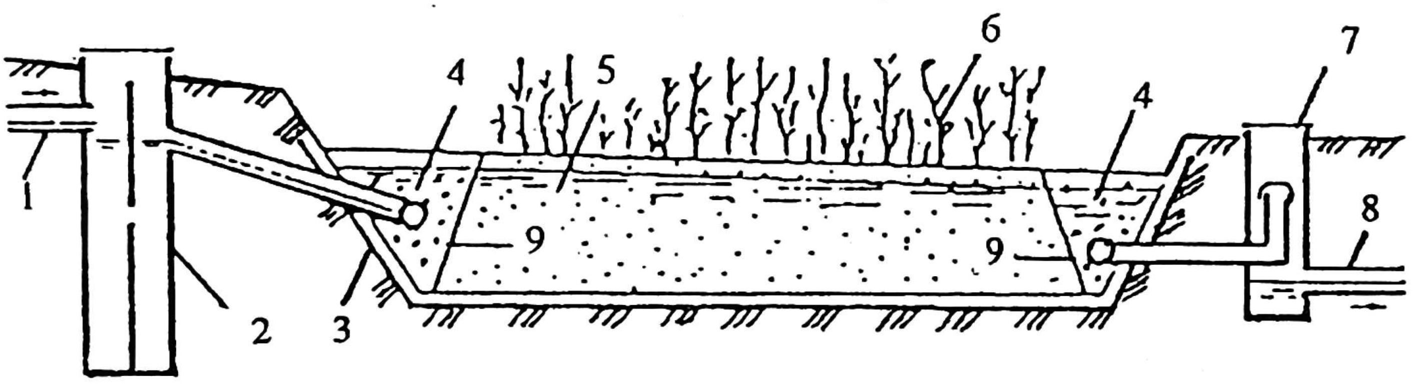


Fig. 1 Žasliai waste water treatment system, schematic longitudinal section:
1 - Inlet of waste water; 2 - septic for mechanical treatment; 3 - hydroinsolation membrane; 4 - prism of small broken stone; 5 - ground-plant filter; 6 - reeds; 7 - tank for water level control; 8 - pipe of discharge; 9 - geotextile.

Waste water treatment system consists of: equipment for mechanical treatment, ground-plant filter and additional constructions.

Three concrete tanks form mechanical treatment equipment, two tanks have 3 m diameter and one - 2 m, depth of water layer in the tanks is 2,9 m. Suspended solids are restrained and precipitated. Depending on quantity sediments are removed one or two time per year.

After mechanical purification waste water through distributing pipes flows into prism of broken stone, from which horizontal seepage through ground-plant filter is going on to the second prism of broken stone. From this prism through installed in it drainage pipe cleaned water flows to the collector - drainage canal.

Additional constructions consist of waste water discharge measurement tanks and flow-rate control tank. One tank for waste water discharge measurement is installed after mechanical treatment equipment, second - after water level control tank.

Triangular thin-walled hydrometrical screens are installed in these tanks for discharge measurement. Water level control tank is necessary to regulate water level in ground-plant filter. For that purpose the flexible pipe is used. Maximum water level may be 5 cm higher than soil surface for reeds, and minimal level coincides with the bottom of the reed soil. Total regulated water head between maximum and minimal water levels is about 1 m.

Žasliai waste water treatment systems technological designed parameters are:

- maximum hydraulic loading rate 45, 24 m^3/d (0,52 l/s);

- pollutants concentration before mechanical treatment according to BOD - 187 mg O_2/l;

- pollutants concentration before ground-plant filter according to BOD - 150 mg O_2/l;

- standard concentration of pollutants after treatment < 20 mg/l suspended solids and < 15 mg O_2/l according to BOD.

Fig. 2. Dynamics of suspended solids in Žasliai waste water treatment system

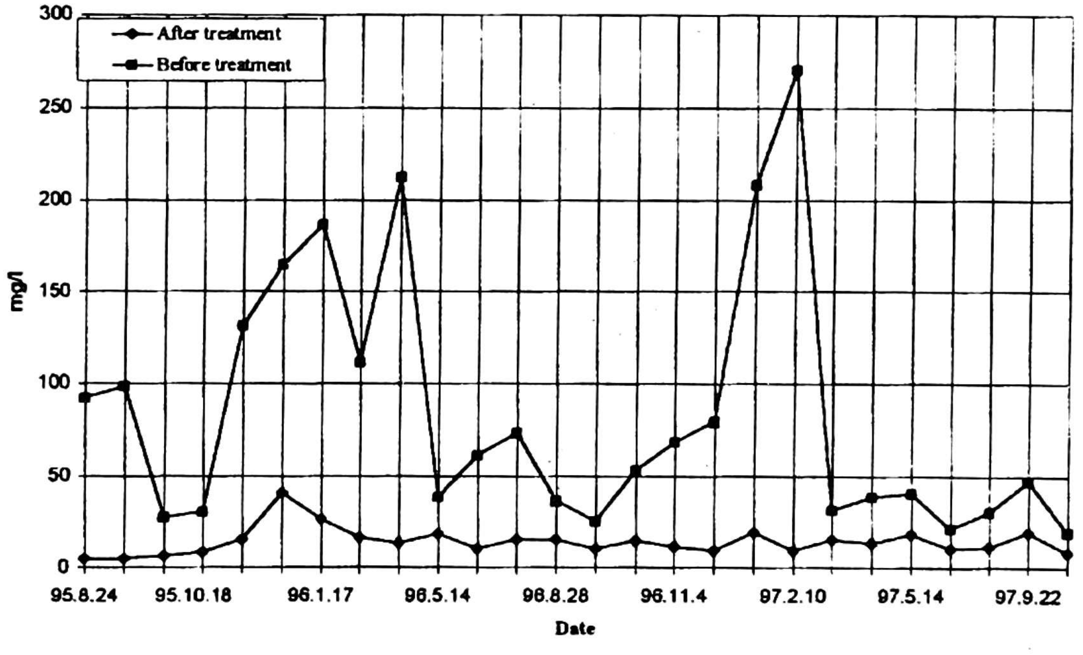
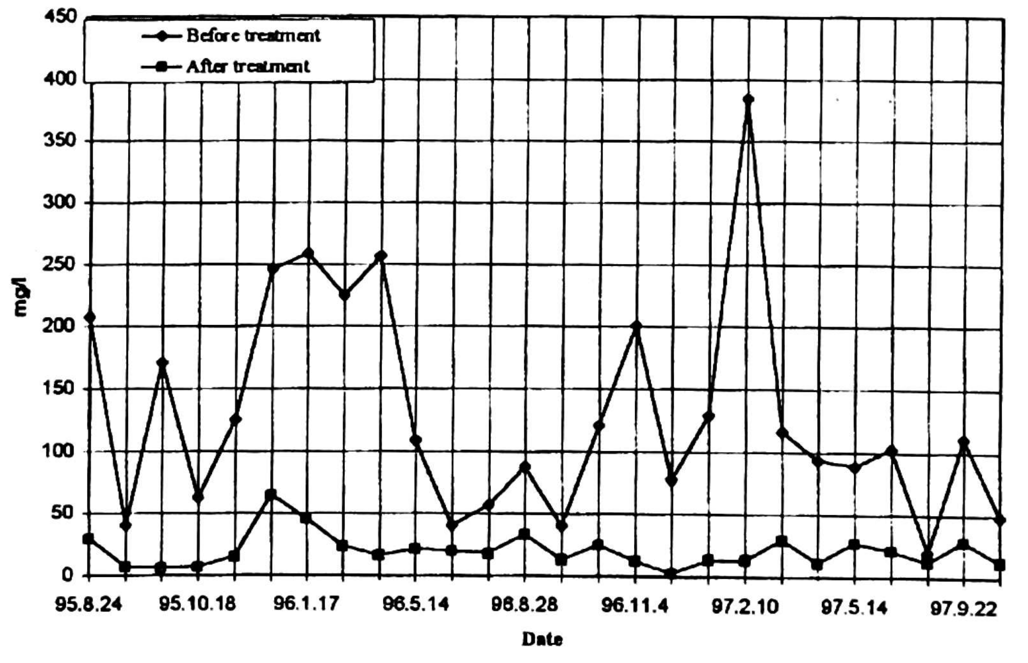


Fig. 3. BOD_7 dynamics in Žasliai waste water treatment system



Results and discussion

Žasliai waste water treatment system is the first one of this type in Lithuania. Water quality parameters at this system according to suspended solids and BOD_7 are presented in the fig. 2 and fig. 3 correspondingly. In 1995-1997 hydraulic loading rates of Ţasliai waste water treatment system changed from 2 m^3/d to 8,8 m^3/d, so real waste water loading rate was significantly lower than maximum admissible (45,24 m^3/d) but pollutants concentration was sometimes 2-3 time more than it was designed.

The graphs illustrate that purification efficiency as according to the suspended solids (60-92 %) or according to BOD_7 (70-95%) is rather good. The efficiency in percentage is more significant when concentration is higher.

Reduction of another parameters (total nitrogen and phosphorus, permanganic oxidation rate) is also quite significant. Their investigation data were collected too but they are not presented in this paper.

Conclusions

Present design criteria for waste water treatment systems are approximate and not always well founded. There is a general need for optimization of system implementation and design to better suit local requirements.

The loading rate is a function of waste water quality and ground-plant filter properties.

Analysis of our investigation demonstrates that ground-plant filters work quite efficiently in the climatic conditions of Lithuania and they can be successfully used for small quantities waste water treatment.

References

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Summary

Water quality and waste water treatment in Lithuania. Waste water treatment in ground-plant systems has been promoted as a low cost, effective alternative for treatment and disposal of waste water flows from small communities and separate farmsteads. Unlike many mechanical waste water treatment systems, ground-plant seepage systems are subject to complex influences related to seminatural site condition and interaction of waste water with soil and plant. As a result, design and performance relationships are not always well defined and need further investigations in local climatic conditions.

This paper presents short review of alternative technologies applied in Lithuania for treatment of small amounts of waste water, as well as analysis of investigation data for ground-plant filters. The results of the investigations show that ground-plant filters and sand filters of vertical filtration can be successfully applied for treatment of small amounts of waste water in climatic conditions of Lithuania.

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