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Date: **8/29/2018**

Location: Plant #10 USA
Contacts: Mr. Ron Blake
Subject: Bond Wastewater Trial Summary (5/16 & 5/17)

Trial Summary Phase 1

Bond Water Technologies began trialing our BondClear 400S (coagulant) and BondPoly 2431-90B (flocculant) on 5/16/2017 at 8:30 am. DAF flow rates are now maintained at 170 gpm. On Monday, Tuesday and Thursday the DAF system will run for 15 hours. On Wednesday and Friday the DAF system will run for 10 hours. I used an average of 13 hours per day at 5 days per week for calculation purposes. The current chemical vendor was running their treatment chemicals at the following feed rates:

Coagulant (X)) at a feed pump setting of 160/100 (3.77 gph) equaling 370 ppm by volume
Flocculant (X)) at a feed pump setting of 105/100 (2.48 gph) equaling 243 ppm by volume
**chemical output based on pump output and unable to verify actual feed via drawdown
coagulant feed rate may actually be slightly higher and flocculant slightly lower due to viscosity

Before switching to our Bond treatment chemicals TSS and turbidity were measured as a starting point. The chemical feed pump rates were kept the same when the Bond treatment chemicals were put on-line, but quickly discovered this was a gross overfeed. We were able to settle on a coagulant feed rate of 105/100 (2.48 gph) equaling 243 ppm by volume and flocculant feed rate of 50/100 (1.18 gph) equaling 116 ppm by volume. Here is a comparison on the feed rates of Bond versus your current vendor.

| Product | Feed Rate | Daily Usage Estimate | Monthly Usage Estimate | Turbidity | TSS |
|---------------|-----------|----------------------|------------------------|-----------|--------|
| Vendor Coag | 360 ppm | 49 gpd | 980 gallons | | |
| Vendor Floc | 243 ppm | 32 gpd | 645 gallons | 35.8 NTUs | 79 ppm |
| Bond 400S | 243 ppm | 32 gpd | 645 gallons | | |
| Bond 2431-90B | 116 ppm | 15 gpd | 300 gallons | 26.8 NTUs | 48 ppm |

Looking at historical usage rates on these chemicals the chemical pump feed rates are off due to the differences in coagulant and flocculant viscosity as the vendors coagulant is approximately 2 drums per day and the vendor flocculant usage is approximately 1 drum every 2.0 – 2.5 days. Simply using the pump outputs as a comparison, we are looking at a 34% reduction using the BondClear 400S coagulant and a 53% reduction using the BondPoly 2431-90B flocculant.

While the effluent water looks pristine with the Bond treatment scheme there is a major issue and disconnect with the way the wastewater plant is being operated... **YOU DO NOT NEED TO MAKE THE WATER PRISTINE AND THE OPERATORS ARE NOT TARGETING ANALYTICAL BENCHMARKS FOR SUCCESS! THEY ARE SIMPLY TAKING A VISUAL LOOK AT THE EFFLUENT AND MAKING ADJUSTMENTS IF THE WATER IS "CLEAN" OR "DIRTY". THIS IS COSTING YOUR PLANT THOUSANDS OF DOLLARS PER YEAR.**



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Trial Summary Phase 2 – Further Cost Reduction

As mentioned you do not need to make potable water via the effluent of the DAF. You simply need to add enough treatment chemicals to achieve the following results while keeping the pH in range:

<1950 pounds per day of BOD

<3900 pounds per day of COD

<1200 pounds per day of TSS

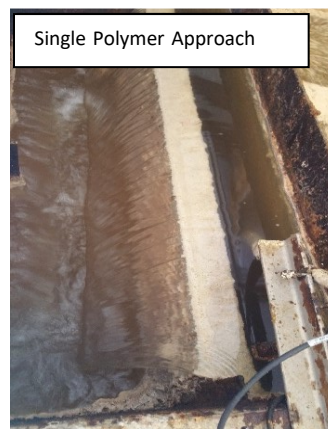
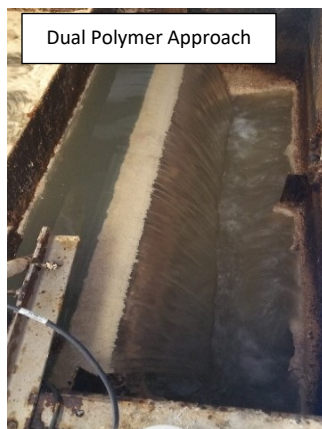
While our results are excellent, it makes no sense to run this way as you are wasting money with a zero ROI. With a two product approach (coagulant & flocculant) it appears that this treatment is an “all or none” result. That is, you either make extremely good water or there is significant carryover with the TSS approaching 1200 ppm when we try to reduce the feed rates. I brought a 5 gallon pail of a supplemental polymer called BondPoly 3211-38B to run a dual polymer program with the coagulant to see if we could greatly reduce the coagulant feed rates and reduce the overall polymer/flocculant feed rates.



Our goal is not to produce a visually appealing effluent from the DAF, the goal is to produce a high enough quality effluent to meet your limits above. Here in the picture I temporarily hooked up our BondPoly 3211-38B with some activation water and injected into the second pass of the floc tubes before the air injection. The pump that I brought had limited adjustability and feed rates were estimated. With this dual flocculant approach we were able to lower the coagulant feed rate to 75/100 (1.77 gph) equaling 174 ppm and keep the total polymer feed rate slightly lower. In addition sludge production is greatly reduced.

| Product | Feed Rate | Daily Usage Estimate | Monthly Usage Estimate | Turbidity | TSS |
|---------------|-----------|----------------------|------------------------|-----------|---------|
| Bond 400S | 174 ppm | 23 gpd | 260 gallons | | |
| Bond 2431-90B | 58 ppm | 7.7 gpd | 154 gallons | | |
| Bond 3211-38B | 49 ppm | 6.5 gpd | 130 gallons | 210 NTUs | 522 ppm |

*COD was 1949 ppm equaling 2,129 pounds per day of COD









The picture on the left has an effluent of 1949 ppm COD and the picture on the right has an effluent of 1476 ppm COD. The picture on the left will save you 52% of coagulant and 56% of polymer compared to the current vendor.

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The following are the cost estimations using Bond's coagulant & single polymer treatment versus Bond's coagulant and dual polymer treatment.







SINGLE POLYMER APPROACH

| BOND Water Technologies | | | | | | |
|---|---|------------------|---|---|--|--|
| POLYMER PROPOSAL | | | | | | |
| CALCULATION & ESTIMATED COST OF OPERATION ANALYSIS | | | | | | |
| CLIENT: |  | | | | DATE: May 16, 2017 | |
| GALLONS / DAY: | | 131,000 | mls/minute based off of average flow through unit | | | |
| HOURS OF OPERATION: | | 13 | | | | |
| DAYS OF OPERATION/YEAR: | | 260 | | | | |
| SYSTEM TYPE: | | DAF | | | | |
| AVERAGE FLOW THROUGH UNIT (gpm): | | 170 | | | | |
| PRODUCT(S) CHOSEN: | DOSAGE (PPM) | MLS/MIN | LBS/DAY | COST/LB | COST/DAY | |
| BONDClear 400S | 243 | 156.4 | 334.2 |  |  | |
| BONDPoly 3211-38B | 0 | 0.0 | 0.0 | | | |
| BONDPoly 2431-90B | 116 | 74.6 | 124.6 | | | |
| | | | TOTAL LBS/DAY | TOTAL COST/DAY |  | |
| | <u>GALS/DAY</u> | <u>GALS/YEAR</u> | | | | |
| BONDClear 400S | 31.8 | 8276.58 | | Yearly Cost: |  | |
| BONDPoly 3211-38B | 0.0 | 0 | | Yearly Cost | | |
| BONDPoly 2431-90B | 15.2 | 3950.96 | | Yearly Cost | | |
| | | | | | ANNUAL ESTIMATED COST  | |
| Notes: | | | | | | |
| 170 gpm flow rate through DAF average. On Monday, Tuesday, Thursday there is approximately 15 hours of run time through the DAF. On Wednesday and Friday there is approximately 10 hours of run time through the DAF. I used an average of 13 hours of daily operation Monday - Friday at 52 weeks per year for estimating cost calculations. | | | | | | |



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DUAL POLYMER APPROACH

| BOND Water Technologies | | | | | | |
|---|---|-----------------|---|--|--|--|
| POLYMER PROPOSAL | | | | | | |
| CALCULATION & ESTIMATED COST OF OPERATION ANALYSIS | | | | | | |
| CLIENT: |  | | | | DATE: May 16, 2017 | |
| GALLONS / DAY: | | 131,000 | mls/minute based off of average flow through unit | | | |
| HOURS OF OPERATION: | | 13 | | | | |
| DAYS OF OPERATION/YEAR: | | 260 | | | | |
| SYSTEM TYPE: | | DAF | | | | |
| AVERAGE FLOW THROUGH UNIT (gpm): | | 170 | | | | |
| PRODUCT(S) CHOSEN: | DOSAGE (PPM) | MLS/MIN | LBS/DAY | COST/LB | COST/DAY | |
| BONDClear 400S | 178 | 114.5 | 244.8 |  |  | |
| BONDPoly 3211-38B | 49 | 31.5 | 52.6 | | | |
| BONDPoly 2431-90B | 58 | 37.3 | 62.3 | | | |
| | | | TOTAL LBS/DAY | 359.8 | TOTAL COST/DAY | |
| | | | | |  | |
| | | <u>GALS/DAY</u> | <u>GALS/YEAR</u> | | | |
| BONDClear 400S | | 23.3 | 6062.68 | | Yearly Cost:  | |
| BONDPoly 3211-38B | | 6.4 | 1668.94 | | Yearly Cost | |
| BONDPoly 2431-90B | | 7.6 | 1975.48 | | Yearly Cost | |
| | | | | | ANNUAL ESTIMATED COST | |
| | | | | |  | |
| Notes: | | | | | | |
| 170 gpm flow rate through DAF average. On Monday, Tuesday, Thursday there is approximately 15 hours of run time through the DAF. On Wednesday and Friday there is approximately 10 hours of run time through the DAF. I used an average of 13 hours of daily operation Monday - Friday at 52 weeks per year for estimating cost calculations. | | | | | | |





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TRIAL CONCLUSION

Unfortunately, I had only brought 5 gallons of the BondPoly 3211-38B to trial. As it stands I have Mike running the BondClear 400S (243 ppm) and BondPoly 2431-90B (116 ppm) until the BondPoly drum runs out (should last approximately 4 – 5 days). He will go back on the current vendor program temporarily until the new polymer drums arrive. I have ordered some additional drums of the BondPoly 2431-90B and BondPoly 3211-38B to allow you to run the dual polymer approach for approximately 3 or so weeks and gather data. Here are the highlights:

- Estimating the dual polymer approach will save you 52% on coagulant and 56% on flocculant compared to your current vendor's treatment scheme.
- Estimating the dual polymer approach will reduce sludge generation/disposal by on truck haul per day.
- Bond will provide a chemical pump for the BondPoly 3211-38B and static mixer at no charge.
- Operators need to run daily COD, TSS and turbidity tests and record to be. Turbidity will be used as a quick indicator for success (10 second test).
- We will use these results to adjust chemical feed rates to balance usage with effluent quality based on analytical results.
- Water pressure coming back to the DAF building is extremely poor at times, virtually zero flow. This grossly affects the activation and performance of the polymer and results in significant floc carryover from time to time. This will ultimately result in some spikes of TSS, COD, BOD during composite sampling.
- Operators need to better track inventory and usage.

I will schedule a time to come back to the plant to connect the supplemental polymer pump and static mixer and start back on our treatment within the next few weeks. In the meantime, Mike is supposed to communicate with me the results on our products.

Thank you,

A handwritten signature in black ink that reads "John T. Dunford".

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ALWAYS HIRE A CERTIFIED WATER TECHNOLOGIST (CWT) FOR YOUR WATER TREATMENT NEEDS!