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RECENT STUDIES OF SYSTEMS FOR SMALL-SCALE WASTEWATER TREATMENT IN THE NETHERLANDS

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INTRODUCTION

During the last decade there have been rapid developments in waste water collection and treatment in The Netherlands. At present, almost all large residential centers in The Netherlands have sewers and in most cases the waste water collected is being treated. In addition, in most residential nuclei of small and intermediate size (larger than 400 inhabitants), there is collection and central treatment of waste water.

What remains are the discharges of individual houses or groups of houses for which the now-conventional solution for larger units is, for some reason or another, inappropriate. It is estimated that, at present, the total flow of waste water from domestic sources, being discharged after little or no treatment, amounts to roughly 1.5 million population equivalents (p.e.). No plans exist for treatment or connection to sewer systems for about three quarters of this load, as connection to sewer systems has become very costly. However, the lack of treatment will cause environmental problems at some places.

As the knowledge about on-site treatment systems is very limited, the Dutch Department of Environment initiated a program to find effective solutions for processing small flows of (un)segregated waste water.

RESEARCH PROGRAM

The research program consists of the following components:
- state of the art survey (literature review, approach in other countries);
- field investigation (the netherlands, neighbouring countries);
- preliminary comparison (design, financial analysis);
- field research (final design, construction and monitoring of 13 selected systems for a period of 2 years);
- establishment of guidelines (selection, design, operation and maintenance).

EVALUATION OF TREATMENT SYSTEMS

Based on the state of the art survey and on the field investigation, the whole range of treatment systems encountered was analyzed and evaluated. Table 1 summarizes the results.

TABLE 1 - COMPARATIVE EVALUATION OF TREATMENT SYSTEMS

TREATMENT SYSTEM	SUITABLE FOR	POSSIBLE ADVANTAGES	POSSIBLE DISADVANTAGES
CESSPOOL	STORAGE OF - UNTREATED, UNSEGREGATED WASTE WATER - GREY WATER - BLACK WATER	- NO ENERGY COMSUMPTION - LITTLE MAINTENANCE - SUITABLE IF TREATMENT OR CONNECTION TO SEWERAGE IS NOT POSSIBLE	- HIGH TRANSPORTATION COSTS OF CESSPOOL CONTENTS
SEPTIC TANK	- UNSEGREGATED WASTE WATER - BLACK WATER - GREY WATER	- NO ENERGY CONSUMPTION - LITTLE MAINTENANCE - PROOF AGAINST SHOCK LOADS	- MODERATE TREATMENT EFFICIENCY, PARTIAL TREATMENT ONLY
ANAEROBIC TREATMENT	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING - BLACK WATER	- LOW ENERGY CONSUMPTION - METHANE PRODUCTION - GOOD SLUDGE DEWATERABILITY, HIGHLY STABILIZED - SLUDGE REMAINS ACTIVE, EVEN AFTER LONG PERIODS OF REST	- MODERATE TO HIGH TREATMENT EFFICIENCY - FREQUENT INSPECTION - STILL IN THE EXPERIMENTAL STAGE (FOR DOMESTIC WASTE WATER)
TRICKLING FILTER	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING AND PRESEDIMENTATION	- HIGH TREATMENT EFFICIENCY - LITTLE MAINTENANCE - RELIABLE - LITTLE SENSITIVE FOR ZERO AND SHOCK LOADS	- CLOGGING - FREQUENT INSPECTION
ROTATING BIOLOGICAL CONTACTORS (R.B.C.'S)	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING AND PRESEDIMENTATION	- HIGH TREATMENT EFFICIENCY - COMPACT - LITTLE MAINTENANCE - RELIABLE - LITTLE SENSITIVE FOR ZERO AND SHOCK LOADS - MODERATE ENERGY CONSUMPTION	- FREQUENT SUPERVISION - POSSIBILITY OF PROBLEMS AFTER PERIODS OF NO ROTATION (IMBALANCE, DESICCATION OF ACTIVE LAYER)
ACTIVATED SLUDGE (COMPACT EXTENDED AERATION)	- UNSEGRATED WASTE WATER FOLLOWING COARSE SCREENING AND PRESEDIMENTATION OR MACERATION	- HIGH TREATMENT EFFICIENCY - COMPACT - SLUDGE HIGHLY STABILIZED	- HIGH ENERGY COMSUMPTION - MUCH MAINTENANCE - VERY FREQUENT INSPECTION - HARDLY PROOF AGAINST SHOCK LOADS (WASH OUT OF ACTIVE MASS) - BULKING SLUDGE
ACTIVATED SLUDGE (OXIDATION DITCH)	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING	- HIGH TREATMENT EFFICIENCY - RELATIVELY SIMPLE - PROOF AGAINST SHOCK LOADS - SLUDGE HIGHLY STABILIZED	- HIGH ENERGY CONSUMPTION - FREQUENT INSPECTION - BULKING SLUDGE
PONDS	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING - GREY WATER - EFFLUENT	- HIGH TREATMENT EFFICIENCY - SIMPLE DESIGN, OPERATION AND MAINTENANCE - NO ENERGY CONSUMPTION (EXCEPT IF AERATED) - LARGE BUFFER CAPACITY - INCORPORATION IN COUNTRY SIDE	- REQUIRED SURFACE AREA - SEASONAL INFLUENCES - POSSIBLE SMELL PROBLEMS
LAND TREATMENT	- UNSEGREGATED WATER WATER FOLLOWING COARSE SCREENING - GREY WATER - EFFLUENT	- SIMPLE - NO ENERGY CONSUMPTION (EXCEPT FOR EFFLUENT IRRIGATION)	- REQUIRED SURFACE AREA - HYGIENICAL AND SMELL PROBLEMS - POSSIBILITY OF SOIL POLLUTION - SEASONAL INFLUENCES
PHYSICAL-CHEMICAL TREATMENT	- UNSEGREGATED WASTE WATER FOLLOWING COARSE SCREENING - GREY WATER - EFFLUENT	- HIGH TREATMENT EFFICIENCY - HIGH DEGREE OF REMOVAL OF PHOSPHATES, HEAVY METALS AND ORGANIC MICRO-POLLUTANTS POSSIBLE - PROOF AGAINST ZERO AND SHOCK LOADS - NO STARTING-UP PERIOD	- VERY REGULAR INSPECTION - COMPLICATED OPERATION - LITTLE EXPERIENCE (WITH DOMESTIC WASTE WATER TREATMENT)
INFILTRATION BED	- GREY WATER FOLLOWING PRESEDIMENTATION - EFFLUENT	- SIMPLE - NO ENERGY CONSUMPTION - EASY INCORPORATION IN COUNTRY SIDE - LITTLE MAINTENANCE - WATER AND NUTRIENTS RECYCLING	- APPLICABILITY DEPENDS ON SOIL PARAMETERS - SOIL POLLUTION - CLOGGING
SEEPAGE PIT	- GREY WATER FOLLOWING PRESEDIMENTATION - EFFLUENT	- SAME AS INFILTRATION BED	- SAME AS INFILTRATION BED
ELEVATED MOUND	- GREY WATER FOLLOWING PRESEDIMENTATION - EFFLUENT	- APPLICABILITY LITTLE DEPENDENT ON ON SOIL PARAMETERS	- WATER LIFTING REQUIRED - CLOGGING
SAND FILTER	- GREY WATER FOLLOWING PRESEDIMENTATION - EFFLUENT	- HIGH PURIFICATION EFFICIENCY - SIMPLE	- WATER LIFTING GENERALLY REQUIRED - FREQUENT INSPECTION
UPFLOW GRAVEL FILTER	- GREY WATER FOLLOWING PRESEDIMENTATION - EFFLUENT	- SIMPLE - CAN BE PLACED IN POST SEDIMENTATION TANK	- MECHANICAL SCREENING OF SUSPENDED SOLIDS ONLY - MUCH AND FREQUENT MAINTENANCE
COMPOST TOILET	- BLACK WATER	- WATER CONSERVATION - NUTRIENT RECYLING - STRONG VOLUME REDUCTION - LITTLE MAINTENANCE - PROCESSING OF KITCHEN WASTE	- CARE REQUIRED - FREQUENT INSPECTION DURING STARTING-UP PERIOD
INCINERATION TOILET	- BLACK WATER	- WATER CONSERVATION - FLOW REDUCTION - HYGIENICALLY	- HIGH ENERGY CONSUMPTION - FREQUENT MAINTENANCE

FIELD RESEARCH

A field study on the performance of 13 selected treatment systems has been started recently, and will be performed at different field sites up to the end of 1986. So far no other equivalent field research has been done on the different types of treatment systems in The Netherlands; in this respect the research will be a demonstration project for The Netherlands. Effluent from the systems will either be infiltrated or discharged into surface water. Some of the systems and their main characteristics are shown below.

Important aspects during this research will be:

- waste water (e.g. effluent) sampling and analysis;
- general operation;
- maintenance;
- environmental impact (noise, odour);
- flow measurement;
- costs (investment, energy, sludge removal, personnel).

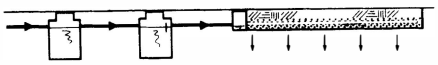
- O FLOW : 0.15 M³/P.E. DAY = 0.6 M³/DAY
- O DESIGN CAPACITY : 4 P.E. = 0.2 KG BOD/DAY

SEPTIC TANK

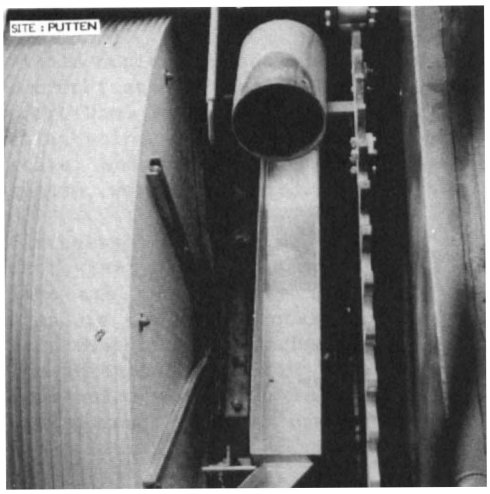
- O NUMBER OF COMPARTMENTS : 2
- O VOLUME (RATIO) : 1.75 M³/P.E. = 7 M³ (1:1)

INFILTRATION BED

- O HYDRAULIC LOAD : 0.008 M³/M.DAY
- O LENGTH OF 2 CIRCULAR TRENCHES : 75 M
- O WIDTH OF TRENCHES : 0.4 M
- O DEPTH OF TRENCHES : 0.75 M



SEPTIC TANK INFILTRATION BED



- O FLOW : 0.15 M³/P.E. DAY = 15 M³/DAY
- O DESIGN CAPACITY : 100 P.E. = 5.4 KG BOD/DAY

SEPTIC TANK

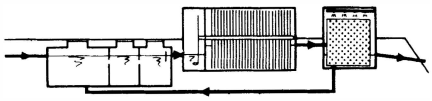
- O NUMBER OF COMPARTMENTS : 3
- O VOLUME (RATIO) : 0.4 M³/P.E. = 40 M³ (2:1:1)
- O BOD-EFFICIENCY : 30%

ROTATING BIOLOGICAL CONTACTOR

- O DESIGN CAPACITY : 3.8 KG BOD/DAY
- O TYPE : BIODISCS (POLYSTYRENE)
- O ORGANIC LOAD : 6 G BOD/M².DAY
- O NUMBER OF DISCS : 120

MICROSTRAINER

- O AUTOMATIC BACK-WASHING BY HIGH-PRESSURE JETS



SEPTIC TANK ROTATING BIOLOGICAL CONTACTOR MICROSTRAINER

- O FLOW : 10 M³/DAY
- O DESIGN CAPACITY : 180 P.E. = 9.7 KG BOD/DAY

SEPTIC TANK

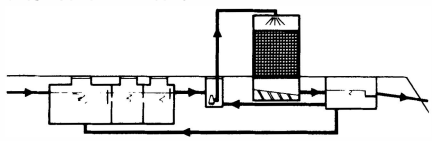
- O NUMBER OF COMPONENTS : 3
- O VOLUME (RATIO) : 0.17 M³/P.E. = 30 M³ (2:1:1)
- O BOD-EFFICIENCY : 30%

TRICKLING FILTER

- O DESIGN CAPACITY : 7 KG BOD/DAY
- O ORGANIC LOAD : 0.5 KG BOD/M³.DAY
- O FILTER MEDIUM : POLYPROPYLENE RINGS
- O FILTER VOLUME : 14 M³
- O HYDRAULIC LOAD : 0.8 M³/M³.H

SETTLING TANK

- O SURFACE OVERFLOW RATE, MAX. : 0.6 M³/M².H
- O SLUDGE RETURN TO SEPTIC TANK



SEPTIC TANK TRICKLING FILTER SETTLING TANK