Polymer Reduction and Drier Cake Solids in Centrifuge Dewatering Result from *Hydro*FLOW Struvite Control Investigation

Composed by

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Municipal Wastewater Treatment Plant Dewatering Centrifuge

Somersworth New Hampshire

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Background

Wastewater treatment can be a very elaborate process. Controlling the physical, chemical and biological treatment processes requires knowledge with the correct tools and equipment. The Somersworth, New Hampshire Wastewater Treatment Plant uses a Modified University of Cape Town (MUCT) biological nutrient removal process to control nitrogen (limit of 7 mg of NH_3-N/L) discharges to the environment. They are required by permit to remove phosphorus (season limit of 0.5 mg PO_4/L) during the summer months to reduce the impact of their discharge on downstream waters. The City has a population of about 11,800 people. The citizens and local industry are served by a city-wide collection system that delivers their wastewater to be treated at the 2.4 million gallon per day (MGD) facility. The facility utilizes a GEA Westfalia Separator, model CB 505-00-32 centrifuge in its sludge dewatering process. The plant's management team agreed to evaluate Hydropath technology's ability to reduce polymer usage in their process. This investigation of polymer usage in centrifuge dewatering resulted from previous *Hydro*FLOW studies for struvite control in other wastewater treatment facilities.

Technology Background

*Hydro*FLOW USA is based in Redmond, Washington. The company is the sole US distributor of the *Hydro*FLOW water conditioning devices that is powered by the patented Hydropath technology. The *Hydro*FLOW device induces an electric signal of ±150kHz in the liquid inside any pipe on which it is installed. A specialized transducer connected to a ring of ferrites performs the electric induction.

The technology was developed in England over 20 years ago, for calcium carbonate scale removal and scale prevention in domestic water heating applications. However, the use of Hydropath technology is not limited to residential systems; various device configurations are being successfully applied in the following water use sectors: power generation, commercial, industrial, hospitality, municipal, mining, oil & gas, maritime, agriculture, food service and aquaculture.

Expansion plans include application development in the wastewater sector, with the focus on enhancement of existing processes and the reduction of struvite and other scale forming issues.

Wastewater Development Status - Struvite control leads to polymer reduction

During the summer of 2013, *Hydro*FLOW equipment was installed at the Walla Walla, Washington wastewater treatment plant. The purpose was to determine if the Hydropath technology could reduce the accumulation of struvite forming on their belt press dewatering equipment. The initial results were very promising.

*Hydro*FLOW equipment was subsequently installed in the fall of 2013 on the Orlando, FL Water Conserv II Water Reclamation Facility for a struvite removal and prevention trial. The results reported after five months of trials showed significant reduction of struvite build up and a 20% reduction in polymer use.

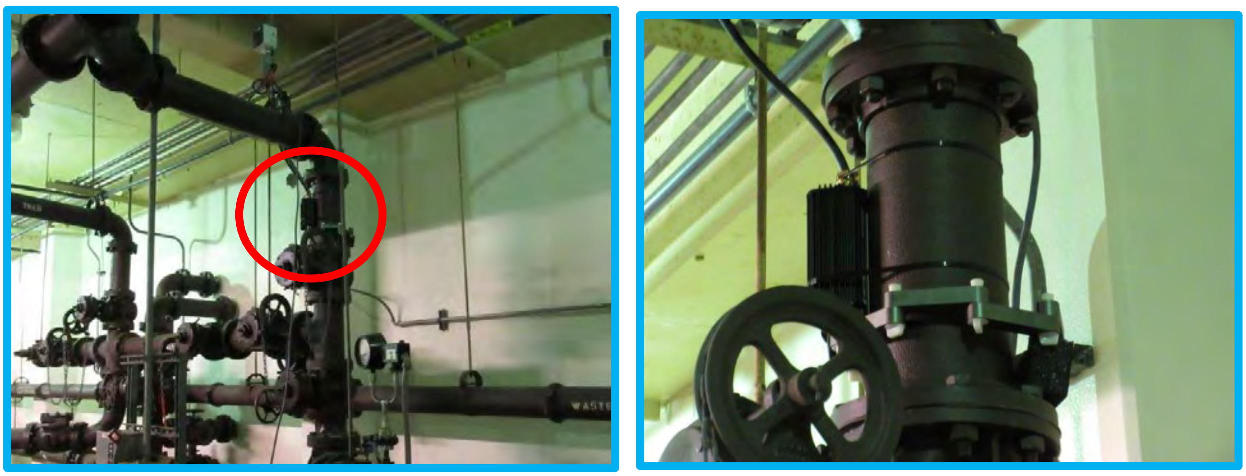
These positive results lead *Hydro*FLOW USA to conduct a mini-seminar at WEFTEC 2015 in Chicago, with the goal of sharing this technology within the wastewater treatment industry and finding partners with which to collaborate. One outcome of this seminar was the arrangement with

GEA Westfalia Separator to suggest a trial at a centrifuge installation in Somersworth, New Hampshire.

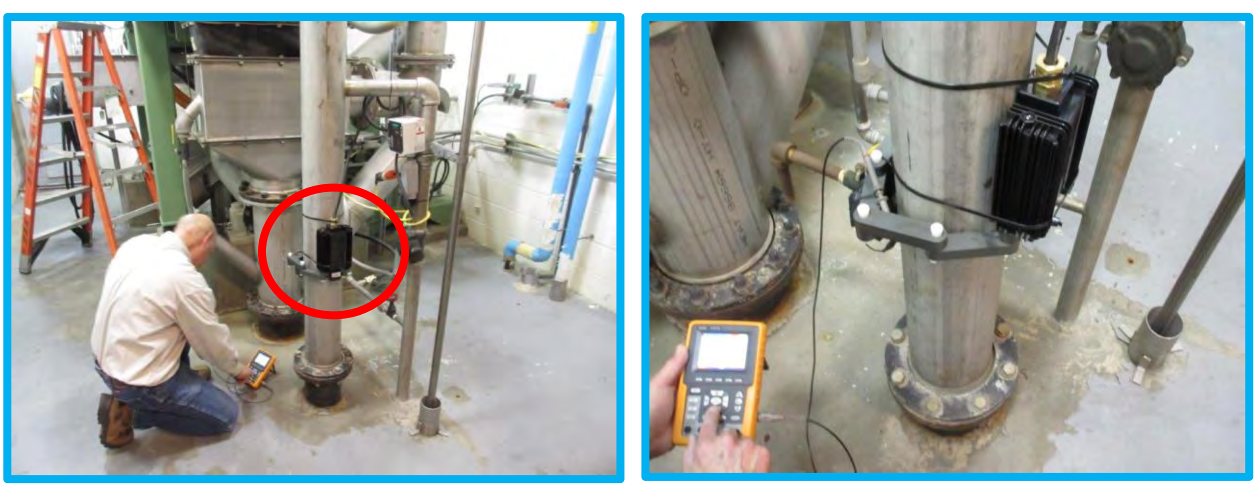
Installation of *Hydro*FLOW Units

In November 2015, *Hydro*FLOW USA staff installed two *Hydro*FLOW 160i units on the 6” sludge piping feeding the GEA Westfalia Separator, model CB 505-00-32 centrifuge. One *Hydro*FLOW unit was placed about 50 feet prior to the centrifuge, just after the thickened waste activated sludge (TWAS) pump, and the other unit was placed five feet prior to the feed tube just before the centrifuge. Both units were installed without process down-time as they are fitted around existing piping and do not require plumbing modifications. The units use 120 V AC and draw less than 1 Amp, which is similar to the power consumed by a 60 watt light bulb.

Locations of Unit #1 and Unit #2



Unit #1 - 50 feet before the centrifuge, just after the TWAS pump.



Unit #2 - Five feet prior to the sludge entrance to the GEA Westfalia centrifuge.

Success Factors

The centrate quality in Somersworth typically averages about 500 mg TSS/L (TSS-Total Suspended Solids), but rarely above 1,000 mg TSS/L. Surpassing the 1,000 mg TSS/L threshold could affect the plant treatment capacity. Success for this facility was to reduce polymer usage and produce dryer cake but could not negatively impact the centrate quality. The trial protocol dictated an incremental reduction of polymer dosing while monitoring the cake solids. If the cake became too wet (below 20% Total Solids (TS)), polymer reduction would cease.

Baseline Data Collection Procedure

On December 14, 2015, the plant staff was directed to gather baseline data by operating their centrifuge normally at a feed solids flow rate of 175 to 185 gpm with the *Hydro*FLOW units turned **OFF**.

- The feed sludge usually is in the 10,000 mg TSS/L (1%) concentration.
- The staff related that they use about 27 pounds of polymer per dry ton of solids to produce a sludge cake of about 21-22% TS solids. This was confirmed while *Hydro*FLOW technicians were on site.
- The plant staff was instructed to incrementally (or step wise) reduce their polymer addition by about one pound per dry ton and allow the centrifuge to stabilize after each adjustment (about 30 to 60 minute process).
- After about an hour and a half of reductions, the plant lowered the polymer feed to 22 pounds per ton at which point the dewatering process became ineffective (lost the centrifuge "seal") and the sludge cake became wet.
- Thus the polymer use lower limit on this day was determined to be 24 pounds of polymer per ton of dry solids.

First *Hydro*FLOW Testing Sequence

On December 16, 2015, the trial began under normal centrifuge operations with feed sludge of 12,000 mg TSS/L. The centrifuge was started at 27 pounds of polymer per ton of dry solids with the *Hydro*FLOW unit **OFF** until the centrifuge was stabilized with cake solids of 23.1% TS. The *Hydro*FLOW Unit #1 (near the TWAS pump) was energized (Unit #1 **ON**) and the polymer was incrementally reduced to 19.8 pounds per ton with a cake solids of 22.7% TS. The centrate remained about 200 mg TSS/L (+/- 40 mg TSS/L) throughout the trial. The trial ended when the cake container became full. A polymer reduction of <u>26.7% was achieved during the first testing sequence.</u>

Second *Hydro*FLOW Testing Sequence

On January 4, 2016 the trial continued with *Hydro*FLOW Unit #1, to repeat a successful dewatering point of roughly 20 pounds of polymer per dry ton with a centrate quality of 100-200 mg TSS/L and cake solids of 21% TS or higher. The trials began under normal centrifuge operations with feed sludge of 10,000 mg TSS/L. The centrifuge was started at 25 pounds of polymer per ton of dry solids with the *Hydro*FLOW unit **OFF** until the centrifuge was stabilized with cake solids of 21.5%. The *Hydro*FLOW unit was turned **ON** and incremental polymer reduction began. The cake solids and centrate quality remained consistent as the polymer was reduced, cake solids of 21.5% TS and centrate 100-200 mg TSS/L. The trial continued to a point where the polymer dose became ineffective at 18.5 pounds per dry ton when the centrate quality exceeded 1,000 mg TSS/L and the cake solids stayed at +/-21.5% TS. <u>Over 20% polymer reduction was achieved during the second testing sequence.</u>

Third *Hydro*FLOW Testing Sequence

On January 6, 2016 the trials began with normal centrifuge operations with feed sludge of 10,500 mg TSS/L polymer dose at 22 pounds per ton, a cake solids of 21.3% TS and centrate of 60 mg TSS/L. *Hydro*FLOW Unit #2 (next to the centrifuge) was then energized (Unit #2 **ON**). The sludge cake solids initially increased to 23.6% TS with the centrate at 78 mg TSS/L. At a polymer dose of 20 pounds per ton the centrate rose to 246 mg TSS/L with cake solids of 24.6% TS. The polymer dose was decreased to 17 pounds per ton that resulted in a 23.9% TS cake and centrate of 672 mg/l TSS. <u>During the third testing sequence a 22.8% polymer reduction was achieved and cake solids improved.</u>

Fourth *Hydro*FLOW Testing Sequence

On January 11, 2016 both *Hydro*FLOW units (#1 & #2) were turned **ON** after the centrifuge was stabilized at 25 pounds of polymer per dry ton of solids with a feed concentration of 12,300 mg TSS/L, producing a cake of 21.9% TS. The polymer was reduced with both *Hydro*FLOW units **ON** until a polymer dose of 18 pounds per dry ton was achieved producing a cake of 20.5% TS and a centrate of 732 mg TSS/L. Feed solids had reduced slightly to 11,300 mg TSS/L during the trial period. Some biological scum was added which adversely impacted the results causing the centrate to get dirtier with one sample exceeding 1,000 mg TSS/L. This fourth trial achieved a <u>28% polymer reduction.</u>

Fifth *Hydro*FLOW Testing Sequence

On January 20, 2016, testing was conducted with a jumper wire inserted within the ferrites of both *Hydro*FLOW units. This was done in order to boost the Hydropath signal throughout the piping network and liquid feeding the centrifuge and potentially increase performance. This did not produce any noticeable improvement. Quite a bit of scum was added on this day as well. Result summary is: 10,140 mg TSS/L feed solids, polymer 18.5 pounds per ton, cake solids of 20.8% TS and centrate of 1,036 mg TSS/L. A polymer reduction of 26% was achieved during the fifth testing sequence (based on the normal centrifuge operations without *Hydro*FLOW).

Sixth *Hydro*FLOW Testing Sequence

It appeared that the trial with *Hydro*FLOW Unit #2, close to the centrifuge, proved to provide the most effective results. A confirmation trial was conducted on February 1, 2016. Due to plant operations, there was a significant amount of biological scum that had to be processed through the centrifuge affecting its general performance. Dewatering results with *Hydro*FLOW **OFF** with a feed solids of 11,700 mg TSS/L and a polymer dose of 27 pounds per ton, produced a cake of 21.1% TS and centrate of 1,252 mg TSS/L. *Hydro*FLOW Unit #2 was turned **ON** and was able to reduce polymer dose to 23 pounds per ton while producing a cake of 24.8% TS and a centrate quality of 718 mg TSS/L. A polymer reduction of 15% was achieved during this sixth testing sequence. In addition cake and centrate quality improved greatly.

Summary

During six testing sequences, the *Hydro*FLOW devices reduced polymer use from an average of 25.5 to 19.1 pounds per ton (25.1% reduction), increased cake solids by up to 3% TS and kept centrate quality within testing limits of less than 1,000 mg TSS/L.

Acknowledgements

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For more information about *Hydro*FLOW go to the website: www.*Hydro*FLOW-USA.com.

Dr. Glen Daigger announces retirement after storied career with CH2M HILL

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DENVER, December 22, 2014 – After 35 years with CH2M HILL, Dr. Glen Daigger, Senior Vice President and Chief Technology Officer, has announced his retirement from the firm. Daigger, recognized worldwide as an expert in wastewater treatment technologies, has contributed significantly to CH2M HILL, as well as the entire water industry, most recently through his work as president of the International Water Association (IWA). Daigger's last day as a full-time employee of CH2M HILL was December 19, 2014. In the future, Daigger will continue to work with CH2M HILL as a special advisor on key pursuits and project delivery.

Daigger received his doctorate and master's degrees in environmental engineering from Purdue University, as well as his bachelor's degree in civil engineering from Purdue. In 2009, he was given Purdue University's Civil Engineering Alumni Achievement Award. Daigger joined CH2M HILL in 1979 and has remained with the firm since then, except for two years in the mid-1990s when he was professor and chair of Environmental Systems Engineering at Clemson University.

Daigger was CH2M HILL's first Technical Fellow, an honor which recognized the leadership that he provided for CH2M HILL and for the profession in the development and implementation of new wastewater treatment technology. As the author or co-author of more than 100 technical papers, four books, and several technical manuals, he has contributed to advancing practice within the wastewater profession. His eleven patents for wastewater treatment processes have helped establish the nation's wastewater treatment standards.

“Glen is an icon in our industry,” said Greg McIntyre, CH2M HILL Global Water Market President. “His work with CH2M HILL and the water industry at large has helped improve our water constrained global situation by influencing and transforming water management policies and practices. We stand by Glen in celebration of his 35 years of service to CH2M HILL and our industry, as he settles into retirement and transitions to a new consulting role.”

Daigger’s commitment to the profession runs deep, having served in senior roles for the Water Environment Federation, the American Academy of Environmental Engineers and Scientists, and the Water Environment Research Foundation. Daigger recently completed his term as President of the International Water Association (IWA), where he worked with water leaders around the globe to advance the science and practice of water management to create more livable cities and accelerate the rate at which people gained access to drinking water and sanitation, all while protecting the environment. He will continue serving IWA as immediate past president of the association. Daigger also is a member of the National Academy of Engineering and received the Harrison Prescott Eddy Award from the Water Environment Federation three times.