United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-81-084 July 1981

EPA

Project Summary

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds

E. Corbin McGriff, Jr.

The performance of "phase isolation" lagoons was investigated at Clinton, Mississippi, from May 1978 to May 1979. The study system consisted of two facultative lagoons arranged in series followed by two isolation ponds used alternately for final polishing. The isolation ponds were operated on a fill and draw basis with isolation periods varying from 20 to 44 days.

The study indicated that phase isolation would not consistently meet the National Permit Discharge Effluent System (NPDES) limitations of 15 mg/L-BOD_5, 30 mg/L-TSS, and 5 mg/L-TKN-N established for Clinton. The isolation process did, however, demonstrate its ability to produce the following average effluent: pond 1, 11 mg/L-BOD_5, 39 mg/L-TSS, and 3.7 mg/L-TKN-N; and pond 2, 13 mg/L-BOD_5, 36 mg/L-TSS, and 3.9 mg/L-TKN-N.

The Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

General History

Since the passage of the Federal Water Pollution Control Act (PL 92-500) in 1972, most cities and communities have been required to upgrade their existing treatment systems. A number of communities have opted to use facultative lagoon systems to meet the secondary standards; for the most part, however, it has been the small community whose economics dictate this type of treatment.

A number of existing municipal lagoon systems will not be able to comply with EPA's secondary treatment standards for municipal installations. The regulations state that the effluent BOD_5 and suspended solids should not exceed an arithmetic mean value of 30 mg/L on samples collected in 30 consecutive days. A final amendment to the secondary treatment regulation allows a case-by-case adjustment in suspended solids limitations for publicly owned stabilization ponds if the following applies: the pond has a design capacity of 2 mgd or less, ponds are the sole process for secondary treatment; and the pond meets BOD limitations.

To assist the small community in complying with the PL 92-500 standard for secondary treatment, researchers have investigated various concepts for upgrading the basic lagoon system. One such concept, termed "phase isolation" by its originators in Woodland, California, was reported to enhance existing lagoons by isolating the effluent before discharge. The system consisted of conventional facultative ponds in series with a final isolation pond operated on a fill and drain basis. The isolation pond was capable of producing a relatively solids-

free upper water strata, that, when discharged, would meet secondary standards.

Because of the simplicity of phase isolation demonstrated in California, Clinton, Mississippi, was selected for a demonstration project to evaluate the isolation concept in a different geographical location. Clinton had been issued the following NPDES limitations based on a monthly average: BOD_5, 15 mg/L; SS (or TSS), 30 mg/L; TKN, 5 mg/L; and fecal coliform, 200/100 ml.

Project Scope and Objectives

The study was designed to evaluate the phase isolation process on a seasonal basis and to determine its applicability in meeting local as well as national standards Two existing facultative ponds arranged in series were connected to two isolation cells. Effluent from the series facultative ponds was discharged to either of the isolation ponds on an alternate basis for final treatment. Because of budget and pond configuration constraints, a single isolation pond depth was maintained throughout each isolation pond. The effluent was isolated from 20 to 44 days before being discharged depending on the *in situ* water quality. At the end of each isolation cycle, the pond upper strata was discharged and evaluated for effluent quality

To evaluate the phase isolation process, the following specific objectives were outlines

1 To monitor biological, chemical, and physical parameters during each isolation cycle and during final drawdown.
2. To determine whether the isolation process will produce an effluent that consistently meets Clinton's NPDES limitations and the national EPA secondary standards

Description of Study System

Clinton is a community of 15,500 people located about 10 miles west of Jackson, Mississippi, and about 35 miles east of the Mississippi River. Clinton's climate is significantly humid during most of the year, with a relatively short, cold season and a long, warm season The proximity of the Gulf of Mexico, about 150 miles south, and the prevalence of southerly winds amounts to a maritime characteristic during the warm season.

Clinton currently uses four separate facultative lagoons and one mechanical treatment plant to treat approximately 18,248 m^3/day of domestic wastewater. The existing treatment units are located at various natural collection points throughout the city. Clinton's one industrial park treats its own wastewater and is totally separate from the municipal system Except for a number of typical commercial users, the municipal system handles domestic wastewater.

The southwest facultative lagoon system was selected as the study site because of its convenient configuration, with ponds 3 and 4 in series handling city wastewater (Figure 1). Ponds 1 and 2, constructed for future expansion and unused before this study, received the effluent from pond 4 on an alternate basis where it was held from 20 to 44 days.

The isolation ponds were separated from the facultative ponds by typical earthen dikes. A positive control valving system was installed to divert effluent to either isolation pond as required by the study The facultative effluent was introduced to the isolation ponds near the center of each pond. Each isolation pond was equipped with a typical control structure that was adjusted according to the drawdown requirements. Once the drawdown level was reached, the discharge valve was shut off and the fill cycle was initiated.

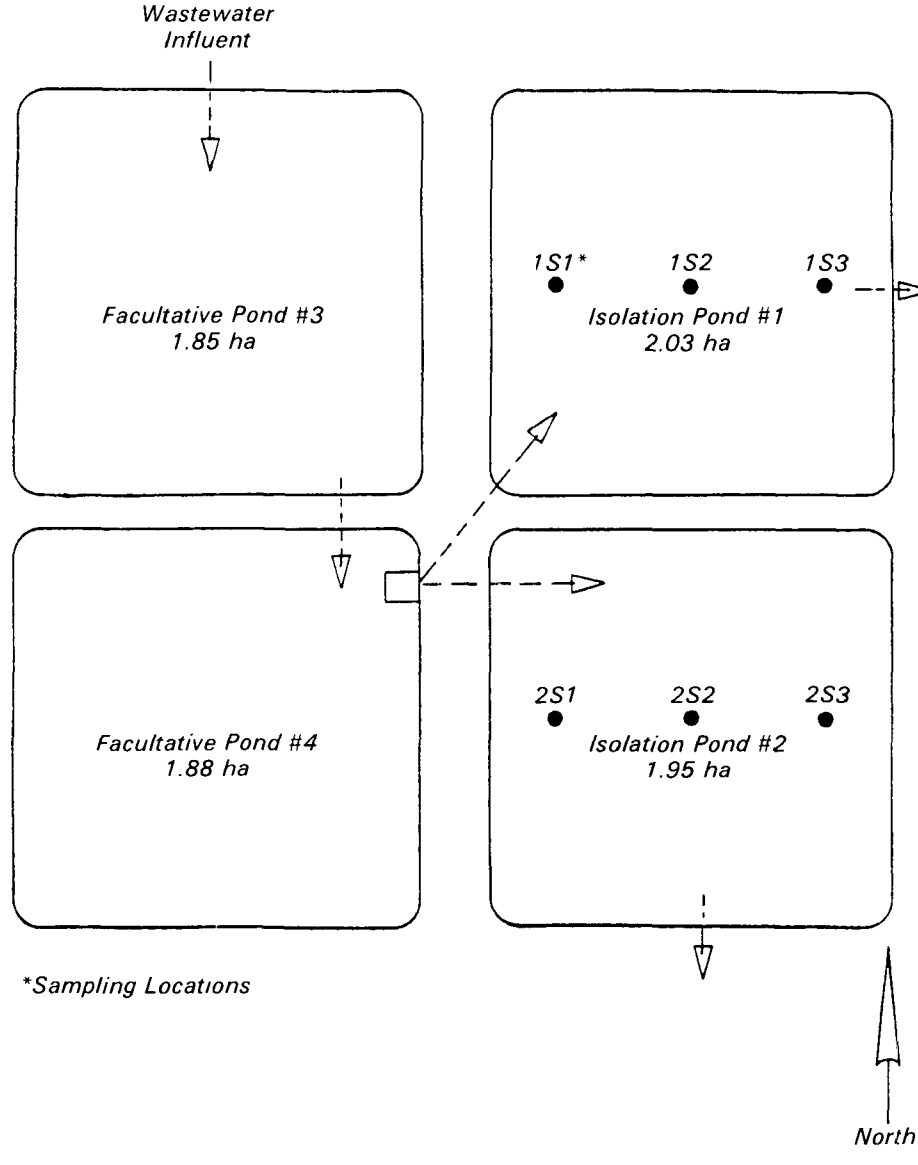

Figure 1. *Facultative and isolation pond arrangement at Clinton, Mississippi.*

Discussion of Results

Isolation Pond Performance

Initially both isolation ponds were filled with facultative pond effluent to an operating study depth of approximately 1.83 meters, a depth selected because of physical and economic constraints. Pond 1 was filled first and began the isolation period on May 24, 1978; pond 2 was started on June 21, 1978. Subsequent isolation cycles were operated by fill and drawdown control. At the beginning of each isolation cycle, the ponds were filled with a quantity of facultative pond effluent equal to the previous drawdown to maintain a study depth of 1 83 meters. The isolation period began when the study pond reached the operating depth and was terminated on the day of drawdown. On an average concentration basis, isolation pond 1 received 42 mg/L BOD_5, 61 mg/L TSS, 17.6 mg/L TKN, and pond 2 received 54 mg/L BOD_5, 57 mg/L TSS, and 17.6 mg/L TKN.

In an effort to evaluate the performance of the study system, a broad list of parameters, both total and soluble forms, was used. The key parameters used to evaluate the period of isolation were BOD_5, TSS, and TKN. The facultative pond effluent was held in isolation until one or more of the following decision points occurred: (1) the water column concentration of TSS and BOD_5 decreased to a level below 30 mg/L and 15 mg/L, respectively; (2) the minimal level of TSS and BOD_5 was attained, and these parameters appeared to be on the increase; or (3) the facultative ponds attained the maximum operational capacity. Except for the initial isolation period for each pond, this protocol was followed In most cases, once it appeared that a minimal level had been attained, the effluent was held for a few more days to establish the stability of the water column quality. Using these criteria as decision points during the study, the isolation cycles, which varied from 20 to 44 days, were measured from the end of one fill tc the beginning of the drawdown. Each isolation cycle or holding pond varied in duration depending upon evaluation of *in situ* quality. During the study period, eight cycles were evaluated for pond 1 and seven cycles for pond 2.

Performance Summary

It appears that the phase isolation process can, at times, produce an effluent that will meet the NPDES limitations for Clinton, Mississippi. As demonstrated during this study, however, the process is not consistent in its performance and should not be considered as a final process unit. Pond 1 produced an effluent that complied with the NPDES limitations four out of eight discharge cycles for TSS and seven out of eight discharge cycles for BOD_5 and TKN. Pond 2 was in compliance two out of eight discharge cycles for TSS, four out of eight for BOD_5, and eight out of eight for TKN. Both ponds complied with the NPDES limits for dissolved oxygen, fecal coliform, and pH. A significant correlation between the area rainfall and effluent BOD_5 and TSS indicates sensitivity of the process to climatic and seasonal conditions.

A multiple regression equation with a correlation coefficient of 0.935 provides a predictive tool for effluent suspended solids as a function of secchi depth, TSS, BOD_5, COD, TOC, organic nitrogen, ammonia nitrogen, nitrite and nitrate nitrogen, and total phosphorus. A correlation matrix showed a relationship between the effluent suspended solids and *in situ* secchi depth, suspended solids, nitrate nitrogen, and total phosphorus.

Microscopic examinations revealed the algal form of *Chlorella* to appear most often in both isolation ponds, with *Oscillatoria, Ankistrodesmus, Pediastrum,* and *Ulothrix* dominating to a lesser degree.

The full report was submitted in fulfillment of Grant No. R-805296 by Environmental Protection Systems, Inc., subcontractor to the City of Clinton, MS, under the sponsorship of the U.S. Environmental Protection Agency.

E. Corbin McGriff, Jr. is with Environmental Protection Systems, Inc., Jackson, MS 39209.

***Ronald F. Lewis** is the EPA Project Officer (see below).*

The complete report, entitled "Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds," (Order No. PB 81-205 965; Cost: $14.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Municipal Environmental Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

☆ US GOVERNMENT PRINTING OFFICE 1981 -757-012/7193

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335

Official Business
Penalty for Private Use $300

RETURN POSTAGE GUARANTEED

Third-Class
Bulk Rate