Working Group on Appropriate Technology for the Treatment of Waste Waters for Small Rural Communities

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SWEDEN - ASPECTS ON RAPID INFILTRATION OF WASTEWATER

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INTRODUCTION

The population of Sweden is about 8,3 M persons. The main part - about 7,3 M - of the population is connected to municipal sewers with the following wastewater treatment:

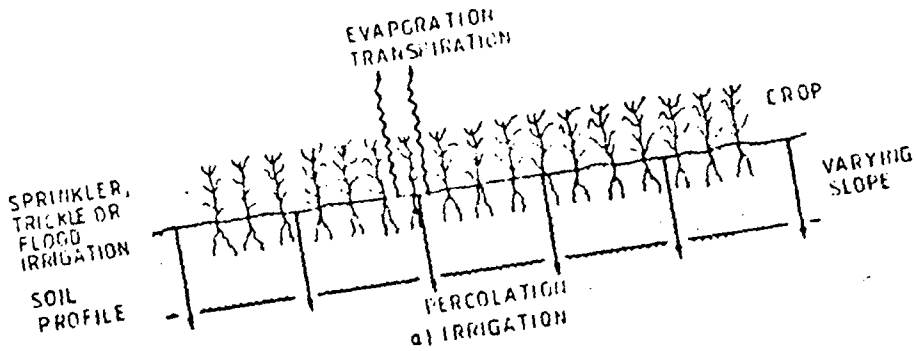
Mechanical, Chemical or mechanical/chemical	5 %
Biological	22 %
Biological/chemical	73 %

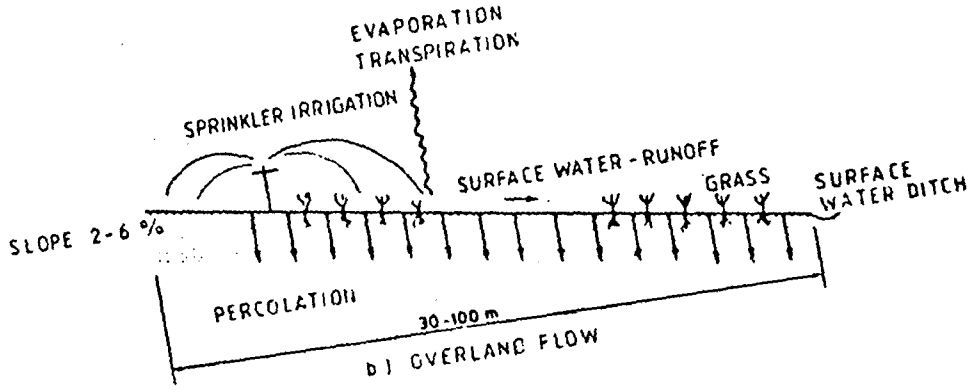
The treatment plants were mainly built during the last 20 years.

The rest of the population - mainly single households - have separate treatment systems of various kinds. This is also the case regarding many recreation areas, hospitals, motels etc.

Experience has shown that problems often arise when conventional treatment is used for smaller units. The maintenance is rather expensive and the treatment results are irregular. There is therefore a clear tendency to choose land treatment to an increasing extent.

On principle there are several methods for land treatment (fig 1). In Sweden only rapid infiltration has been used more extensively.





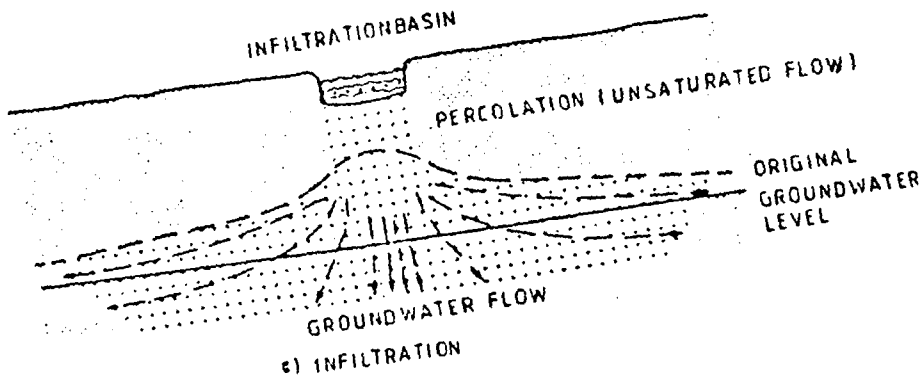


FIGURE 1 Land treatment systems

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DEVELOPMENT AND RESEARCH

The development work on rapid infiltration started at the end of the 1950s. In 1962 the first manual appeared. Since 1967 questions regarding rapid infiltration are handled by the National Swedish Environmental Protection Board (SNV), who published the current manual in 1974. This manual is only applicable to single households. Work is going on in co-operation with other Nordic countries to establish a revised manual, also applicable to larger units.

Research on rapid infiltration began at the end of the 1960s. The work includes column experiments and case studies of full-scale systems. Primarily the research is concentrated on chemical and biological processes taking place during infiltration and on the influence of wastewater infiltration on ground water at different distances from the plant. Part of the research work is summarized in appendix 1.

SMALL SYSTEMS

Infiltration systems for single households and other small units are built according to the manual from 1974. The wastewater is presedimented in a septic tank. In permeable soils the wastewater is infiltrated (fig 2).

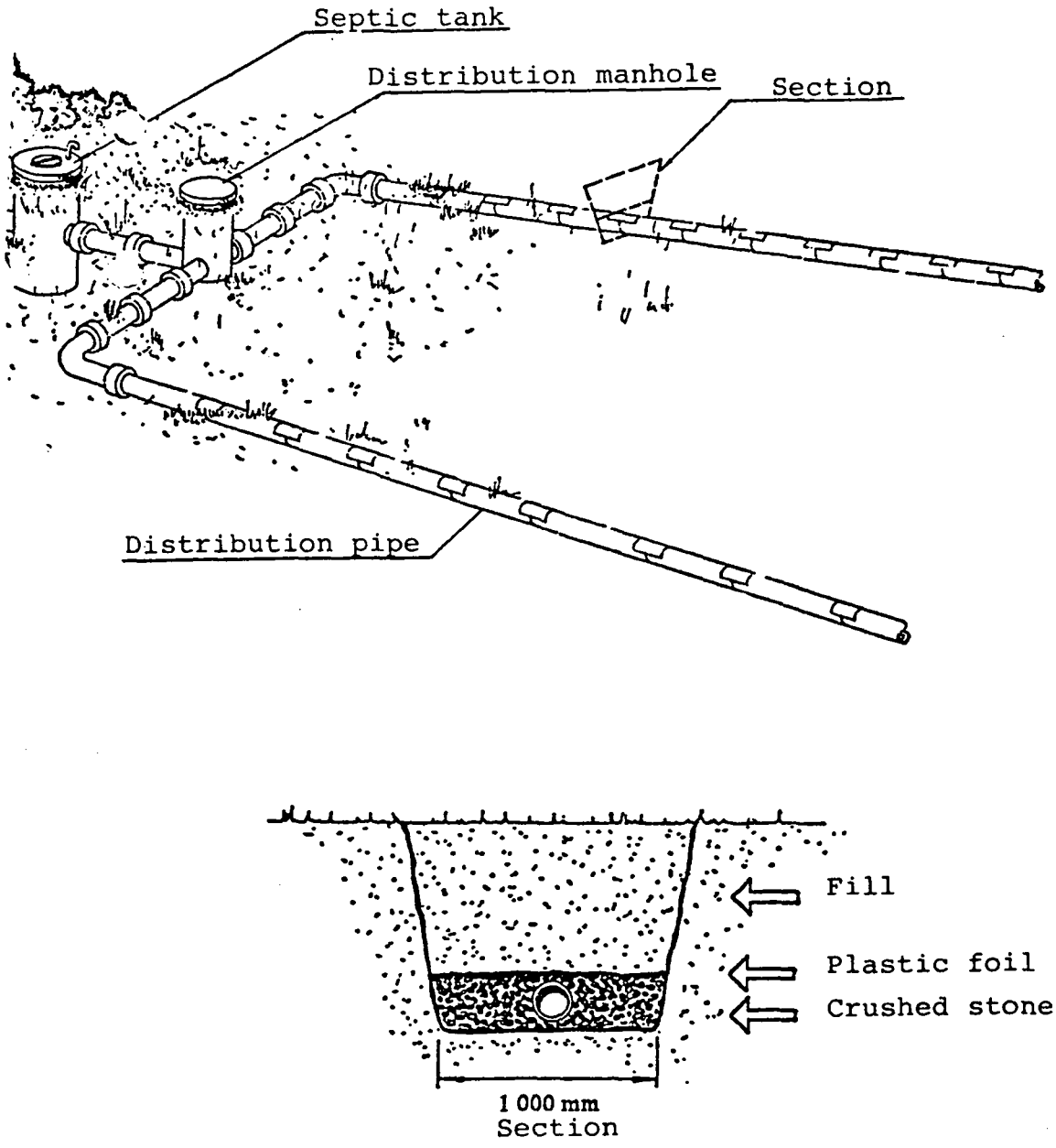


Figure 2 Infiltration for single households

The size of the infiltration ditch is based on analyses of soil samples.

If the soil conditions are unfavourable the water is distributed to a sand filter. After percolation the water is collected in a pipe and let out in a stream or lake (fig 3).

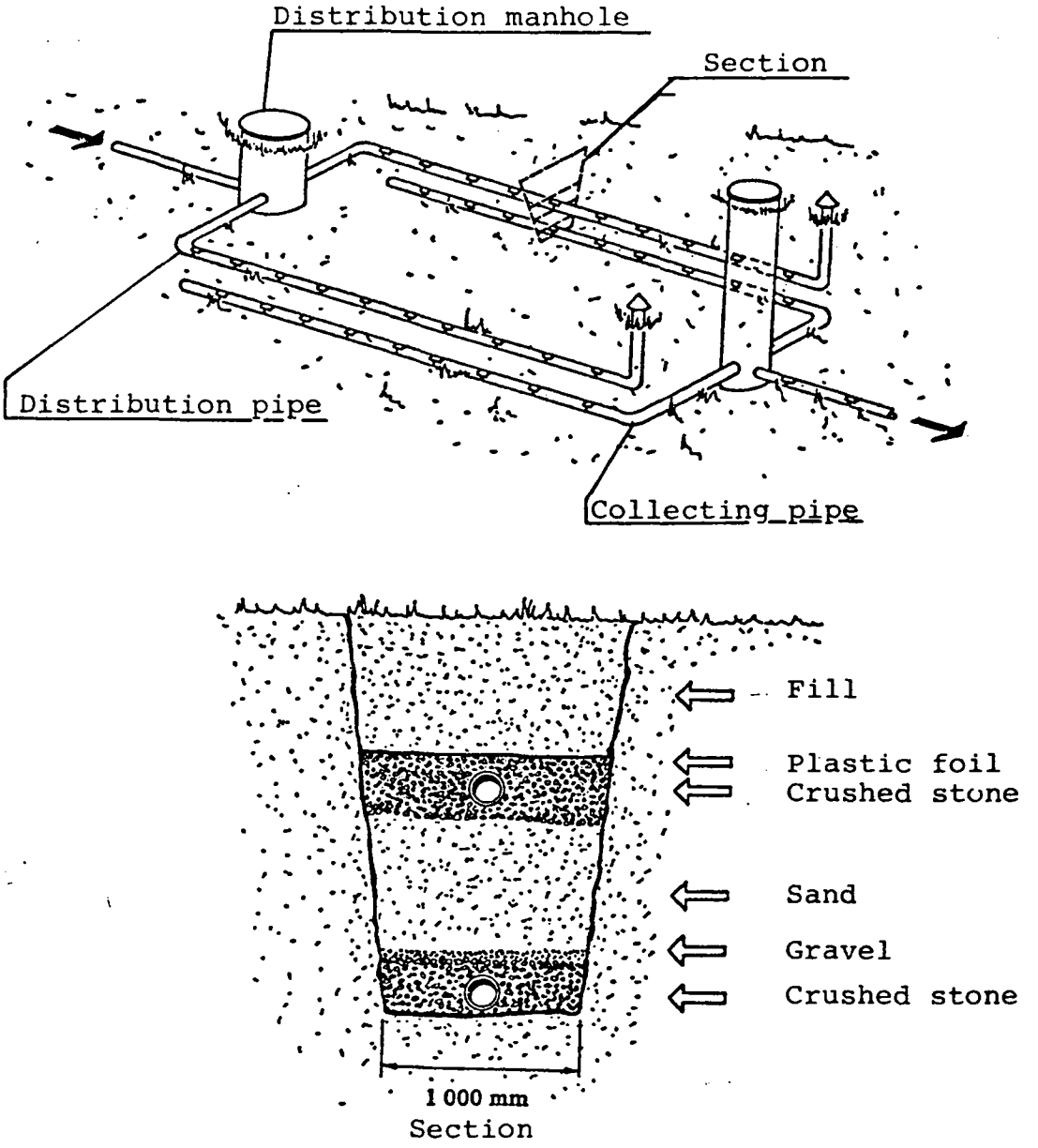


Figure 3 Sand filter for single households

It is estimated that 200-300 000 small systems have been built, with an increase of 15-20 000 each year.

LARGER SYSTEMS

Mainly during the last 10 years larger infiltration systems have been built for villages and groups of houses up to 500-1000 persons. Often also hospitals, motels and recreation centres have chosen this solution for wastewater treatment.

Design

There are two major types of technical solutions: infiltration plants and sand filters. Infiltration plants can be constructed when a permeable soil (e g gravel and sand) is available. If the soil is more or less impermeable (e g silt or clay) the sand filter solution is the only alternative.

Both infiltration plants and sand filters can either be closed (subsurface) or open (dams).

In fig 4, sketch drawings of the three major technical solutions are shown.

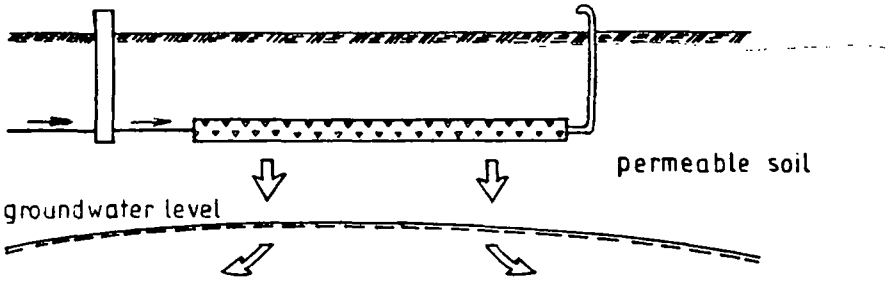
The pretreatment in the subsurface alternatives is only mechanical separation, whereas the open infiltration plant normally requires secondary treatment. In fig 4, an oxidation pond before infiltration is shown. Also other biological treatment methods, such as activated sludge, could be adopted.

For smaller plants, the subsurface alternatives are most feasible, whereas for larger plants (more than 200-300 m^3/d) infiltration dams become competitive.

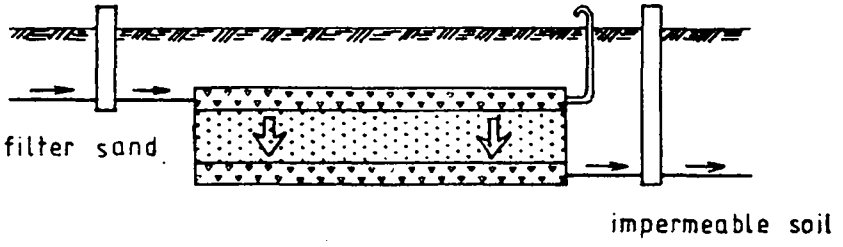
In order not to cause a reduction of the hydraulic capacity of the infiltration beds with time, they are designed in such a way that part of the plant could be left idle. By running the plant intermittently, there is a decomposition of organic matter resulting in a restoration of the hydraulic capacity of the beds.

SUBSURFACE PLANTS FOR MEDIUM-SIZED UNITS (approx < 200 - 300 m^3/d)

Subsurface infiltration plant



Subsurface sand filter



OPEN INFILTRATION DAMS FOR LARGER UNITS (> 200 - 300 m^3/d)

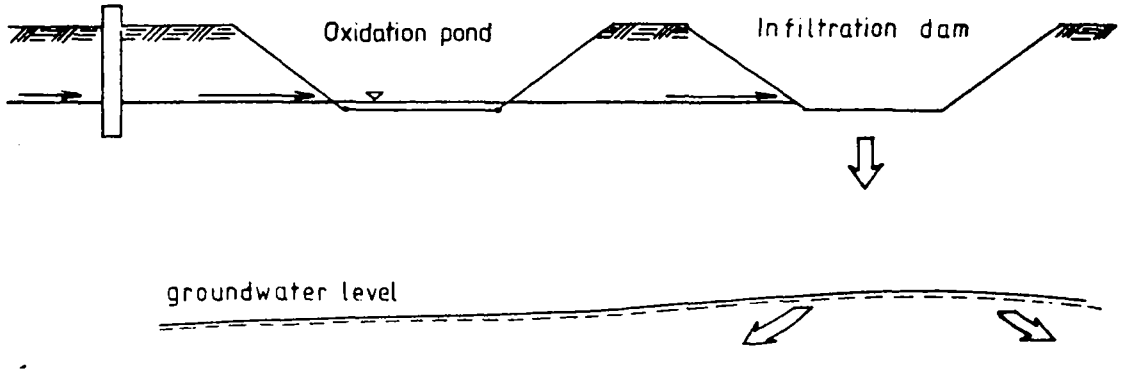


Figure 4 Sketch drawing of infiltration systems

Experiences from operation

The knowledge of rapid infiltration is rather comprehensive with regard to treatment effects and influence on the environment. Also the design, operation on maintenance of plants are well known.

In principle the treatment effects are the same in sand filters and infiltration plants. In practice there is normally lower effects in sand filters because the filter volume is limited by financial reasons.

In sand filters, loaded with 40-80 l/m^2d the following treatment effects are normal:

	Reduction %
Organic matter	80-90
Bacteria	99-99,9
Nitrogen	10-30
Phosphorus	30-60

The treatment effects in infiltration plants are higher, mainly because of the larger available soil volumes. Usually the reduction of organic matter, bacteria and phosphorus is practically complete and the influence on the ground water is recorded by increased contents of chloride, sulphate and nitrogen.

The maintenance of infiltration systems is simple and restricted in comparison with conventional treatment plants (normally 2-3 hours/week). It is also important that the maintenance can be carried out by rather unqualified staff.

CONCLUDING REMARKS

As mentioned above infiltration systems are often a favourable alternative for solution of wastewater problems.

However, there are several cases where solutions with infiltration plants or sand filters have failed.

The reason is often inadequate knowledge of the hydrogeological conditions in the infiltration area. It is therefore most important that the choice and design of the infiltration systems are based on an accurate knowledge of geology and ground water conditions.