INTERIM REPORT

"Nutrient Removal and Sludge Disposal

Within Septic Systems. Phase III."

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Nicholas L. Clesceri and James J. Ferris

Rensselaer Fresh Water Institute at Lake George

Troy, New York 12181

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Project Supervisor: [signature]
Nicholas L. Clesceri, Ph.D.

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INTRODUCTION

Many investigators have begun intensive research on the problems associated with our natural water routes. Although aquatic ecosystems are changing continuously, yet at different rates and in response to various perturbations (natural and/or cultural), one possible method that may help in maintaining their biological stability is to monitor and where necessary control those input variables that can seriously alter the integrity of these natural systems. This is very true for lake ecosystems since they have been used as receiving waters for multiple types of wastewater discharge. Two morphological factors which are quite influential in the modification of lake trophic state are hydrology and nutrient loading. Internal loading of nutrients varies from one water body to another yet internal loading appears to be more detrimental to small than to large lakes whereas external nutrient loading plays a more important role in bigger lakes (Vollenweider, 1968). Biological production can be stimulated by four principle interdependent categories of physical factors, namely, radiant energy input, nutrient input and loss, oxygen supply, and interactions of lake morphometry and motion (Mortimer, 1969). Of these, nutrients and oxygen are controllable to some extent, and apparently, minimizing the effects of eutrophication may be most plausible by nutrient control. Further, point sources of nutrients (e.g. from sewage systems) must be given more attention in any eutrophication control program.

The Rensselaer Fresh Water Institute at Lake George has been developing a mechanism by which septic tank system efficiency in removing excessive bio-stimulatory nutrients (especially phosphorus and nitrogen) can be improved.

SUMMARY OF PAST RESEARCH

Previous research at the Fresh Water Institute demonstrated that ferric chloride could be used as a chemical precipitant for phosphorus removal from septic tank systems. More explicitly, the following conclusions can be considered as brief statements of the overall status of previous investigations (Schauffler, 1974).

1. The addition of either ferric chloride or alum in the range of 150 to 200 mg/1 will result in the inhibition of gas production during anaerobic digestion.
2. The extent of inhibition will be controlled in part by the amount of alkalinity in the system, and will decrease with increasing alkalinity.
3. The aluminum-phosphate complex is quite stable and will remain insoluble during anaerobic digestion.
4. The stability of the iron-phosphate complex is variable and may be affected in part by microbial activity.
5. In a poorly mixed system, the addition of 110 mg/1

or more of alum will result in phosphorus removal efficiencies of 80 percent or more in an average strength wastewater.

6. In a poorly mixed system, a dose level of 200 mg/l ferric chloride is required to effect 80 percent phosphorus.
7. The treatment of digested sludge with 120-180 mg/l alum will improve the dewatering ability and subsequent compaction of the sludge during settling. Such a decrease in volume of solids could benefit the system by:
   a) potentially increasing the time between tank cleanings, and
   b) lowering the cost to the homeowner.
8. Modifications to the activity of the methane bacteria due to pH decreases are likely to occur with ferric chloride addition and little, if any effect on the "acid formers". An increase in the concentration of volatile acids in the septic tank effluent due to inactivity of the methane bacteria could enhance the tile field clogging by increased slime growth as an organic mat.

CURRENT MATERIALS, METHODS AND PRELIMINARY RESULTS

The replacement of the 750 gallon septic tank and associated materials of the system that has been operational at the Bolton Landing, New York, field site for this project is now complete. A 1,000 gallon tank for the year round residence and another for the seasonally used cabins have been installed. Since the system has recently become functional it is anticipated that the wastewater discharge will approximate 750 gpd originating solely from the residence.

As noted in an earlier report (Clesceri, 1974) the one family residence septic tank effluent is pumped to the distribution box by a ½ HP sewage lift pump, which the effluent from the 7-8 cabins septic tank reaches its respective distribution box under gravity flow. Both boxes feed a leach field area of 2,600 sq. ft. containing 325 linear feet of 6" tile. Between the housing units and their respective septic tanks are alum holding tanks and feed pumps for the introduction of the chemical precipitant solution directly into the system.

Sampling is occurring weekly; however, this schedule will likely be modified with an accumulating series of data. Sampling ports are located at the following sites: 1. family residence septic tank and lift pump pit, 2. the two distribution boxes, 3. two points located in the leach, and 4. one well point located down slope from the leach field.

To date, samples have been secured with a hand operated marine crank case pump connected to an 8 foot segment of ¼" copper tubing. As a matter of routine, depth profile samples of the septic tank itself has occurred in an attempt to determine the presence of any nutrient concentration gradients. Samples are collected either in 1.0 liter pyrex glass bottles or wide-mouth plastic containers.

Initially the samples have been taken without alum being introduced in order to characterize the operation of the system prior to chemical precipitation and at the different sampling locations. To date, all methods employed for the determination of macronutrients (nitrogen and phosphorus) in the samples obtained have been according to Standard Methods (1971). pH has been determined at the time of sample collection and the temperature of the septic tank will be obtained using a Whitman probe device. Also, the following parameters are planned for regular determination during the remainder of this project:

Total organic carbon

Alkalinity

Sulfur

Nitrate - N

Aluminum

Suspended solids (in the pump pit)

Data shown in Tables 1 and 2 are representative of the information regarding nitrogen and phosphorus at various sampling sites in the septic system. It appears that these preliminary data suggest that the new system is operating effectively.

Table 1. Representative Values of Nitrogen Contained in Septic Tank System Samples.

Date	Sample Site	Sample Location	pH	Total Kjeldahl Nitrogen (ug/l)	NH_3-N(ug/l)
11/1/74	Septic Tank	Top		5.6	86.8
		Middle		7.0	89.3
		Bottom		420 *	280 *
11/8/74	Septic Tank	Top		3.92	79.2
		Bottom		168 *	336 *
	Pump Pit			3.92	87.4
	Water Well			---	---
11/15/74	Septic Tank	Top	6.8	2.52	82.9
		Bottom	6.85	1.5	364 *
	Pump Pit		6.9	2.8	86.8
	Water Well		6.9	---	---

* These data are shown as mg/l

Table 2. Values of Phosphorus and its Fraction Forms in Septic Tank System Samples.

Date	Sample Site	Sample Location	pH	Total P (ug/l)	Total Soluble P (ug/l)	Ortho P (ug/l)
10/12/74	Septic Tank			5.5	3.1	---
	Pump Pit			4.4	2.2	---
10/19/74	Septic Tank			7.2	5.2	---
	Pump Pit			5.5	5.7	---
11/1/74	Septic Tank	Top		7.3	5.2	12.7
		Middle		11.1	3.1	5.9
		Bottom		100	30	10
11/8/74	Septic Tank	Top		6.9	4.6	9.4
		Bottom		60	13	7.0
	Pump Pit			7.25	4.9	.85
	Water Well			<0.1	---	---
11/15/74	Septic Tank	Top	6.8	8.6	---	---
		Bottom	6.85	90	---	---
	Pump Pit		6.9	7.6	---	---
	Water Well		6.9	<0.1	---	---

The high values shown for all chemical parameters listed (e.g. 420 mg/l total kjeldahl nitrogen, 100 mg/l total phosphorus, et al.) are expected if one examines the location of these samples. In all cases the data arose from samples secured at the bottom of the septic tank. These samples contained numerous particulate material which is the likely source and sink of the elements under consideration. The average value of total kjeldahl nitrogen and NH_3-nitrogen in "top" septic tank samples were 4.01 mg/l and 82.9 mg/l respectively. Similarly, average values of total phosphorus, total soluble phosphorus and orthophosphate are 7.1 mg/l, 4.5 mg/l and 11.05 mg/l respectively. As previously noted this indicates that the operation of the unit is acceptable and dosing with chemical precipitants will begin.

LITERATURE CITED

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