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Evaluation of Sludge Pump Clogging Issue for an Industrial Waste Pretreatment Plant in the Ceres Industrial Park, Vicksburg, MS

Victor F. Medina, Scott A. Waisner, and Michelle Wynter

April 2018

Environmental Laboratory

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Final Report

Prepared for City of Vicksburg as an Engineer Research and Development Command (ERDC) community outreach project

Abstract

Dr. Victor F. Medina conducted a site visit on 12 June 2017 for the evaluation of a sludge pump clogging issue at an industrial waste pretreatment plant in the Ceres Industrial Park, Vicksburg, MS. Escorted by Mr. Pablo Diaz of the Port of Vicksburg, the operating issue was that the sludge pump routinely clogs. The sludge material had accumulated around the ball that serves as the check valve, preventing its operation. The ERDC team offered recommendations based on the site visit to resolve the pump clogging issue.

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Preface

This study was conducted for the City of Vicksburg as an Engineer Research and Development Center (ERDC) community outreach project. Funding for the project was approved by the Commander of the ERDC, COL Bryan S. Green.

The work was performed by the Environmental Engineering Branch (EEB) of the ERDC - Environmental Laboratory (ERDC-EL), U.S. Army Engineer Research and Development Center (USACE). At the time of publication, Mr. Andy Martin was Branch Chief, CEERD-EP-E; and Mr. Warren Lorentz was Division Chief, CEERD-EP. The Deputy Director of ERDC-EL was Dr. Jack Davis and the Director was Dr. Ilker Adiguzel.

COL Bryan S. Green was Commander of ERDC, and Dr. David W. Pittman was the Director.

Acronyms and Abbreviations

DoD	Department of Defense
EL	Environmental Laboratory
EEB	Environmental Engineering Branch
ERDC	Engineer Research Development Center
TanTec	ISA TanTec Leather tannery
USACE	U.S. Army Corps of Engineers

1 Introduction

1.1 Background

Dr. Victor F. Medina, with members of the Engineer Research and Development Center – Environmental Laboratory (ERDC-EL), conducted a site visit on 12 June 2017 for the evaluation of a sludge pump clogging issue at an industrial waste pretreatment plant in the Ceres Industrial Park, Vicksburg, MS. Escorted by Mr. Pablo Diaz of the Port of Vicksburg, the operating issue was that the sludge pump routinely clogs. The system operator, Mr. Vick Hasie, was available to answer questions. The ERDC team also met with Mr. Kirk Manley and Ms. Gabriela Morogan of ISA TanTec Leather tannery (TanTec) to discuss the issue of effluent discharge.

1.2 Overview

The treatment system under evaluation is relatively simple (Figure 1). Wastewater from the TanTec facility flows out of the plant and through a screen that removes large solids (Figure 2). Wastewater then flows via a waterway to a sump at the wastewater treatment site (Figure 3). Water is pumped into a large equalization tank, which also acts as an initial flocculation tank (Figure 4). In the tank, the wastewater is initially treated with a lime slurry to make the pH slightly basic (Figure 5). The water is then put into a sludge floatation system that separates the sludge from the water (Figures 6–8). The sludge is then augured (Figure 9) into a pneumatically operated, diaphragm sludge pump (Figure 10). The processed sludge is highly fibrous in nature (Figure 11). The sludge pump then pumps the sludge into outdoor bins, where it can dry in the sun and is eventually picked up for disposal or recycling.

Figure 1. A schematic of the industrial wastewater treatment plant.

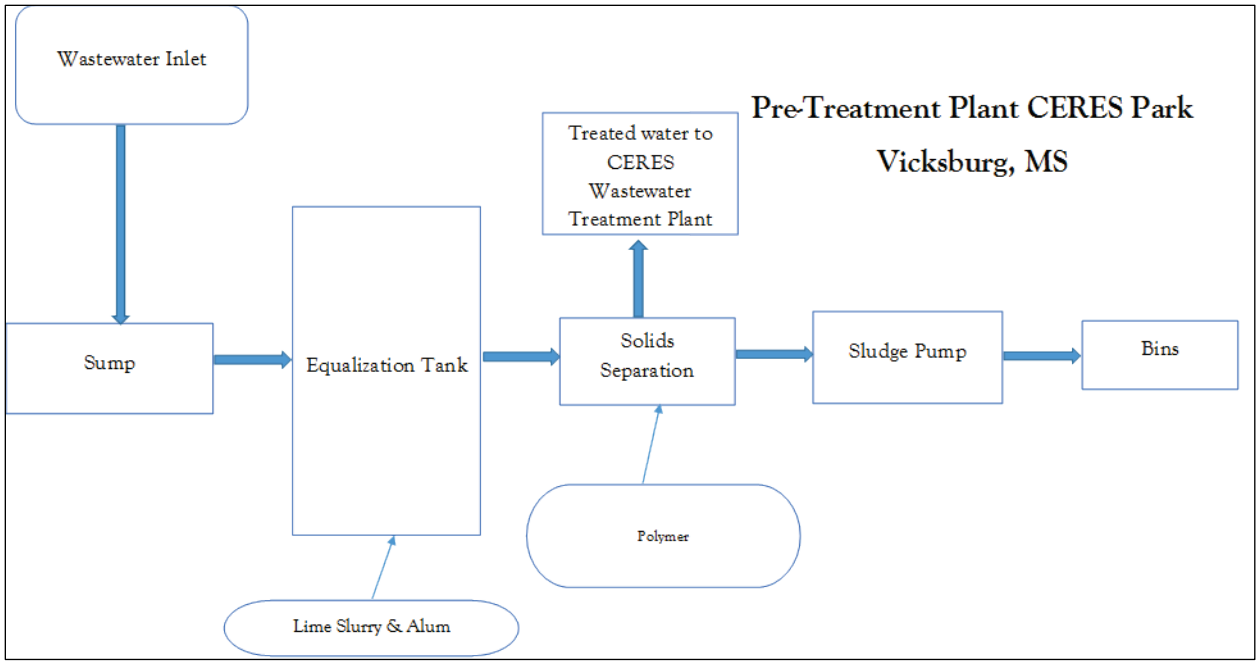

Figure 2. Discharge point from the TanTec facility showing the screen for removal of large constituents.

Figure 3. Collection sump.

Figure 4. Equalization tank.

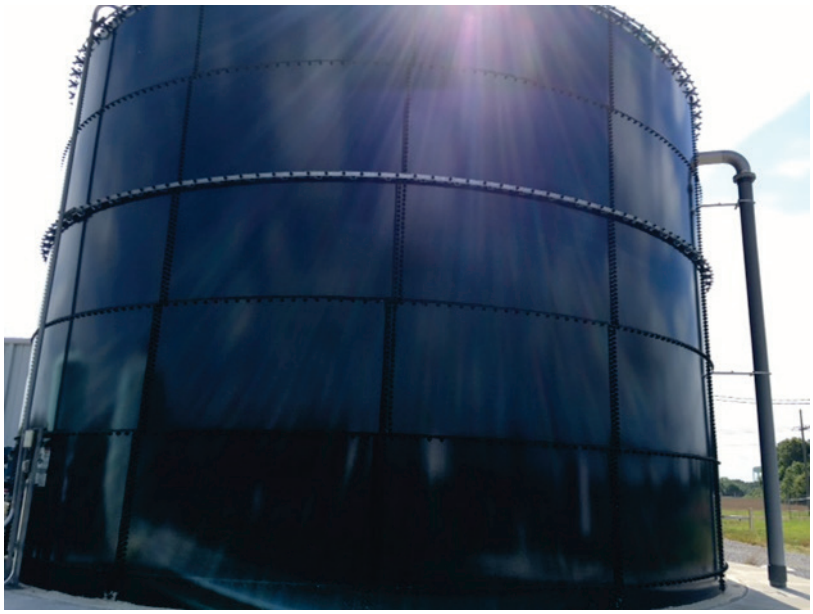

Figure 5. Lime slurry tank and pH meter on equalization tank.

Figure 6. Sludge floatation reactor.

Figure 7. Sludge floatation.

Figure 8. Sludge separation.

Figure 9. Sludge augur.

Figure 10. Pneumatic diaphragm sludge pump.

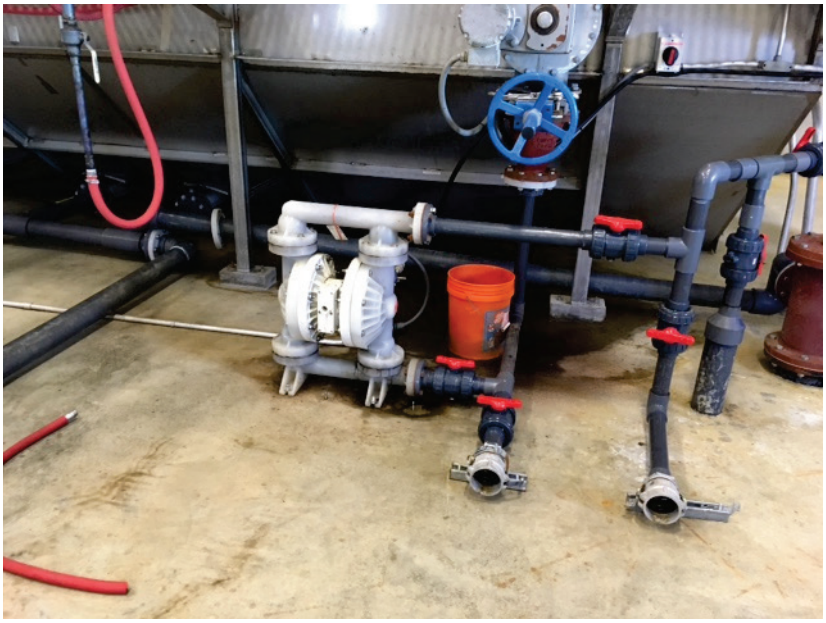

Figure 11. Processed sludge showing fibrous nature of the material.

1.3 Clogging of the sludge pump

The operating issue is that the sludge pump routinely clogs. The operator showed the ERDC team a clogged pump (Figure 12). The sludge material accumulates around the ball that serves as the check valve, preventing proper operation (Figure 12). The caked material was difficult and costly to remove, causing system outages and adding repair time.

Figure 12. Clogging of the ball check valve in the pneumatic sludge pump.

The operator indicated that there has been an improvement in the frequent clogging since TanTec modified the screening treatment from the plant effluent. Previously, the screen had areas where water could flow

around it. However, this was modified, and appears to have helped. In addition, the operator communicated that clogging appears more frequent when the water level in the equalization tank reaches about seven feet. The possible reason for this is that the tank may contain sludge buildup, and at seven feet, entrainment of this sludge could occur. The ERDC team did not review any records to substantiate these claims. However, the assumption was that these claims were accurate.

2 Potential Causes and Actions

2.1 Sampling to assess suspended solids in TanTec effluent

Mr. Diaz, relayed input to the inspection team from the designer of the treatment system. According to the designer, the clogging issue is most likely due to suspended solids in the TanTec effluent being outside the design concentration. However, there have been no measurements conducted to confirm this. In addition, the ERDC team did not receive any information on the design assumptions for the TanTec effluent. However, as mentioned above, the operator indicated that clogging frequency had reduced when TanTec improved their screening process, this suggests that the plant effluent quality can affect pump operations.

A sampling program could be conducted to determine the solids content of the wastes entering the facility from TanTec. This program could consist of daily samples for five days, followed by weekly samples for six weeks, to look for variability. However, until the design criteria is identified, it would be difficult to assess if TanTec concentrations are impacting the plant. Furthermore, TanTec has already taken corrective action by installing the debris screen, and it is not clear what process changes they could make to improve their effluent.

2.2 Addressing the effect of sludge in the equalization tank

Based on discussions with the system operator, it appears that the sludge tank could be a contributing factor in the pump clogging. It was reported that clogging increased when the tank water level reached seven feet or lower. If the tank contents are bottom removed, then the tank level would not affect the water added to the system. However, if a floating pump is used, then lower tank levels may result from the entrainment of settled sludge in the tank. The operator was not aware of the tank sludge ever being removed.

The equalization tank receives lime slurry and aluminum sulfate to adjust pH and promote setting of particulates, therefore, it is likely that some sludge is settled in it. The sludge settled in the tank is likely dense, therefore, it is likely to be problematic for operation of the pneumatic pump.

Frequent measurements of the sludge depth in the tank, coupled with detailed recordkeeping to determine if clogging is, in fact, more frequent when the water level approaches the sludge depth, are recommended. A method for measuring sludge depth would need to be developed and currently does not exist. A common method is to use a long rod that is inserted at the top of the tank, measuring where it hits the top of the sludge layer. It would be interesting to use this method to measure the sludge depth at this time. However, this is cumbersome and potentially dangerous as a routine method since the equalization tank is very high (estimated around 30 feet). There are sonic and optical options that could be retrofitted for measurement of the sludge in the tank (Figure 13). Last, pumping out the sludge at regularly timed intervals and recording the date and the amount of sludge that was removed from the tank would be beneficial. Recording plant operations (specifically clogging of the pump) in conjunction with this procedure is recommended.

Figure 13. An ultrasonic sludge depth measurement system (https://www.environmental-expert.com/downloads/ge-102s-ultrasonic-sludge-interface-depth-meter-399136).

2.3 Adding a grinder/shredder pump

Grinder/shredder pumps are pumps designed to break apart agglomerating materials (Figure 14). Grinder pumps are generally applied to smaller size materials, producing a slurry-like consistency. Shredder pumps are used to break apart relatively large chunks, and are sometimes used as pretreatment for grinder pumps.

Figure 14. A shredder pump from SKG (marketed by BJM Pumps). A grinder pump is very similar looking.

Waisner and Medina (2012) used a grinder pump to reduce the size of solids prior to their input into a deployable wastewater treatment system, and the approach was highly effective. McCollum et al. (2016) describes a study in which a shredder pump was added online to a municipal wastewater treatment plant in Alabama to correct severe clogging issues at a pump station that was requiring unacceptably frequent cleanouts. The shredder pump solved the clogging problem very effectively.

However, in this case, the sludge appears to be highly fibrous. It is the teams' experience that grinder/shredder pumps are not effective for highly fibrous materials. Therefore, the use of a grinder or shredder pump is not recommended. It might be useful, however, to rent or lease one to evaluate operational effectiveness.

2.4 Use of an alternative sludge pump

As an alternative to the grinder/shredder pump, a positive displacement pump has been rented and used. The use of this pump requires water, and is counterproductive to the dewatering efforts made for the sludge. This pump did operate for long periods without clogging. A similar pump could be purchased and permanently installed or other types of sludge pumps could be evaluated.

3 Summary

Over time, it is expected that there will be an accumulation of sludge in the equalization tank (Figure 4). It is possible that this sludge could become entrained in the feed solution, particularly if the water level is low, near the sludge level. Frequent measurements of the sludge depth in the tank, coupled with detailed recordkeeping would be useful for determining if clogging is, in fact, more frequent when the water level approaches the sludge depth. Additionally, a sampling program could be conducted to determine the solids content of the wastes coming from TanTec. This program could consist of daily samples for five days followed by weekly samples for six weeks to look for variability. Last, pumping out the sludge at regularly timed intervals, and recording the date and the amount of sludge that was removed from the tank would be beneficial. Recording plant operations (specifically clogging of the pump) in conjunction with this procedure is recommended.

The ERDC team also recommends that an alternative sludge pump would solve the pump clogging problem. There are many pump types better suited to moving high solids compared to the diaphragm pump currently used. These include progressive cavity, rotary lobe, hose, or screw pumps. Working with a reputable pump company that represents a range of pump technologies, or a consultant with a strong expertise in pump systems, is recommended.

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14. ABSTRACT

Dr. Victor F. Medina conducted a site visit on 12 June 2017 for the evaluation of a sludge pump clogging issue at an industrial waste pretreatment plant in the Ceres Industrial Park, Vicksburg, MS. Escorted by Mr. Pablo Diaz of the Port of Vicksburg, the operating issue was that the sludge pump routinely clogs. The sludge material had accumulated around the ball that serves as the check valve, preventing its operation. The ERDC team offered recommendations based on the site visit to resolve the pump clogging issue.

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