RESEARCH HIGHLIGHT

Technical Series 01-132

Assessment of the Takla Landing Contour Trench Wastewater Disposal System

INTRODUCTION

Assessment of the Takla Landing Contour Trench Wastewater Disposal System describes a two-year monitoring survey undertaken by NovaTec Consultants in Takla Landing, B.C. Takla Lake is a community of some 350 people located on Takla Lake Band Reserves No. 7 and 7A approximately 300 km northwest of Prince George.

The contour trench system is a relatively new wastewater disposal system for soils having moderate to poor permeability. It consists of distribution pipes in two parallel trenches placed along a contour for distances of 200-300 m and perpendicular to slopes of 5-15°. From the homes, a dosing chamber discharges enough sewage to fill one of the distribution pipes four times a day. The other pipe rests for approximately a six-month period.

The overall objective of this project was to provide guidelines for the application of this wastewater disposal system in areas with coarse grain soils. Its specific objectives were to:

- determine the applicability of the system for attenuating fecal organisms;
- determine its effectiveness in mitigating nutrient loading on surface waters;
- demonstrate the potential for use of the appropriate biomat formation media on the trench bottom; and
- determine the soil temperature profiles alongside the contour trench and upgradient of the trenches, and evaluate the effects of the system on frost penetration in course granular soils.

In addition, the project assessed the relative filtering and fecal organism attenuation of three trench liner media: (i) a synthetic geotextile; (ii) in-situ material (a moderate to highly permeable sand/gravel), and (iii) a specified sand.

RESEARCH PROGRAM

Equipment

The test area was an 80-m long section of one of the trenches in the disposal field. This area was subdivided into three sections of equal length, and each section had three effluent and three biomat samplers set out in pairs. Each of the sections also had one of the three infiltrative surface materials (synthetic geotextile, coarse in-situ sand/gravel mixture or specified sand mixture) at the trench bottom. The effluent samplers provided the capability of comparing the effect of the three biomat media on micro-organism and nutrient concentrations in the effluent. The biomat samplers allowed the researchers to compare the biomat-forming characteristics of the three media being investigated.

The researchers installed trench observation ports to determine whether ponding was occurring in the trench and pipe observation ports to allow for visual checks of the flow along the trench length. To monitor the temperature profile of the soil, they installed a thermistor rod with sensors at ground level and depths of 0.5, 0.65, 1.2 and 1.5 m at the edge of the trench. A similar thermistor rod was installed 20 m upgradient from the trench as a control. Seven groundwater monitoring wells were installed near the disposal field to determine its effect on the quality of the groundwater migrating towards the lake.

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METHODOLOGY

Sampling and monitoring

The project team visited the site four times from October 1987 to March 1989 to conduct sampling and monitoring. During each visit, they took samples from the dosing chamber and the effluent samplers. Slime layers from the surfaces of the filtrative media were collected, as were samples of the geotextile biomat, for biological testing in a laboratory at the University of British Columbia. In addition, the researchers took measurements of the flow rate to the disposal field by monitoring the running time of the pump station upstream of the dosing chamber. Control and experimental ground temperature profiles were recorded using an ohm meter and the thermistor calibration graph.

Sample analysis

In the laboratory, the researchers measured sample BOD, nutrient and TOC values and conducted total and fecal coliform analyses. They also carried out microbiological examinations on the biomat samples. These tests included microscopic microbial quantification and identification of the organisms present; comparison of the microbial activity of the biomats formed; and an examination and photographing of the geotextile biomat using phase microscopy and scanning electron microscopy.

FINDINGS

Wastewater treatment

The analysis indicated that the contour trench system operated satisfactorily from a wastewater-renovation standpoint, with the exception of one malfunction in the trench system at one of the samplers. Average total and fecal coliform reductions of 99% were observed between the dosing chamber and the samplers located underneath the trench. Approximately 95% of the phosphorus was removed and about 80% of the wastewater TKN was either removed or nitrified to nitrite (NOX).

Statistical analysis of the data indicated there was no significant difference in the treatment efficiencies of the three surface infiltrative media. There was also no significant difference among the three media in their affect on groundwater quality.

Biomat characteristics

During the early stages of the study, the geotextile biomat appeared to have good biomat formation characteristics. However, after approximately 18 months of operation, the fabric was plugging up with organic material to the point that its long-term hydraulic conductivity was in doubt.

Groundwater monitoring

Groundwater monitoring indicated that the contour trench had only minimal effect on the downstream groundwater quality. There were no detectable fecal coliform concentrations present.

Temperature profiles

Ground temperature recordings indicated that the trench bottom and the perforated disposal pipe at depths of 1.2 m and .65 m, respectively, were satisfactory to prevent freezing in severe cold temperatures.

CONCLUSIONS

While, the Contour trench wastewater disposal system performed well, the geotextile should not be used as an infiltrative medium for ground disposal systems until the problem of its long-term clogging with organic material has been addressed. This would best be done at the bench or pilot project scale under carefully controlled conditions. There was also no additional benefit concerning the degree of wastewater improvement from the use of a geotextile liner compared with the specified sand or the in-situ sand medium. In addition, the coliform, nutrient and carbon removal characteristics of all three media were not significantly different. However, in remote areas, cost to transport synthetic geotextile material is economical and is easy to handle and install.

The contour trench system does not contaminate the surrounding groundwater when it is placed in moderately permeable sands and gravels. However, a continued groundwater monitoring program is necessary to determine the long-term effect on the local groundwater quality.

For the contour trench system to operate successfully, there must be an even flow distribution along the length of the trench. The uneven flow distribution observed in this study could have been the result of post-construction settlement of the trench or distribution pipes, or a malfunctioning of the dosing chamber. The authors recommend a thorough investigation of the existing system to review the problems of the uneven flow distribution.

In areas of the country that experience prolonged cold weather conditions (i.e., -20°C for 2-3 weeks), the disposal pipes should be installed at depths greater than 0.5 m in course granular soils.

In summary, even with the above-noted qualifications, the contour trench system has good potential for the development of housing in remote or isolated locations. It is well-suited for communities in which the housing is located along a narrow strip parallel to lake or river, where the impact on a receiving water course is a major concern, or where the construction of a conventional sewage disposal system is impractical. It also provides a lower-cost disposal system and results in an improvement of environmental and health conditions. As a system that operates successfully in the severe northern climate and far from regular maintenance by trained personnel, it could be used in many housing developments and small communities across Canada.

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Consultant: NovaTec Consultants Inc.

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