RECOVERY OF FAILING DRAINFIELDS AND SAND FILTERS USING AEROBIC EFFLUENT

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This paper includes an abridged report originally presented at an ASAE conference and published in the proceedings. As the report has been used and or marketed improperly, causing much confusion, this paper will endeavor to clarify various, important, aspects.

The report clearly identified the methods utilized to evaluate a system prior to installing an aerobic system in an attempt to recover a failing system. It is not possible however to recover all failing systems using aerobic effluent. A comprehensive investigation and analysis of all information gathered must be preformed prior to attempting a recovery.

RECOVERY OF FAILING DRAINFIELDS AND A SAND MOUND USING AEROBIC EFFLUENT

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ABSTRACT

This paper presents three case studies where aerobic effluent was utilized to recover failing onsite systems. The sites are described as follows: 1) a residential system with a gravity drainfield, 2) a residential system with a mound, and 3) a café with a gravity drainfield. The paragraphs to follow summarize the methods employed when determining the cause of the failures. This report also demonstrates how the onsite systems can be recovered. As a comparative analysis the data associated with each case study is tabulated showing the design loading (Health Department Guidelines), the loading at failure, and the loading after recovery. The data includes Flow, (GPD), (Flows per square foot), BOD_5, TPPD of BOD_5, (Total pounds per day per square foot), TSS, (Total Suspended Solids), FOG, (Fats, Oils, Grease), pH, Temperature, and DO, (Dissolved Oxygen).

One Aerobic Treatment Unit (ATU) product line was selected for the study, which consisted of a residential model and a commercial model. Both models maintained similar features including; 1) control of system flow, 2) the reduction BOD_5 by a percentage, 3), the discharge of a very high DO with an pH near seven, and 4), and discharge aerobic microorganisms.

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CASE STUDIES

Case Study #1:

In April 1996 Aqua Test, Inc., a monitoring and maintenance company was employed to evaluate a failing onsite septic system serving a three-bedroom home. The system was six years old with a household consisting of two adults and two teenagers. The original septic system design was based on 360 GPD with a loading rate of .8 g/ft^2 or 450 ft^2 of drainfield. The septic system consisted of a 1000-gal, two-compartment tank and 225 ft., two-foot wide serial distribution, gravity drainfield. The lengths of drainfield lines starting adjacent to the septic tank are as follows: 28', 30', 70', and 97' respectively (Fig. 1).

Figure 1. Case Study #1. Biologically Failed Drainfield.

At the time of the first inspection, all drainfield lines were flooded and the lowest line in elevation was surfacing. The owner reported the onsite system had been pumped out three times since installation, at two, three and a half, and five years. Each time the system was pumped because sewage had backed up into the home.

The system evaluation was initiated with a soil investigation that consisted of describing the soil profile between drainfield lines one and two to a depth of 64". The results of which indicate the site soils exhibit the characteristics of Loamy Sand to a depth of 60", verifying the .8-loading rate called for in the original design, followed by Hardpan or Glacial Till between 60" and 64".

The system evaluation concluded with an analysis of the wastewater characteristics including BOD_5, TSS, FOG, pH, Temperature, and DO. An effluent sample was collected from the outlet of the septic tank on 5/17/96. The results are shown in Table 1. Water district records indicated the flows to be 300 GPD. The Washington State Regulation defines the maximum residential BOD_5 waste strength as 230 mg/L and no clear definition for TSS and Fats, Oil and Grease. Aqua Test, Inc. maintains an extensive database for residential waste strengths analyzed in Washington. From this data base the maximum residential waste strength for TSS and Fats, Oil and Grease are 76 mg/L and 25 mg/L respectively. Based upon the frequency of pumping and the analytical testing results, Aqua Test, Inc. and the Health Regulator concluded that organic overloading, which resulted in the formation of a heavy biomat, was the most probable cause for the drainfield failure. After review of the site assessments and conclusions, the construction of additional drainfield would be an unwise repair. The addition to the drainfield without a simultaneous change in the waste stream would consequently result in another failure within a relatively short period of time. However recovering the existing system utilizing an ATU and adding 100 ft. of drainfield would provide an adequate long-term solution. Table 1 summarizes the waste strengths and loading rates for the three modes of operation as follows: the design, the failure, and the recovery. The loading rates in the table are reflective of the total drainfield area receiving effluent.

Table 1. Summary Table.

Mode	**Flow (gpd)**	**Unit flow (gal/ft^2)**	**BOD_5 (mg/l)**	**BOD_5 # per day**	**BOD_5 # per ft^2 per day**	**TSS (mg/l)**	**FOG (mg/l)**	**pH**	**Temp** (C)	**DO (mg/L)**
Design	360	0.8	230	.69	.0015	76	25	NA	NA	NA
Failure	300	0.66	340	.85	.0019	24.7	57.7	6.6	18°	.3
Recovery	313	5.59	61.7	.16	.0029	35	26	7.6	20°	5.5
Available Area	313	.48	61.7	.16	.00024					

The repair was initiated through pumping the septic tank and the first line of the drainfield, followed by the installation of an ATU in the second compartment (outlet) of the 1000 gal. septic tank and 100' of drainfield added onto the end of the drainfield lines. After 30 days, only a small amount of ponding was evidenced in each of the drainfield lines. Within 90 days of installation, the only line showing evidence of ponding was the first line, which at this time is still the only line that shows any trace of ponding. The total flow from the home, now averaging 313 GPD,is being completely absorbed into the first 28' of drainfield.

Case #2:

In early February 1996, Aqua Test, Inc. was asked to investigate a failing onsite mound system located at a three-bedroom home built in 1990. The owner reported that the system had first surfaced in 1992, when the home was two years old. For this particular residence, the family consisted of two adults and two small children. The onsite system had been designed for 360 GPD with a loading rate of 1.2 $g/ft^{\wedge 2}$ or 300 ft^2 of disposal bed. The system consisted of a 1000 gal. two-compartment septic tank, a 250 gal. pump tank, a 1/3-hp. float controlled pump, and a mound (Fig.2).

Figure 2. Case Study #2. Failed Mound.

The investigation of this system included characterizing the waste stream and measuring the flows. Effluent samples were collected from the pump tank on 2/22/96 and results are shown in Table 2. At the time of sample collection, an hour meter was installed on the pump in the pump tank. Daily readings were recorded and after a one-month period, the flows were averaging 196 GPD. Further investigation showed 52 gal. were being pumped in a two-minute cycle. This is exactly half of what the pump was discharging at time of installation. The GPM was due to ponding in the gravel bed in the top of the mound. The amount of effluent surfacing was determined to be approximately 10 gal. per cycle. This meant that the mound was absorbing roughly 42 gal. per cycle. *Note: Prior to determining the amount of effluent surfacing, the mound had been allowed to rest for two hours.* A further investigation was carried out as to the composition of the sand used in the bed of the mound. A sample of the sand was collected and subjected to a sieve analysis. The results indicated that the sand passed the C-33 standards used for classifications in this area. Table 2 below summarizes the waste strengths and loading rates for the three modes of operation as follows: the design, the failure, and the recovery. The loading rates in the table are reflective of the disposal bed area receiving effluent.

Table 2. Data Summary

Mode	**Flow (gpd)**	**Unit Flow (g/ft^2)**	**BOD_5 (mg/l)**	**BOD_5 # per day**	**BOD_5 # per ft^2 per day**	**TSS (mg/l)**	**FOG (mg/l)**	**pH**	**Temp (C)**	**DO (mg/L)**
Design	360	1.2	230	.69	.0023	76	25	NA	NA	NA
Failure	196	.65	262	.43	.0014	36	61.	7.4	16°	.2
Recovery	319	.94	63.5	.17	.00056	31.3	10.1	7.7	23°	6.3

Aqua Test, Inc. and the health regulator reviewed the information collected to date and concluded that organic overloading, which resulted in the formation of a heavy biomat, was the most probable cause of the mound failure.

At this point, Aqua Test, Inc. recommended a phased approach to correct the failing system. Phase I would be the recovery of the existing onsite system and Phase II would be the installation of additional drainfield. Phase I included the installation of an ATU in the outlet of the septic tank to recover the partially failing mound, and monitoring of the system for 30 days. If the surfacing stopped, the drainfield would not be installed. In the event that the mound continued to surface, Phase II, the proposed drainfield addition, would be installed and a sufficient amount of the flow would be directed to the drainfield. This would prevent the mound from surfacing. All parties agreed that a phased approach would be implemented. Phase I commenced with the pumping of the septic tank and the gravel bed in the mound, followed by the installation of an ATU on 4/16/96. On 4/23/96, effluent was no longer surfacing. The system has been continuously monitored biannually. Evidence of surfacing has never been detected at this site since the ATU installation. As a result, Phase II has never been implemented.

<u>Case #3:</u>

Case #3 involves a café serving a menu of typical American dishes. The restaurant is open seven days a week, serving lunch and diner over a ten-hour period. The seating capacity is 45 corresponding to 150 meals per day on average.

There are no historical records available prior to the installation of a new onsite system in late 1986. The design flow used to size the site was 1100 GPD. The new system consisted of two 1000 gal. septic tanks, one serving the black water, the second serving the gray water. A common line conveys the flow from the tanks to the drainfield. The drainfield is a gravity serial distribution system that uses drop boxes between the lines. There are eight trenches, 3’ wide and 65’ long for a total of 1,560 ft^2 corresponding to a loading rate .70 g/ft^^{2} (Fig 3).

Figure 3. Case Study #3 Commercial System.

In 1988, within two years of the installation, the gravity drainfield failed. The failed drainfield was overgrown with blackberries, which hid the failure from the public eye. In 1991, citizens were filing complaints with the Health Department regarding the odors coming from the failing onsite system. To determine the waste strength of the effluent, the Health Department collected samples from the flow as it entered the first drop box. The results are shown in Table 3. The Health Department notified the owner that the problem needed to be corrected within 30 days or the facility would be closed. Table 3 summarizes the waste strengths and loading rates for the three modes of operation as follows: the design, the failure, and the recovery. The loading rates in the table are reflective of the total drainfield area receiving effluent.

Table 3. Test Results From Sample Collected By The Health Department In 1991.

Mode	Flow (gpd)	Unit Flow (g/ft^2)	BOD_5 (mg/l)	BOD_5 # per day	BOD_5 # per ft^2 per day	TSS (mg/l)	FOG (mg/l)	pH	Temp (C)	DO (mg/L)
Design	1100	.64	230	2.11	.0014	76	25	NA	NA	NA
Failure	1013	.64	4900	41.39	.027	1700	130	NA	NA	NA
Recovery	891	1.14	130.74	.97	.0012	99.4	13.84	7.03	17	.96

Aqua Test, Inc. was provided the information gathered by the Health Department, shown in Table 3, and employed to design a system that would comply with Health Department requirements. A drainfield investigation was conducted to determine the soil profile, soil depth, and depth of drainfield. The soil log report depicts the soil as Loamy Sand from zero to 52" and Glacial Till or Hard Pan to 60". The existing drainfield was installed in the top 24", which met local regulations for drainfield separation. With the information collected to date, Aqua Test, Inc. again recommended a phased approach. Phase I consisted of the following:

- ATU would be installed to reduce the waste strength of the gray water to residential levels.
- The existing drainfield would be vacuumed out.
- The system would be restarted and monitored weekly for a two-month period.

If it were found during the monitoring period that drainfield lines seven and eight were ponded, or sewage surfaced, Phase II would be implemented. Phase II would be the replacement of the entire existing drainfield with a new drainfield. Since the startup of the ATU to this date, 8/20/00, there have never been more than four lines ponded. The average of ten samples collected in the 30 months since the Phase I implementation is shown in Table 3. All of these samples were collected from the flow as it enters the first drop box, the same location as the Health Department collected the original sample (Fig.3). *Note: The routine pumping of this system has included the vacuuming out of drainfield lines one and two.*

Summary

As has been demonstrated by the case studies presented in this paper, before attempting recovery of any onsite septic system using aerobic effluent, you must first establish whether or not an excessive biomat is truly the problem. If the biomat is verified to be the cause of the problem, you must evaluate the extent of the clogging. If the onsite disposal system will not hydraulically accept any flow, it may not be recoverable without adding additional disposal area. In reviewing the records of many recovered systems, clearly the fastest recoveries occur when the treatment or disposal system is vacuumed out before the aerobic effluent is introduced into the system. The question to ask ourselves is what are the differences between aerobic and anaerobic effluent as they relate to the State Design Guidelines?