



MEMORANDUM

Date: November 18, 2013

To: The Honorable Chairman and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator 

Re: **October 15, 2013 Board of Supervisors Meeting – Request for Additional Information**

In response to a request for additional information regarding the award of contract for Regional Wastewater Reclamation Department (RWRD) services, RWRD Director Jackson Jenkins prepared the attached memorandum. The nutrient recovery process that is to be implemented in the future will eliminate the need for the costly chemicals that are the subject of this awarded contract.

If you have any questions regarding this matter, please contact Deputy County Administrator John Bernal or Mr. Jenkins.

CHH/mjk

Attachment

c: John Bernal, Deputy County Administrator for Public Works
Jackson Jenkins, Director, Regional Wastewater Reclamation



PIMA COUNTY
REGIONAL WASTEWATER RECLAMATION DEPARTMENT
201 NORTH STONE AVENUE
TUCSON, ARIZONA 85701-1207

JACKSON JENKINS
DIRECTOR

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November 14, 2013

TO: C.H. Huckelberry, P.E., County Administrator
John M. Bernal, P.E., Deputy County Administrator – Public Works

FROM: Jackson Jenkins, Director – RWRD 

SUBJECT: **Sustainable Nutrients Recovery from Wastewater**

On October 15, 2013 during the Board of Supervisors' meeting, Supervisor Elias made an inquiry requesting more information on a low bid contract that was on the Consent Calendar Agenda for Ferric Chloride (Item No. 7) and its relation to Struvite build-up in our wastewater treatment system at the Tres Rios WRF.

- Low Bid: Award of Contract, Requisition No. 14-43, Kemira Water Solutions, Inc. (Headquarters: Atlanta, GA) for ferric chloride for five-year award amount of \$2,072,304.00 (annual amount of \$414,460.80). Contract is for a five year term and includes annual review periods. Funding Source: Enterprise Fund.
Administering Department: RWRD

Attached please find a copy of a report that was previously provided to the Wastewater Reclamation Advisory Committee members which should provide the additional information sought by Supervisor Elias.

The Tres Rios WRF has been and continues to control Struvite build-up with the chemical addition of ferric chloride per the CH2M HILL (ROMP design professional) design. RWRD is currently evaluating and preparing to go out for bids to construct a nutrient recovery process. Once completed, RWRD will be able to eliminate the need for chemical addition to control Struvite and will also create a revenue-generating fertilizer product.

I am available to discuss this further, should you require additional information.

Attached



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**Sustainable Nutrients Recovery from Wastewater in Pima County
May 16, 2013**

Introduction

With the pending completion of the Regional Optimization Master Plan (ROMP), the expanded Ina Road Wastewater Reclamation Facility (WRF) and the new facility that will replace the existing Roger Road WRF will have a combined capacity of 82 million gallons per day (MGD). These two facilities will produce high-quality reclaimed water (Class A+) through a state-of-the-art treatment process known as "5-stage Bardenpho." The production of such high-quality effluent presents a number of challenges that do not exist when lower-quality effluent is produced. These challenges include sidestream treatment and struvite.

What is Sidestream?

In a wastewater reclamation facility, a sidestream is a wastewater stream resulting from the dewatering of digested sludge. A sidestream is also known as centrate, as centrifuges are used for sludge dewatering.

The upgrades at the Ina Road WRF will result in the reduction of macronutrients in the effluent discharged from the facility. Specifically, the 5-stage Bardenpho process separates nitrogen (N) and phosphorus (P) from the primary wastewater stream. With this separation, N and P are concentrated in the sidestream at much higher concentrations than in the raw sewage that enters the facility. For example, nitrogen concentration in sidestream can be found on the order of 1,000 milligram per liter (mg/l) as opposed to about 40 mg/l found in raw sewage. In addition, phosphorus concentration sidestream is much higher than observed in raw sewage.

Typically, this concentrated sidestream is diverted back to the front end of wastewater treatment plant, where it comprises up to one-third of the overall plant nutrient loading contributing to higher treatment costs.

What is Struvite?

Struvite is the common name for a compound consisting of magnesium ammonium phosphate hexahydrate. (Nitrogen is present in ammonia and is a nutrient RWRD is being required to reduce in order to meet the regulatory requirements) Struvite forms under certain pH conditions, resulting in a light-colored crystal that causes scaling and clogging of pipes, pumps and other associated equipment. Struvite deposition is a common operational problem

encountered at many wastewater treatment facilities across the country.

Nationwide, struvite control has become more critical as treatment facilities begin meeting more stringent water quality standards. Nonetheless, struvite control is costly and labor intensive.

When planning for the ROMP began in 2006, the standard for struvite control was the addition of Ferric Chloride to the sidestream. At that time, new ways to control struvite were being tested but had not yet been proven effective and reliable.

Six years later, it has been proven that under controlled conditions, the recovery of struvite from the sidestream can result in the following benefits: 1) the removal of N and P from wastewater; 2) the minimization of unintended struvite scaling; and 3) the production of a commercially desirable fertilizer product that can potentially generate revenues.

Sidestream Management and Struvite Control at the Ina Road WRF

Prior to ROMP, the nutrient-rich centrate (sidestream) derived from sludge dewatering via centrifuges was pumped to the front end of the treatment facility. Because the facility was not required to remove N and P, the additional nutrient load from centrate was not of a concern. Also, because N and P were not being removed in large quantities, the buildup of struvite was minimal. Struvite that did form was successfully managed for decades by blending centrate (sidestream) with flush water from the Roger Road WRF.

The 5-Stage Bardenpho process complicates struvite control because higher concentrations of phosphorous and nitrogen in centrate enhance the formation of struvite. In addition, flush water from the Roger Road WRF will not be available after the facility is closed. The new facility that will replace the existing Roger Road WRF will not treat solids and therefore will not create flush water that now is sent to Ina Road. That flush water has played an important role in diluting the centrate and reducing the build-up of struvite.

With this in mind, ROMP designers planned for the use of Ferric Chloride to reduce struvite at the upgraded and expanded Ina Road WRF. The introduction of Ferric Chloride in the treatment process is the traditional method to control struvite and is used by many treatment facilities across the U.S. The struvite control systems have recently been completed and put into operation at the Ina Road WRF.

Recently when a new process train began operating at the Ina Road WRF, RWRD quickly learned just how quickly struvite can build up when extremely high removal rates of N and P are achieved.

After three months of operations, struvite formation in the system had significantly restricted piping and pumping capacities (Figure 1). The excessive build-up of struvite inside the newly installed centrifuges caused a few shutdowns. This rapid and dramatic build up came as a surprise because only part of the system was actually removing N and P. However, this situation provided good evidence that our system is producing very high quality effluent and it prompted us to expedite the installation of the struvite control system that relies on Ferric Chloride. The struvite build up has been removed and proper functioning of our new equipment has been restored.



Figure 1: Struvite Crystal Build-up in Sludge Pipes and Pumps

Ferric Chloride Usage vs. Other Struvite Control Technologies

The introduction of Ferric Chloride temporarily solved the struvite problem; however, Ferric Chloride does have drawbacks:

- Ferric Chloride is corrosive and stains surfaces it contacts
- Ferric Chloride increases sludge mass
- Annual O&M costs for Ferric Chloride addition at the Ina Road WRF will be approximately \$1,000,000

Recently, RWRD conducted an Ina Road WRF Sidestream Treatment Feasibility Assessment (the Assessment), which evaluated and identified the most sustainable and cost effective approach to manage sidestream and control struvite.

The new technologies identified in the Assessment were unproven at the time the ROMP was initially planned, now have been proven to control struvite very effectively. In addition, the annual O&M costs associated with those systems would be significantly less than costs associated with the use of Ferric Chloride. However, the new technologies do require up-front capital investments, which are estimated to range from \$4 million to \$10 million. In spite of the initial capital costs for the most expensive option, this expenditure would be paid back in approximately eight years through cost savings and revenue generation. After the initial eight years, cost savings and incoming revenues would continue over the life of the facility.

The Assessment, performed by a panel of nationally known wastewater experts, began with a review of the processes available for the treatment of the wastewater sidestream. Following the experts' review, a couple of workshops to examine the advantages and disadvantages of available sidestream treatment processes were held. During these workshops, close attention was paid to social, economic and environmental considerations.

Consultants and the panel of experts concurred that the two shortlisted sidestream treatment processes are patented processes known as: Nitritation/Anammox (DEMON[®]) and Struvite Recovery (Ostara[®]) with WAS Pre-treatment (WASSTRIP[®]).

Nitritation/Anammox is a process primarily for N removal. It is a biological treatment with no nutrient recovery/recycling. It does not remove P from the system.

Ostara with WASSTRIP is a controlled process to recover nutrients as struvite from wastewater. The harvested struvite has become a marketable fertilizer product. This process will significantly remove N and P from the sidestream and will effectively control struvite in the system.

Following the development of the technical analysis for the implementation of the two sidestream treatment candidates, an economic analysis was conducted in comparison to Ferric Chloride addition. The results are summarized in Table 1:

The panel of experts and consultants who studied the various options for struvite control concluded that the Ostara with WASSTRIP method was the best alternative for Pima County. It provides for the discontinuation of costly annual chemical purchases and will pay for itself after approximately eight years. Thereafter, the Ostara with WASSTRIP type of method is recommended.

Table 1: Economic Analysis Summary

Sidestream Processes	Capital Cost	Annual Expenses vs. Cost Savings	Payback Period (years)
Nitriation/Anammox	\$4,100,000	\$(157,000)	none
Ostara WASSTRIP	\$9,400,000	\$1,153,000	8.2
Continued Use Of Ferric Chloride	Already Spent	\$(1,000,000)	none

Conclusions

As part of ROMP, RWRD will move forward with a sidestream treatment project to implement a struvite recovery system to provide the following benefits:

1. Remove nutrients (N and P) from centrate (sidestream).
2. Reduce operational costs for the treatment of the main wastewater stream.
3. Recover a revenue-generating product from wastewater.
4. Eliminate the use of Ferric Chloride (a costly chemical addition) to control struvite.
5. Return of investment in approximately eight years through cost savings and the sales of fertilizer (struvite).
6. Enhance the overall sustainability of wastewater treatment systems.