Finnish regulations, European standards and testing of small wastewater treatment plants

Erkki Santala, Leading expert

Finnish Environment Institute, P.O. Box 140, 00251 Helsinki, Finland
(E-mail: *erkki.santala@ymparisto.fi*)

INTRODUCTION TO THE FINNISH REGULATION

Finland has quite long and successful history of water pollution control. The large towns started to construct sewerage networks and wastewater treatment plants already during the first decades of the 20th century. The Water Act, enacted in 1961, initiated a comprehensive process of wastewater treatment plant construction in towns and even in villages. In 1972 it became possible for the municipal sewerage works to collect a special wastewater fee in order to finance the widespread construction of wastewater treatment plants. As a result, already in 1985 every town and village with more than 200 inhabitants had a treatment plant. At present, all collected wastewaters in Finland receive efficient treatment with mean reduction values of 96% for BOD, 95% for phosphorus and 54% for nitrogen loads.

But even after some minor amendments, the Water Act did not solve the problems in sparsely settled areas. The traditional minimum treatment requirement, i.e. a proper septic tank system, ended up too often as a maximum requirement, even though much guidance on more effective treatment systems had been published since the early1960s.

National water protection targets were introduced for the first time in 1976 (and later every 10 years) to guide the activities in the water protection sector. In the beginning, water protection activities were concentrated in reducing loads from point sources. Eutrophication, which is mainly caused by excessive phosphorus loads, is the primary water pollution problem in Finland. After the municipalities and industries had succeeded to reduce the phosphorus load from point sources, the role of diffuse loads, like those from agriculture and from scattered settlements not connected to sewerage networks, became significant. However, it was not until 1998 that the Finnish government issued a resolution specifying numerical targets for the year 2005 for decreasing the load from scattered settlements. In accordance with this resolution, discharges causing biological oxygen demand and entering surface water should be cut by at least 60% and phosphorus input by at least 30%, compared with the national levels of the early 1990s.

It was soon obvious that these targets would not be achieved if the legislation was not amended. The problem did not concern so much new housing development, because quite strict requirements were possible, if actions were needed to protect the public health or the immediate environement. But the protection of the environment seen in a larger context was not covered properly. The owners of existing farms and country homes were not willing to increase voluntarily their present wastewater treatment level.

A comprehensive new Environmental Protection Act came into force in March 2000. The Act covers even small discharges that may cause pollution of surface waters or groundwater. Furthermore, the Act made it possible to enact a special decree for more strict regulation of onsite wastewater systems and their effluents. In December 2000 the Ministry of the Environment started preparations for such a new regulation. By the end of October 2001 the working group, consisting of legal, environmental and engineering experts together with representatives from the main

stakeholder groups, completed the proposal for a decree on treating domestic wastewater in areas not served by municipal sewerage networks. After the preliminary preparation phase, all municipalities and other stakeholders had the opportunity to comment on the proposal. Based on the comments, some changes to the draft decree were made and some sections were rewritten.

The proposed decree was the topic of active political discussion, because it was obvious that the new decree would affect almost one-fifth of the population and hundreds of thousands of holiday homeowners. However, the importance of water protection actions in rural areas was also included in the Finnish Government's Programme for the Protection of the Baltic Sea, approved in April 2002. The government thus finally approved the decree in June 2003 and it entered into force on January 1, 2004.

THE MAIN CONTENT OF THE DECREE

The title of the decree is quite complex, Government Decree on Treating Domestic Wastewater in Areas Outside Sewerage Networks (OWSD). The Decree includes some new interesting principles and features, not generally used in other countries.

According to Section 1, the objective of the OWSD is to reduce domestic wastewater discharges. The scope, presented in Section 2, covers such onsite wastewater systems that receive domestic or similar wastewater from individual homes, small businesses, and clusters of homes with a population equivalent of less than 100. The Environmental Protection Act regulates larger clusters. They need special discharge permit that is granted by either one of the country's 13 regional environment centres or one of the three environmental permit authorities.

Basic treatment requirements

Section 3 includes special definitions for domestic wastewater, wastewater treatment systems, wastewater systems and sludge. The most important definition, formulated exclusively for this Decree, is the person-equivalent load for dispersed settlements. Certain daily per capita values are given for this load, namely, 50 grams for organic loads expressed as biological oxygen demand over seven days (BOD_7), 2.2 grams for total phosphorus and 14 grams for total nitrogen.

In Section 4, the treatment requirements are given based on these specific person-equivalent load values. The basic reduction requirement is that a decrease of 90% of BOD_7, 85% of phosphorus and 40% of nitrogen must be achieved. As seen in Table 1, the maximum permissible discharge load for BOD_7 is then 5 grams per person per day, for total phosphorus, 0.33 grams per person per day and for total nitrogen, 8.4 grams per person per day. With the help of the daily wastewater flow per person, it is easy to calculate the allowable effluent concentrations.

Table 1. Maximum permissible daily load per capita outside sewerage networks.

Load parameter	Load of untreated wastewater ($g/per.d^{-1}$)*	Required reduction (%)	Permissible load of treated wastewater ($g/per.d^{-1}$)*
BOD_7	50	90	5.0
P_{tot}	2.2	85	0.33
N_{tot}	14	40	8.4

*$g/per.d^{-1}$ is grams per person per day

There are several reasons for defining the requirement like this. Firstly, for the protection of the environment the lowest possible pollution load is the most important objective, and not the methods used to achieve it, the concentration of the treated effluent or the reduction percentages as such. Secondly, it must also be possible to calculate an equal reduction requirement for other types of polluters than only individual homes. Thirdly, it must be possible to take into consideration such load reductions that may be achieved with special plumbing systems and with choice of toilet type.

The components of daily load per capita are shown in Table 2, which is also included in the appendix to the Decree. These values are used if no reliable site specific information is available. For example, when dry toilets are used, it is possible to reduce the load remarkably and the maximum permissible discharge requirements are reached more easily, as seen in Table 3. In that way the Decree encourages the use of dry toilets, which is important in Finland, especially in areas where many private holiday homes are built very close to lake shorelines.

Table 2. Pollution load components in untreated wastewater from one resident.

Component	Load of untreated wastewater ($g/per.d^{-1}$)		
	BOD_7	P_{tot}	N_{tot}
Faeces	15	0.6	1.5
Urine	5	1.2	11.5
Other	30	0.4	1.0
Total	50	2.2	14

Table 3. An example of determining the needed efficiency in the treatment of grey wastewater when dry toilets are used.

Load parameter	Load of untreated wastewater ($g/per.d^{-1}$)	Permissible load of treated wastewater ($g/per.d^{-1}$)	Needed treatment reduction %
BOD_7	30	5	83
P_{tot}	0.4	0.33	18
N_{tot}	1.0	8.4	0

Requirements in less sensitive areas

Because large less sensitive areas exist in municipalities that are very sparsely settled and that have only a few lakes, the municipality may also accept lower rates of treatment. However, the precondition for such a procedure is proper zoning for the whole municipality. If such zoning is

done, the limits for lower reduction values are 80% for BOD_7, 70% for total phosphorus and 30% for total nitrogen.

Other requirements

In order to ensure proper operation and maintenance of the wastewater treatment, the owner has to be aware of the system that is in use. Hence, Section 6 calls for a description report of the onsite wastewater system. For existing houses, such a report must be prepared within two years of the entry into force of the Decree (within four years for holiday homes without WC). The report must be kept in the house and it must be presented to the supervisory authority when required.

According to Section 7, proper plans for a wastewater system must be included in the application for a building permit. There are certain general requirements for a system and also design and dimensioning requirements, which are given in the appendices to the Decree.

Section 8 highlights the importance of adhering to the accepted plans when constructing the system. The general building and construction rules must also be obeyed.

Without proper operation and maintenance any wastewater treatment system is useless. Hence, Section 9 points out that there must be up-to-date operational and maintenance instructions for each wastewater system. In the appendices to the Decree there are some general requirements for such instructions. In addition, Section 9 highlights the proper transport and handling of sludge.

The availability of information

A prerequisite for the selection of an effective and site-specific treatment method is that the client hires a qualified designer who knows enough about the performance of different onsite treatment methods, both soil adsorption systems and prefabricated treatment plants. In order to help the designers, Section 10 requires that the Finnish Environment Institute collects independent, reliable and up-to-date information on commonly used treatment methods and the performance of such methods. The Institute may collect this information in various ways, for instance, by reviewing domestic and international research reports and by carrying out surveys or test procedures with relevant plants.

The information on wastewater treatment systems and their performance must be accessible to everybody. To ensure such access, the Environment Institute has published this information on the Internet and the files are updated a few times a year. It was assumed that the growing interest among the Finnish manufacturers will bring many new products to the market. This has also been the case. Many promising products has been monitored in research projects and a test procedure and the infrastructure for testing was developed.

Enforcement and transitional provisions

The Decree entered into force on January 1, 2004. Anyone building a new house after that date must fulfil the requirements. The Decree also covers the wastewater systems in existing houses but it would be impossible to carry out the needed improvements simultaneously. Therefore, the Decree includes a provision for a transitional period of ten years.

CONCLUSIONS AND FURTHER ACTIONS

The improvement and implementation of regulations take time

Already during the preparations in the mid-1990s for the national water protection targets it was recognised that a legal remedy would be needed to reduce further the pollution from onsite wastewater systems. Still, it took about eight years before the new regulation was approved.

Together with the allowed transition period of 10 years for old houses, the total interval between the initial idea and final implementation will be almost 20 years.

Information and education

For an ordinary rural house owner, investing in a wastewater treatment system is not among his or her primary interests. Hence, homeowners need to be properly motivated. The municipal environmental, public health and construction supervision authorities must be able to inform people about the problems caused by poorly treated wastewaters. Many short courses and seminars have been arranged since 2003 to inform people, especially the staff working in the municipalities, about the new Decree and to provide information on how to implement it. Designers and entrepreneurs have also been in need of special education and training. Leaflets, brochures, articles in professional journals and especially in newspapers with wide circulation have also been important means of spreading information to the house owners themselves.

Sludge collection and utilisation

The earlier practice of utilising septic sludge in agriculture is no longer accepted. Thus, to implement environmentally sound sludge collection and treatment procedures in really remote areas will require much effort by the supervising municipal authorities. In many of these areas the volume of collected sludge has been rising remarkably since the Decree entered into force. Given this problem, it is necessary that municipalities develop appropriate sludge handling procedures.

Development of treatment systems

Several monitoring programmes and surveys have shown that many problems still exist with onsite wastewater treatment systems. Effective and reasonable priced prefabricated treatment plants are needed to compete against the traditional septic tank with a soil adsorption system. Soil adsorption systems are still valid in certain areas but cannot be used with poorly drained soils or within important groundwater areas. The new Decree sets equitable requirements for all methods and plant types, thus encouraging the development of well-functioning equipment, and highlighting the reliability and ease of maintenance.

EUROPEAN STANDARDIZATION OF SMALL WASTEWATER SYSTEMS

Within the European standardization organization CEN a set of EN-standards and CEN Technical Reports have been prepared covering different types of small wastewater treatment systems for up to 50 persons. They have been prepared by the Working Group 41 (WG41) under guidance of the CEN Technical Committee 165 (TC165, Wastewater engineering).

The European standards shall be given the status of a national standard, either by publication of an identical text or by endorsement within a certain time interval given for each standard and conflicting national standards shall be withdrawn also by the given deadline. According to the CEN International Regulations, the national standards organizations of the following countries are bound to implement these European standards: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom (list valid July 2006).

The European standards discussed here have been prepared under a Mandate M/118 given to CEN by the European Commission and the European Free Trade Association and they support the essential requirements of EU Directives. The relationship with EU Directives is described in the annex ZA of each standard. The clauses shown in annex ZA meet the requirements of the Mandate M/118 given under the EU Construction Products Directive (89/106/EEC).

The range of standards within EN 12566 “Small wastewater treatment systems for up to 50 PT”, prepared by the WG41, contains the following parts:

- Part 1 (EN): Prefabricated septic tanks; (published in 2000, first amendment in 2003)
- Part 2 (CEN/TR): Soil infiltration systems; (published in 2005)
- Part 3 (EN): Packaged and/or site assembled domestic wastewater treatment plants; (published in 2005)
- Part 4 (EN): Septic tanks assembled in situ from prefabricated kits; (in preparation)
- Part 5 (CEN/TR): Pre-treated effluent filtration systems; (in preparation)
- Part 6 (EN): Prefabricated treatment units used for septic tank effluent; (in preparation)
- Part 7 (EN): Prefabricated tertiary treatment units; (in preparation).

Typically, each standard includes the following chapters: description of the scope of the standard, normative references, terms and definitions, specifications and requirements, evaluation of conformity and installation instructions. In addition, annexes of the five product standards, i.e. parts 1, 3, 4, 6 and 7 include descriptions of the necessary testing procedures (e.g. watertightness test, treatment efficiency test, structural behaviour test).

The technical reports (CEN/TR), parts 2 and 5, are different. They are guideline papers, codes of good practice, describing proper ways to construct in situ a small wastewater treatment system (infiltration and different filter beds with or without reeds). Parts 2 and 5 have no such status as the other parts.

Based on the annex ZA of the product standards EN 12566-1 and EN 12566-3 the CE-marking of products covered by them is now possible. In most EU countries the use of the CE-mark is obligatory after the transition period of the relevant product standard has passed. The transition period is now over for septic tanks (part 1) and will be over by July 2008 for packaged plants (part 3).

The procedure of attestation of conformity for septic tanks (according to part 1) or for packaged plants (according to part 3) is in class 3. This means that the manufacturer is responsible for factory production control and other initial type testing than those specially mentioned.

A notified test laboratory must take care of the following initial type tests for septic tanks:

- structural behaviour test or checking manufacturer’s calculations,
- hydraulic efficiency test,
- nominal capacity test,
- watertightness test and
- durability.

A notified test laboratory must take care of the following initial type tests for packaged plants:

- structural behaviour test or checking manufacturer’s calculations,
- treatment efficiency test,
- watertightness test and
- durability.

When compliance with the conditions of the Annex ZA of the standards is achieved, the manufacturer or his agent established in the European Economic Area (EEA) shall prepare and retain a declaration of conformity, which authorises the affixing of the CE marking. The CE marking symbol shall be in accordance with Directive 93/68/EEC and it shall appear on the product. The CE marking symbol shall also appear on the accompanying commercial documents. It shall

include information on the relevant essential characteristics, e.g. on the results of the watertightness test, structural behaviour and treatment efficiency.

TESTING OF PREFABRICATED TREATMENT PLANTS IN FINLAND

The new Decree has created a lot of pressure to homeowners and to municipal environment authorities but also the manufacturers have become more active in developing more efficient and cost-effective treatment systems. In order to help the Finnish manufacturers, the Finnish Environment Institute (SYKE) has recently started testing of small wastewater treatment plants according to the Annex B of the EN 12566-3 standard. All other test laboratories are situated in Central Europe. In Finland there is less demand for testing septic tanks according to EN 12566-1, because a Swedish test institute has already for years carried out hydraulic tests, which are similar to those described in Annex B of the EN 12566-1 standard.

In 2006 SYKE has received the status of a Notified Body (no 1762), which means it is capable and competent of carrying out the performance and watertightness tests according to EN 12566-3.

The tests are conducted at SYKE research station by the Espoo City wastewater treatment plant. SYKE is conducting the tests in cooperation with the Technical Research Centre of Finland (VTT). SYKE is responsible for evaluating the watertightness and treatment efficiency. VTT is responsible for evaluating the structural behaviour of the plants.

The procedure for testing is as follows:

- The influent is pumped from a residential area nearby stored in a completely mixed storage tank. The influent does not include any industrial or trade effluent nor storm water.
- The influent quality is controlled daily with settling solids test and sampling three times a week.
- The wastewater is then pumped to the test plant units and the flows are measured. The feed to the units is controlled with a PC based program, which controls the magnetic valves and gathers data from measuring instruments.
- The plants are placed in a separate space with temperatures varying from 10 degrees in the winter to 25 degrees in the summer.
- Sampling is carried out with flow proportional automatic samplers from the influent and effluent.
- Laboratory analysis are carried out at the laboratory of the research station and at SYKE main research laboratory.
- Complete privacy protection for the plants in test is possible by covering the units, prohibition of unauthorized persons to visit the test space and strict data security.
- The facility can take six units for simultaneous testing.

The treatment efficiency test procedure includes 10 test periods including the start-up phase and lasts altogether 38 + X (start-up) weeks. Daily flow pattern for testing is given in the standard (EN 12566-3) and it simulates the normal daily flow with day and night periods. Influent characteristics are defined in the standard for BOD/COD, SS, TP and TN. Altogether 26 composite (24 hours) samples are taken from the influent and effluent during the testing. As a result, the mean values of the efficiency ratios of different parameters are given.

Based on the results for all the tests and if the factory production control and other requirements in the Annex ZA of the standard are fulfilled, the manufacturer is allowed to place a CE-mark on the product and sell it within the EU-countries.

THE RELEVANCE OF EN STANDARDS IN RESPECT TO ECOLOGICAL SANITATION

When considering the relevance of the EN standards to the concept of ecological sanitation, there is one problem. The scope of the present standards includes only plants that are used for the treatment of raw domestic wastewater. This means that treatment of grey water (domestic wastewater not including toilet waste) is excluded. Hence, the tests and CE marking is not valid for plants designed to treat only grey water.

If a country allows or enhances the use of systems applying separation of urine and/or faeces, the EN standards and tests do not help in evaluating the performance of grey water treatment systems. This situation should be taken into consideration when the next amendment of EN 12566-1 and the first amendment of EN 12566-3 will be done.

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