BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	AS 19-002
Petition of Emerald Polymer Additives, LLC for an Adjusted Standard from 35 Ill. Adm. Code 304.122(b)	))))	(Adjusted Standard)

NOTICE OF SERVICE OF DISCOVERY DOCUMENTS

TO: Persons Identified on the Attached Certificate of Service

PLEASE TAKE NOTICE that on October 11, 2019, I served on the Illinois Environmental Protection Agency the following discovery documents in the above-referenced matter:

1. Letter to Rex Gradeless with documents containing non-discloseable information (EP003467 & EP003468) produced subject to objection (attached without documents); and

2. Expert Report and Response to Recommendations of Illinois Environmental Protection Agency of July 19, 2019 (attached).

Respectfully submitted,

Emerald Polymer Additives LLC

Date: October 14, 2019

By: /s/ Thomas W. Dimond
One of Its Attorneys

Thomas W. Dimond
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CERTIFICATE OF SERVICE

I, the undersigned, certify that on October 11, 2019, I served copies of (1) Letter to Rex Gradeless with documents containing non-discloseable information (EP003467 & EP003468) produced subject to objection; and (2) Expert Report and Response to Recommendations of Illinois Environmental Protection Agency of July 19, 2019, upon the following persons by first class mail:

Rex L. Gradeless, #6303411
Division of Legal Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276
Rex.Gradeless@Illinois.gov

The undersigned further certifies that on October 14, 2019, I served a copy of this *Notice of Service of Discovery Documents* and *Certificate of Service* upon the following persons by electronic mail:

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October 11, 2019

Via First Class Mail

Rex L. Gradeless
Division of Legal Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
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Springfield, IL 62794-9276

RE: In the Matter of: Petition of Emerald Polymer Additives, LLC for an Adjusted Standard from 35 Ill. Adm. Code 302.122(b), AS 19-002

Dear Rex:

Following up on Emerald Polymer Additives, LLC"s ("Emerald") written responses to Illinois EPA's interrogatories and documents requests, which were served on you on October 4, 2019, I am enclosing for the years 2015-2019: (1) Emerald's balance sheets indicating its assets and liabilities (EP003467); and (2) statements of its operating costs and expenses (EP003468). The enclosed documents are "commercial or financial information obtained from a person or business" that is protected from disclosure under the Illinois Freedom of Information Act, 5 ILCS 140/7(1)(g), and Section 1828.202(a)(1)(F) of Title 2 of the Illinois Administrative Code. Emerald maintains this information within the company and corporate affiliates. The disclosure of this information to Emerald's competitors would give them valuable information about Emerald's operations that could be used by its competitors for market analysis and market entry or capacity adjustment decisions. In addition, these documents constitute "Non-Disclosable Information" as defined by Section 101.202 of the Illinois Pollution Control Board Rules. Both documents have been marked to be exempt from disclosure pursuant to applicable regulations of Illinois EPA and the Board.

While we are producing these documents in response to your requests, we have done so over serious objections. Emerald objected to Interrogatory No. 3 and Document Request No. 4 on the grounds that these discovery requests seek information that is not relevant or reasonably calculated to lead to the discovery of admissible evidence. Emerald's financial information is unrelated to the standard for "economic reasonableness" set forth in 415 ILCS 5/27(a) and incorporated into 415 ILCS 5/28.1(a), or any other issue in AS 19-002. Under this standard, "economic reasonableness" is determined relative to "measuring or reducing the particular type of pollution" and not a particular entity's financial condition or ability to pay. *See* 415 ILCS 5/28.1(a). *See also E.P.A. v. Pollution Control Bd.*, 308 Ill. App. 3d 741, 751 (2nd Dist. 1999) (economic reasonableness is a cost-benefit analysis that measures the cost of implementing pollution controls against the public benefits to be derived from the controls). If Illinois EPA seeks to introduce any of this information at hearing or file it with the Board, Emerald will almost certainly object.

Thus, to the extent Illinois EPA seeks to file Emerald's commercial or financial information with the Board or introduce it at hearing, it must do so under Section 130 Subpart D of the Board's Rules. With respect to non-disclosable information, Subpart D requires the filing of a separate application for non-disclosure and that "[w]hen an entire article is sought to be protected from disclosure, the applicant must mark the article with the words 'NON-DISCLOSABLE INFORMATION' in red ink on the face or front of the article." *See* Section 130.404(b).

In addition, I am also enclosing the Expert Report and Response to Recommendations of Illinois Environmental Protection Agency prepared by Houston Flippin, P.E., BCEE of Brown and Caldwell.

If you have any questions on the enclosed or Emerald's confidentiality claim, please contact me.

Very truly yours,

ICE MILLER LLP

Kelsey Weyhing

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Enclosures
cc: Thomas W. Dimond

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October 11, 2019

Brown AND Caldwell

Letter Report
Privileged and Confidential

Mr. Thomas W. Dimond
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200 W. Madison Street, Ste. 3500
Chicago, IL 60606-3417 041514

Subject: Expert Report and Response to Recommendations of Illinois Environmental Protection Agency of July 19, 2019

Dear Mr. Dimond:

Brown and Caldwell (BC) is pleased to respond to part of the comments raised by the Illinois Environmental Protection Agency (IEPA) in the July 19, 2019 Recommendation to Deny Emerald Polymer Additives an Adjusted Standard (AS 19-002). This response specifically addresses comments regarding items listed below.

- Use of present worth costs to express costs of ammonia-nitrogen removal
- Projects and associated capital costs installed by others in the State of Illinois partially related to compliance with ammonia-nitrogen regulatory limits excluding Fox River
- In-plant monitoring of ammonia-nitrogen by Emerald
- Request for updates to conceptual level designs and cost estimates for treatment alternatives to remove ammonia-nitrogen from the Emerald Polymer Additives (Emerald) Plant wastewater treatment plant (WWTP) discharge into the Illinois River[1]
- Request for evaluation of land application for Emerald final effluent
- Impact of biotreater volume on effluent ammonia-nitrogen removal

Cost of Ammonia-Nitrogen Removal

IEPA objected on Page 16 of the Recommendation to BC's comparison of unit cost (dollars per pound of ammonia-nitrogen removed) as a means of judging economic reasonableness of ammonia-nitrogen removal. IEPA also objected, on this same page, to the use of present worth costs (accounting of capital and operating costs) instead of capital costs alone when calculating cost of treatment. BC firmly believes that unit costs and present worth costs are the standard for evaluating true treatment costs. The latest cost document provided by the National Association of Clean Water Agencies (NACWA)[2] reports that the median unit cost of ammonia-nitrogen treatment for 12 agencies was $1.53 per pound of ammonia-nitrogen removed, which is higher than the cost reported

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[1] Ammonia-Nitrogen Treatment Alternatives for Emerald Performance Materials, LLC submitted by Brown and Caldwell to Drinker, Biddle and Reath, LLP under Privileged and Confidential-Attorney/Client Work Product on July 8, 2013.
[2] 2017 NACWA Financial Survey: A National Survey of Clean Water Agency Financing and Management: Final Report, August 2018.

by the Greater Peoria Sanitation District ($0.81 per pound). The basis for these reported costs includes, in all cases, annual operating and maintenance costs. In some cases, these costs may include capitalized present worth cost (amount of money needed today to fund capital and operating costs for a defined project life). The exclusion of capitalized costs by most NACWA members in these reported unit costs is due to the nature of the municipal wastewater treatment plants. Exclusion of capital costs in unit costs by NACWA members is due to several factors. These include the difficulty in separating capital costs into those required for treatment of flow, biochemical oxygen demand (BOD), total suspended solids (TSS), and ammonia-nitrogen (NH_3-N). In municipal plants, the same pieces of equipment contribute to treatment of all four components (flow, BOD, TSS and NH_3-N). In the Emerald plant, the costs described herein are focused entirely on NH_3-N removal, and therefore, delineation of capitalized present worth costs are straightforward. Contrary to NACWA, IEPA has focused strictly on capital costs of projects that included ammonia-nitrogen removal. Such focus is misguided and results in an incomplete understanding of ammonia-nitrogen removal costs.

IEPA references project capital costs reportedly incurred by others in the State of Illinois when including ammonia-nitrogen removal in their treatment plant upgrades. It should be noted that all of these plants relied upon the lowest cost means of ammonia-nitrogen removal which is single-stage biological nitrification. The Emerald plant provides the same degree of aerobic treatment conditions that allow single-stage nitrification in these IEPA referenced plants (solids retention time in excess of 30 days, surplus alkalinity, and available phosphorus). However, the Emerald plant cannot nitrify within a single stage like these other plants due to the unavoidable presence of a compound in the process wastewater. This compound (mercaptobenzothiazole, MBT) is foundational to the production processes at the Emerald Plant and is consistently present in the primary clarifier effluent at 160 mg/L or higher for days at a time (versus a nitrification inhibition threshold of 3 mg/L[3]). To establish reliable single-stage nitrification, MBT removal from the process wastewater would have to exceed 98 percent which has been demonstrated in prior documents as being complex and cost prohibitive[4]. Each cost example provided by IEPA is discussed below.

1. Geneva, IL (BATES 341 and 353) completed a two-phased project in 2004 for a reported cost of $10.9 million dollars. These costs included multiple upgrades that had nothing to do with ammonia-nitrogen removal including the additions of fine screens, raw sewage pumps, grit tank, primary clarifier, UV disinfection, sludge digestion, sludge dewatering, flood proofing, and remodeling of administration/laboratory facilities. The only upgrades that would be partly linked to ammonia-nitrogen removal would have been addition of aeration tanks, blowers, and a final clarifier. These upgrades also provide increased capacity to treat higher flow, BOD, and TSS (BATES 360 through 369). It is uncertain what portion of these upgrades would be attributed to ammonia-nitrogen removal.
2. Batavia, IL (BATES 437) completed a project in 2001 for a reported cost of $10.8 million. These costs included multiple upgrades that had nothing to do with

[3] M.R. Hockenbury and C.P.L. Grady in Journal of Water Pollution Control Federation, Volume 49, page 768, 1977.

[4] Evaluation of Nitrification Alternatives for Emerald-Henry, Illinois Facility prepared by Brown and Caldwell and submitted to Emerald Performance Materials on April 13, 2018.

ammonia-nitrogen removal including the additions of influent flow measurement, mechanical bar screen, primary clarifier equipment in existing tanks, intermediate pump station pump, UV disinfection, effluent flow meter, and rehabilitation of sludge digestion. The only upgrades that would be partly linked to ammonia-nitrogen removal would have been addition of aeration tanks, blowers, diffusers, and secondary clarifier. These upgrades also provide increased capacity to treat higher flow, BOD, and TSS (BATES 454 through 456 and 460). It is uncertain what portion of these upgrades would be attributed to ammonia-nitrogen removal.

3. Saint Charles, IL (BATES 1365) completed a project in 2002 for a reported cost of $8.4 million. These costs included multiple upgrades that had nothing to do with ammonia-nitrogen removal including the additions of headworks modifications, new scum troughs, existing aeration basin rehabilitation, baffles in existing secondary clarifiers, excess flow pump station and clarifier rehabilitation, new return activated sludge and waste activated sludge pumps, UV disinfection, and piping and electrical system upgrades. The only upgrades that would be partly linked to ammonia-nitrogen removal would have been the addition of aeration tanks and blower building. These upgrades also provide increased capacity to treat higher flow, BOD, and TSS (BATES 1387 through 1389 and 1397). It is uncertain what portion of these upgrades would be attributed to ammonia-nitrogen removal.
4. Fox River, IL (BATES 437) completed a project in 2007 for a reported cost of $2.0 million. This project did not increase the rated capacity of the plant since it did not increase treatment capacity. It only provided for the installation of two flow equalization basins and associated appurtenances. This plant upgrade provided for more stable process control but did not enhance ammonia-nitrogen removal.
5. Kishwaukee, IL (BATES 00015) completed a project in 2017 for a reported cost of $53 million. These costs included multiple upgrades that had nothing to do with ammonia-nitrogen removal including the additions of two primary clarifiers, anaerobic biological phosphorus removal tanks, fermenter, and UV disinfection. The only upgrades that would be partly linked to ammonia-nitrogen removal would have been additions of aeration tanks and secondary clarifiers. These upgrades also provide increased capacity to treat higher flow, BOD, and TSS (BATES 34 through 45). It is uncertain what portion of these upgrades would be attributed to ammonia-nitrogen removal.
6. Newark, IL (BATES 1571-1573) completed a project in 2001 for a reported cost of $3.0 million. These costs included multiple upgrades to a lagoon-based treatment system to achieve improved performance (BOD and TSS removal). These included additions of a bar screen, reconfiguration of cells, installation of insulated covers and baffles. The only upgrade intended to provide ammonia-nitrogen and additional BOD removal was the addition of two polishing reactors. It is uncertain what portion of the polishing reactor cost would be attributed to ammonia-nitrogen removal.
7. Mount Carmel, IL (BATES 1601 and 1603) completed a project in 2018 for a reported cost of $1.6 million. These costs included replacement and relocation of an effluent line and river outfall structure which had nothing to do with ammonia-nitrogen removal. Additionally, the plant replaced an existing mechanical aeration system with a diffused aeration system. It is uncertain if this replacement improved ammonia-nitrogen removal and what portion of this replacement was attributed to ammonia-nitrogen removal.

In summary, only five of the seven wastewater treatment facilities upgrades referenced above had anything to do with ammonia-nitrogen removal. None of these five treatment plant upgrades were implemented solely to accomplish ammonia-nitrogen removal. They were implemented in large part to better accommodate higher flows, greater BOD removal, greater TSS removal, and/or improved disinfection. Consequently, the costs of these upgrades cannot be legitimately used to compare or evaluate costs of ammonia-nitrogen removal at the Emerald plant.

In-Plant Monitoring of Ammonia-Nitrogen

IEPA has recommended that Emerald implement an in-plant ammonia-nitrogen (NH_3-N) monitoring program in hopes of reducing effluent ammonia-nitrogen through at-source detection and control. This strategy would work if effluent ammonia-nitrogen was strongly related to influent ammonia-nitrogen. However, this is not the case since influent organic nitrogen is the primary contributor to effluent ammonia-nitrogen.

The two primary raw wastewater contributors to the wastewater treatment plant (PVC Tank and PC Tank) were monitored approximately 3 days per week for Total Kjeldahl Nitrogen (TKN) and ammonia-nitrogen (NH_3-N) during the period of March 28, 2019 through August 8, 2019. The difference between TKN and NH_3-N concentrations represent organic nitrogen. Under normal biological treatment conditions, organic nitrogen is converted to NH_3-N. These data are summarized in Figure 1 and discussed below.

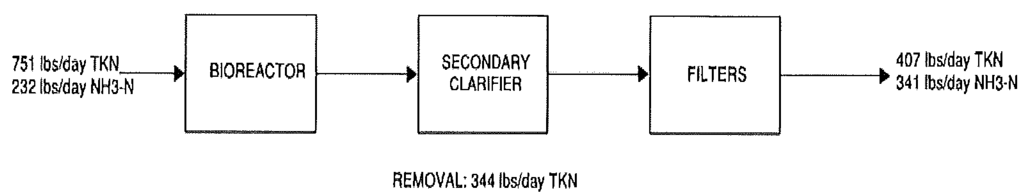

Figure 1. Average TKN Removal Across Emerald WWTP

- The PVC tank discharged on average 524 lbs/day TKN and 230 lbs/day NH_3-N indicating that only 40 percent of the TKN loading was comprised of ammonia-nitrogen. It should be noted that this discharge stream includes the nitrogen loading of tertiary filter backwash water and sludge dewatering filtrate which is generated when treating both PVC tank and PC tank wastewaters. Nitrification of this stream alone has been considered in prior evaluations[5] and does not offer a means of complying with regulatory effluent limits because it would achieve less than 70 percent reduction in effluent ammonia-nitrogen reduction based on prior sampling results. Recent sampling results continue to demonstrate this finding.
- The PC Tank discharged, on average, 227 lbs/day TKN and 2 lbs/day NH_3-N indicating that only 1 percent of the TKN loading was comprised of ammonia-nitrogen.
- Ammonia-nitrogen contributed only 30 percent of the combined TKN loading discharged by the PVC and PC tank (751 lbs/day TKN). Consequently, in-plant monitoring of ammonia-nitrogen only has the ability to influence 30 percent of the

[5] Evaluation of Treatment Alternatives for Reducing Final Effluent Ammonia Load submitted by Brown and Caldwell (formerly Eckenfelder Inc) to Emerald (Formerly BF Goodrich) in February 1997.

potential final effluent NH_3-N load. This finding that the bulk of the final effluent NH_3-N loading is due to organic nitrogen present in the raw wastewaters and converted to ammonia-nitrogen through biological treatment has been documented throughout the years.[1] Additional sampling of raw wastewater sources to determine the origin of effluent ammonia-nitrogen is not needed.

- The Emerald Wastewater Treatment Plant did provide 46 percent removal of influent TKN reducing the effluent ammonia-nitrogen by 344 lbs/day. This removal was associated with nutrient requirements for the BOD removal accomplished by biological treatment within the plant.
- Any in-plant monitoring would need to focus on TKN monitoring. Unlike NH_3-N, there are no direct monitoring probes for TKN in wastewater. Consequently, real-time monitoring and quick response would be impractical.

Updated Conceptual Level Designs and Cost Estimates

IEPA also faulted Emerald for not updating the costs of all compliance alternatives (Recommendation at 15). Updating costs for every alternative is not necessary because many alternatives are known not to achieve significant effluent ammonia-nitrogen reductions or would have costs in excess of other more effective alternatives. Costs have been calculated for five alternatives considered most likely to be effective and for land application.

Conceptual level cost estimates presented herein were developed using an approach recommended by the Association of the Advancement of Cost Estimating (AACE). The estimates are Class 5 estimates with an accuracy of -50 percent to +100 percent. These estimates were developed by generating equipment costs for each alternative and then applying multiplication factors for direct and indirect costs. The direct costs include freight, tax, purchased equipment installation, installed piping, installed electrical systems, buildings, other structural components, yard improvements, and installed service utilities. Indirect costs include engineering and supervision, construction expenses, legal expenses, and contractors fee.

A contingency multiplication factor is applied to the sum of the direct and indirect costs. The sum of the direct, indirect and contingency results in the fixed capital cost (FCC).

The prior 2013 cost estimates were calculated by using the 2002 cost estimates and applying an escalation factor. Due to inflation and other factors, the 2013 estimates underestimated costs and were not as precise as the Class 5 cost estimate contained herein.

The most economical and reliable processes for ammonia-nitrogen removal at the Emerald Plant would consist of further treating the plant final effluent (not plant raw wastewater influent). BC has updated the design final effluent wasteload based on 2018 information when the plant was reportedly operating at typical production levels. A summary of the design final effluent wasteload is illustrated below in Table 1. This wasteload was used to update the conceptual level designs and cost estimates for the most economically feasible alternatives determined in prior work (see footnote 3). The details around these cost estimates is included as Attachment A.

Table 1. Design Final Effluent Wasteload for Emerald Wastewater Treatment Plant

	Average	Maximum Monthly	Daily Maximum
Flow, gpm	360	412	475
Flow, MGD	0.52	0.59	0.68
TKN, lbs/day	407	508	618
NH_3-N, lbs/day	341	449	553
COD, lbs/day	2,300		
CBOD, lbs/day	47	115	312
TSS, lbs/day	87	220	485
pH, s.u.	7.5	7.7	8.2
Temperature, deg F	77	86	66 to 88 Range
Alkalinity, mg/L	940		
Hardness, mg/L	360		
TDS, mg/L	10,000		
TDFS, mg/L	10,000		
Na, mg/l	3,100		
K, mg/L	3		
Ca, mg/L	42		
Mg, mg/L	14		
Chlorides, mg/L	805		
Sulfate, mg/L	5,460		

Ozonation

Ozonation has been demonstrated to reduce ammonia-nitrogen by 55 percent at an initial pH 11 and final pH 7.6[6]. Consequently, no further ammonia-nitrogen removal was assumed beyond 55 percent. The resulting effluent ammonia-nitrogen concentration would be an order of magnitude higher than the effluent ammonia-nitrogen regulatory limits (3 mg/L monthly average and 6 mg/L daily maximum in 35IAC304.122).

This process oxidizes ammonia-nitrogen to nitrate-nitrogen as does biological nitrification. The difference is that in ozonation only one of three oxygen atoms is used for oxidation while in biological nitrification all oxygen is used for oxidation. Both processes require caustic addition to neutralize the acid formed.

$$4\ O_3 + NH_4^+ \text{ yields } NO_3^- + 2\ H^+ + H_2O + 4\ O_2$$

The process would be installed downstream of the existing sand filter as illustrated in Figure 2 to minimize the oxidant demand associated with effluent TSS.

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[6] Treatment of Ammonia Nitrogen Wastewater in Low Concentration by Two-Stage Ozonization, Xianping Luo,et al., International Journal of Environmental Research and Public Health, 2015, Volume 12, pages 11975 through 11987

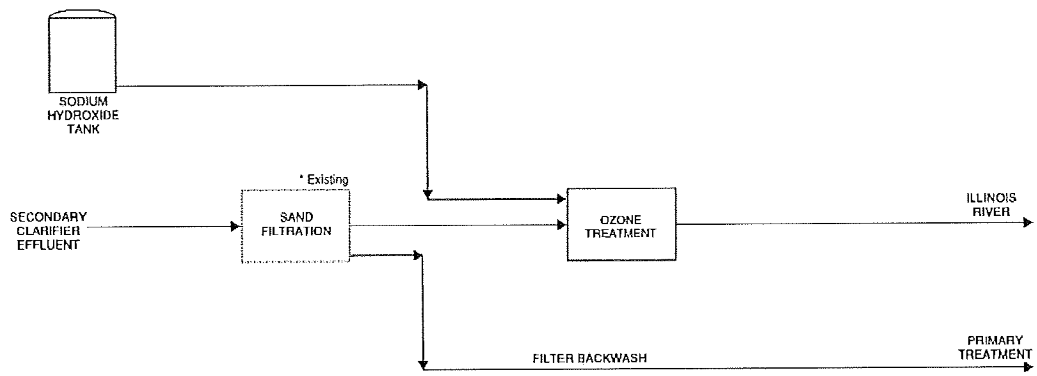

Figure 2. Ozone Treatment Block Flow Drawing

Alkaline Stripping

Alkaline stripping can practically provide up to 95 percent removal of effluent ammonia-nitrogen. However, this degree of removal is inadequate to comply with the regulatory effluent limits.

In this treatment, caustic would be used to raise the filtered effluent to pH 11.5 and passed through an air stripping column packed with media. The column effluent would be lowered to pH 8.5 using sulfuric acid and discharge through the existing outfall as illustrated in Figure 3. The off-gas from the column would pass through an acid scrubber. The acid scrubber would produce a liquid waste (ammonium sulfate) that essentially concentrates the ammonia-nitrogen from one stream (final effluent) into a smaller liquid stream requiring off-site disposal. It is uncertain where this acid scrubber waste (approximately 4,500 gallons per day of 0.9 percent by weight nitrogen) could be disposed making this treatment alternative questionably viable. For purposes of costing this alternative, it was assumed that the waste could be hauled to Greater Peoria Sanitation District for disposal.

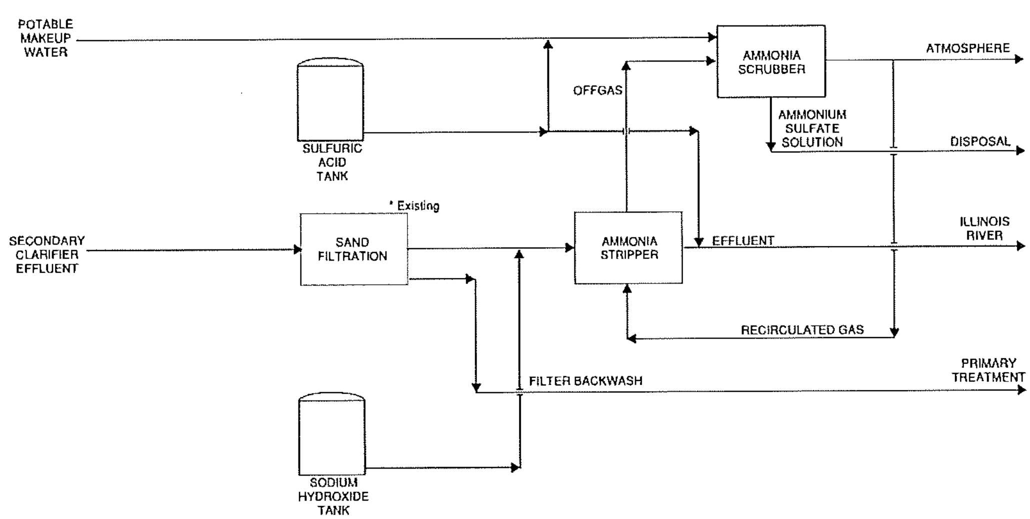

Figure 3. Alkaline Stripping Block Flow Diagram

Tertiary Nitrification

Under normal operating conditions, the secondary clarifier reportedly discharges less than 3 mg/L mercaptobenzothiazole (the reported concentration at which nitrification is significantly inhibited). Under these conditions, tertiary nitrification should be capable of achieving compliance with proposed effluent ammonia-nitrogen limits. It is uncertain how often upstream biological treatment and secondary clarifier upsets would disrupt the performance of tertiary nitrification. The Emerald plant is subject to these upsets periodically due to the poorly degradable nature of the compounds present in the process wastewater and the heavy reliance upon chemical conditioning for secondary clarifier effluent quality control. Pilot-scale demonstration work would be required to demonstrate the reliability of this treatment process.

The process would consist of adding rotating biological contactors (RBCs) downstream of the secondary clarifier as illustrated in Figure 4. Sodium hydroxide would be added to satisfy the alkalinity demand. Heterotrophic bacteria (BOD removing bacteria) and nitrifying bacteria would grow on the fixed film media offered in the RBCs. Excess bacteria would slough off the fixed film and be caught by downstream rotary disk filters. The smaller particles exiting the rotary disk filters would be captured by the existing downstream tertiary filters. The captured solids from both filters would be discharged to the primary treatment system during filter backwashes.

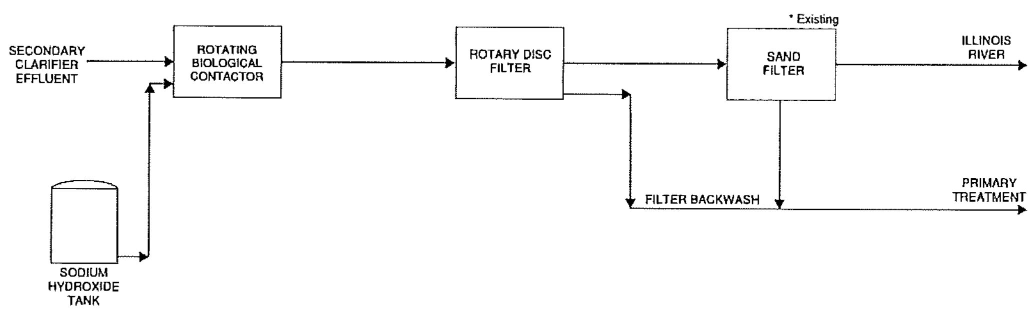

Figure 4. Tertiary Nitrification Block Flow Diagram

Breakpoint Chlorination

Breakpoint chlorination can discharge an effluent in compliance with the effluent ammonia-nitrogen regulatory limits. However, the quantity of treatment chemical addition required increases the effluent salt load by more than 70 percent. Additionally, it is uncertain if this treatment process would form chlorination byproducts which could adversely impact the effluent aquatic toxicity and jeopardize compliance with the effluent acute toxicity criterion (<2.1 percent effluent lethal concentration that results in 50 percent mortality). Further testing would be required to address this uncertainty. In this process, ammonia is oxidized to nitrogen gas using chlorine while producing acid. The process is non-selective in its oxidation and would consume some residual biochemical oxygen demand (BOD) and chemical oxygen demand (COD) as well as some organic nitrogen. Consequently, the dose of chlorine would be approximately 12 pounds chlorine applied per pound of ammonia-nitrogen oxidized and the alkalinity requirement would be approximately 14 pounds of alkalinity applied per pound of ammonia-nitrogen oxidized.

The process would be installed downstream of the existing tertiary filter as illustrated Figure 5. This location would minimize the required chlorine demand.

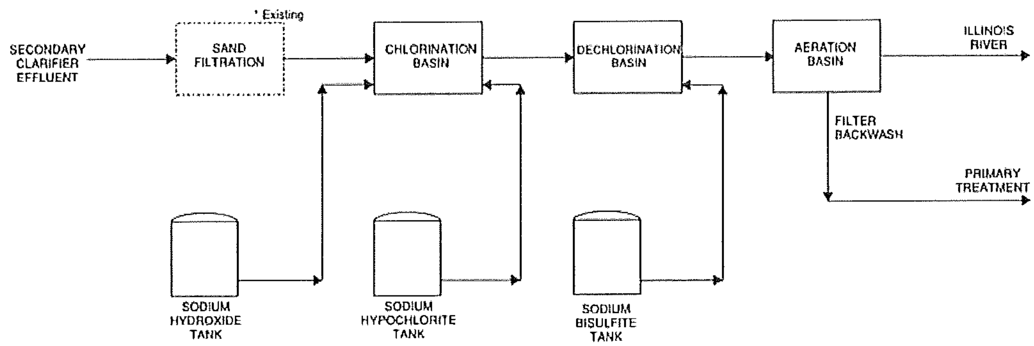

Figure 5. Breakpoint Chlorination Block Flow Diagram

Ion Exchange

Ion exchange can discharge an effluent in compliance with the effluent ammonia-nitrogen regulatory limits. Purolite recommended a hydrogen-based cation exchange resin for this treatment which will remove ammonia (NH_4^+) and other cations as well from the wastewater. Caustic will be used to maintain a minimum effluent pH 6.5. Hydrochloric acid will be used to regenerate the resin. In essence, this treatment concentrates the ammonia-nitrogen in one stream (the final effluent) into a smaller stream requiring off-site disposal. It is uncertain where this spent regenerant (ammonium chloride at approximately 4,500 gpd of 0.90 percent by weight nitrogen) could be disposed making this alternative questionably viable. For purposes of costing this alternative, it was assumed that the waste could be hauled to Greater Peoria Sanitation District for disposal.

The process would be installed downstream of the existing sand filter to prevent solids fouling of the ion exchange column as illustrated in Figure 6.

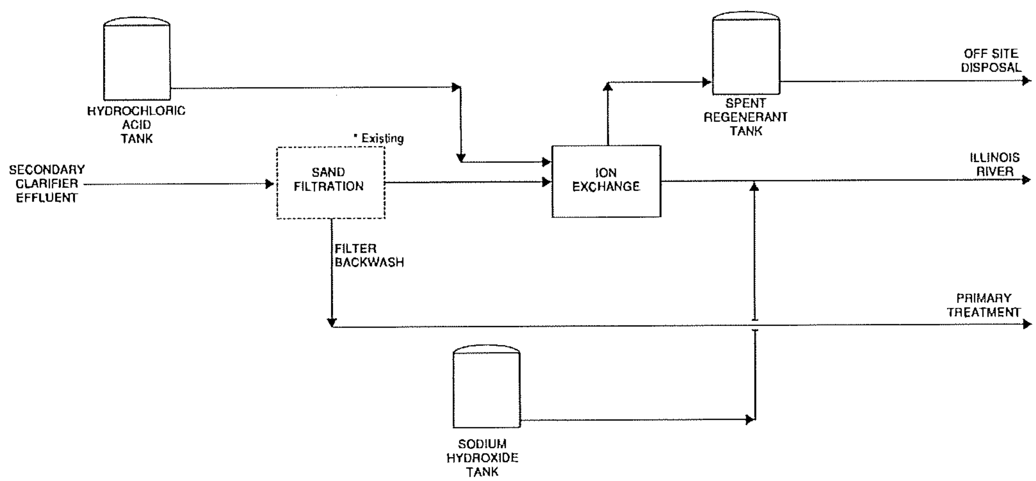

Figure 6. Ion Exchange Block Flow Diagram

Land Application

The Emerald Plant owns 80 acres on land adjacent to the plant that could be used to grow a salt tolerant, high nitrogen uptake hay (e.g., Bermuda grass) which would exert a nitrogen uptake of approximately 350 pounds per acre per year. This nitrogen uptake would support an average of 160,000 gpd (30 percent of the average final effluent flow) over the course of approximately 9 months per year when the ground is thawed. This effluent would be diluted with 360,000 gpd of clarified river water prior to irrigation to minimize salt impacts on plant growth and associated nitrogen uptake. An average root zone TDS of less than 3800 mg/L was targeted. The water not used for plant growth would discharge as groundwater into the Illinois River. Unlike the Akzo Nobel land application system, dilution water addition is required to mitigate salt impacts on the proposed crops. Tiling of this acreage would not be provided, like at Akzo Nobel, since it would not allow collection of the treated water. At the Emerald site, the normal groundwater level is deeper than tiles are installed (greater than 10 feet) and the soil is highly permeable.

The viability of this process would be contingent on being granted a river water withdrawal permit, being granted a permit that allows the river water clarifier to discharge solids removed back to the river, and finding an entity willing to cut and remove the hay at no cost to Emerald. Currently, the acreage is used to grow profitable crops (corn and soybeans). These crops offer a significantly lower nitrogen uptake and salt tolerance.

Combined the process illustrated in Figure 7 would only treat 22 percent of the annual nitrogen load. Furthermore, operation of this system would be complex.

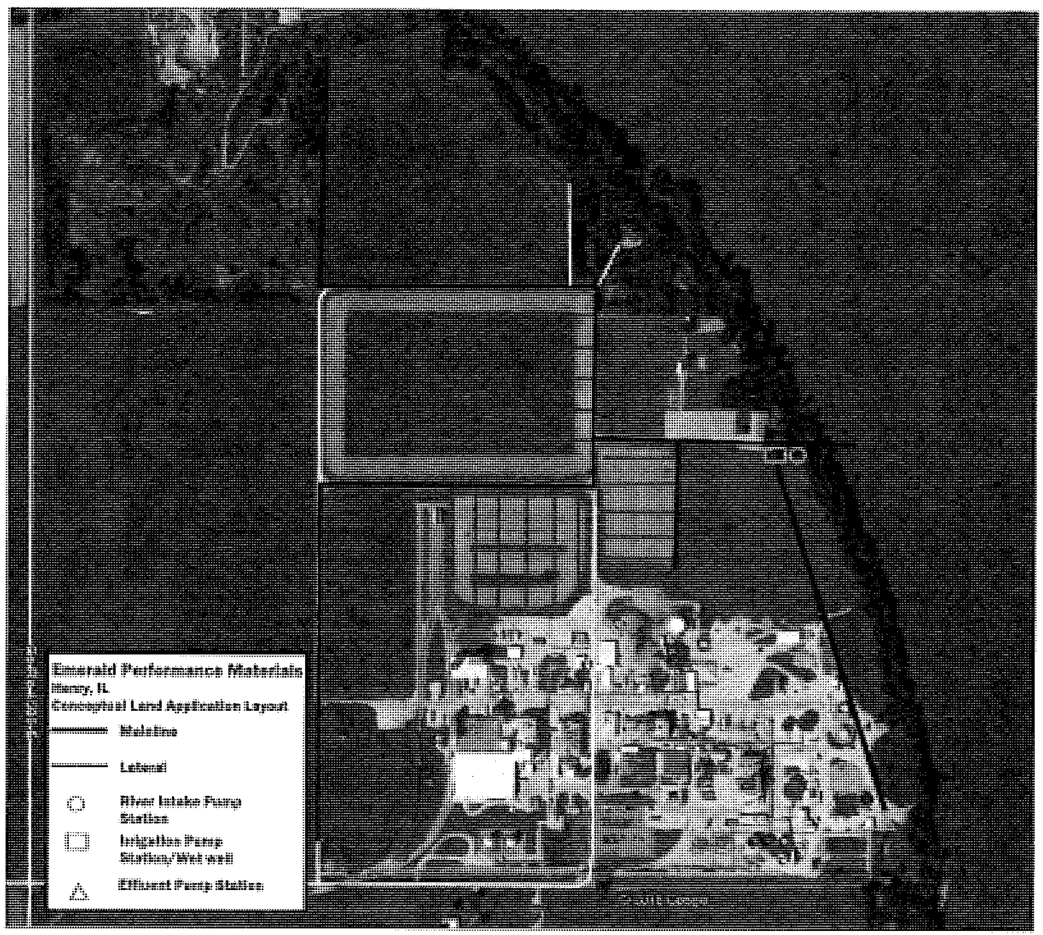

Figure 7. Land Application Layout Drawing

Summary of Treatment Alternatives Performance and Associated Costs

A summary of treatment alternatives performance and associated costs are shown in Table 2. These costs are presented as unit costs in Table 3. These data indicate that tertiary nitrification and ion exchange offer the lowest unit cost for ammonia removal based on annual operations and maintenance costs with ion exchange having a much lower capital cost. These costs, even on an annual operations and maintenance basis, are 4-fold greater than the median unit costs reported by NACWA for others providing ammonia-nitrogen removal. On a present worth basis, Emerald would have to commit a minimum of $12 per pound of NH_3-N removed over the next 10 years (approximately 8-fold the median unit costs reported by NACWA.

Table 2. Treatment Alternatives and Associated Costs

Alternative	Achieve Regulatory Limits?	Average NH_3-N Removal (lbs/day)	Capital Costs ($ million)	Annual O/M[a] Costs ($ million)	Present Worth[b] ($ million)
Ozonation	No	188	22	0.96	30
Alkaline Stripping	No[d]	324	7.3	1.4	19
Tertiary Nitrification	Uncertain	$\leq$331	10	0.74	17
Breakpoint Chlorination	Yes[c]	331	4.1	2.5	24
Ion Exchange	Yes[d]	331	6.0	1.0	14
Land Application	No	77	6.0	0.39[e]	9.2

[a] *Annual operations and maintenance costs.*

[b] *Based on 10 years at 4 percent interest and no salvage value. Present worth of annual O/M costs is annual costs times 8.1 Total present worth is present worth of both the annual O/M and capital costs.*

[c] *Uncertain if treatment process would adversely impact compliance with effluent aquatic toxicity criterion.*

[d] *Uncertainty regarding spent regenerant disposal makes treatment alternative questionably viable.*

[e] *Excludes loss of income from current farming of 80 acres.*

Table 3. Unit Costs of Treatment Alternatives

Alternative	O/M Costs ($/pound NH_3-N removed)	Present Worth ($/pound of NH_3-N removed)
Ozonation	14	44
Alkaline Stripping	12	16
Tertiary Nitrification	>6.3	>14
Breakpoint Chlorination	21	20
Ion Exchange	8.5	12
Land Application	14	33

Environmental Impact of Effluent Ammonia-Nitrogen Removal

This section describes the current water quality status of the Illinois River and the sensitivity of Emerald's ammonia-nitrogen discharge on water quality as well as the negative collateral impacts to the environment that removing Emerald's ammonia-nitrogen would create.

As reflected In Emerald's petition for an adjusted standard, the Illinois River over many years has shown no violations of the acute and chronic water quality standards for ammonia-nitrogen downstream of Emerald's discharge. The petition also presents the results of Whole Effluent Toxicity (WET) testing that have repeatedly shown no toxic effects from Emerald's effluent outside the approved zone of initial dilution. These results demonstrate that Emerald's construction and continued use of the current wastewater treatment plant, the multi-port diffuser, replacement of the BBTS Wet Scrubber and other actions have produced an effluent that has no material negative effect on the environment. Additionally, the wastewater treatment plant operated by Emerald is considered by USEPA to provide the best degree of treatment economically achievable (BAT) for these type wastewaters[7].

As described herein, only one of the six treatment alternatives does not require chemical addition to the final effluent. However, this alternative of land application only reduces the annual nitrogen load on the river by 22 percent and requires complexity related to operating and maintaining a river water treatment system, three pumping systems, and an elaborate irrigation system. It also generates hay which has no defined dependable outlet for use. The other five alternatives require extensive chemical addition which will appreciably increase the effluent salt load to the Illinois River. The only two alternatives that can reliably comply with the regulatory limits (breakpoint chlorination and ion exchange) either a) generate an effluent that may cause failure of the existing effluent aquatic toxicity criterion or b) generate a liquid waste whose disposal method, destination, and costs are uncertain. In addition, every alternative will indirectly increase greenhouse gas emissions due to increased power consumption and additional diesel truck traffic. The collateral negative environmental impact of the treatment alternatives (e.g., greenhouse gas emissions and decreased effluent water quality with respect to higher salt levels) is appreciably more adverse than the current effluent ammonia-nitrogen load.

Given that Emerald's effluent has no negative environmental impact and the treatment alternatives have possible negative collateral environmental effects, implementing any of those alternatives and incurring the estimated costs solely for ammonia-nitrogen removal would be a unique and unreasonable requirement.

Operation of Additional Biotreaters

Ammonia-nitrogen removal at the wastewater treatment facility is a function of solids retention time (SRT) and the extent of BOD removal. The maximum amount of ammonia-nitrogen removal will occur at the lowest achievable SRT that ensures sufficient BOD removal. The wastewater treatment plant is already capable of operating at this condition (SRT of 30 to 60 days depending upon production) with only the North Biotreater in service. Operating additional biotreaters will have no impact on effluent ammonia-nitrogen but will make operations more complicated.

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[7] Code of Federal Register, Title 40, Subpart 414 Organic Chemical, Plastics and Synthetic Fibers.

We appreciate this opportunity to be of service to ICE Miller and Emerald. Please call Houston Flippin at 615.250.1220 if you have any questions or need additional information.

Very truly yours,

Brown and Caldwell

T. Houston Flippin

T. Houston Flippin, P.E., BCEE
Industrial Wastewater Process Leader

Si Givens

Si Givens
Vice President

THF:na

cc: Charlie Gregory, Brown and Caldwell

Limitations:

The information contained in this proposal is proprietary and contains confidential information that is of significant economic value to Brown and Caldwell. It is intended to be used only for evaluation of our qualifications to provide services. It should not be duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate this proposal. Further, Client is cautioned that electronic files may be compromised by media degradation, file corruption,

Attachment A: Capital and Annual Cost Tables for Treatment Alternatives

	Ion Exchange		Tertiary Nitrification		Alkaline Stripping		Ozonation		Breakpoint Chlorination		Land Application	
	Selected Percentage	Cost	Selected Percentage	Cost	Selected Percentage	Cost	Selected Percentage	Cost	Selected Percentage	Cost	Selected Percentage	Cost
Direct Costs												
Purchased Equipment Delivered		$ 1,256,445		$ 2,583,927		$ 1,817,733		$ 4,781,859		$ 855,271		$ 1,265,210
Freight	3%	$ 38,000	3%	$ 78,000	3%	$ 55,000	3%	$ 143,000	3%	$ 26,000	3%	$ 38,000
Tax	6%	$ 79,000	6%	$ 161,000	6%	$ 114,000	6%	$ 299,000	6%	$ 53,000	6%	$ 79,000
Purchased Equipment Installation	6%	$ 75,000	6%	$ 155,000	6%	$ 109,000	6%	$ 287,000	6%	$ 51,000	6%	$ 76,000
Instrumentation and Controls (Installed)	18%	$ 226,000	18%	$ 465,000	18%	$ 327,000	18%	$ 861,000	18%	$ 154,000	18%	$ 228,000
Piping (Installed)	16%	$ 201,000	16%	$ 413,000	16%	$ 291,000	16%	$ 765,000	16%	$ 137,000	16%	$ 202,000
Electrical Systems (Installed)	10%	$ 126,000	10%	$ 258,000	10%	$ 182,000	10%	$ 478,000	10%	$ 86,000	10%	$ 127,000
Buildings		$ 80,000		$ 80,000		$ 80,000		$ 160,000		$ 80,000		$ 80,000
Structural	18%	$ 226,000	18%	$ 465,000	18%	$ 327,000	18%	$ 861,000	18%	$ 154,000	18%	$ 228,000
Yard Improvements	10%	$ 126,000	10%	$ 258,000	10%	$ 182,000	10%	$ 478,000	10%	$ 86,000	10%	$ 127,000
Service Utilities (Installed)	30%	$ 377,000	30%	$ 775,000	30%	$ 545,000	30%	$ 1,435,000	30%	$ 257,000	30%	$ 380,000
Direct Cost Subtotal		**$ 2,810,445**		**$ 5,691,927**		**$ 4,029,733**		**$ 10,548,859**		**$ 1,939,271**		**$ 2,830,210**
Indirect Costs												
Engineering and Supervision	10%	$ 281,000	10%	$ 569,000	10%	$ 403,000	10%	$ 1,055,000	10%	$ 194,000	10%	$ 283,000
Construction Expenses	34%	$ 956,000	34%	$ 1,935,000	34%	$ 1,370,000	34%	$ 3,587,000	34%	$ 659,000	34%	$ 962,000
Legal Expenses	4%	$ 112,000	4%	$ 228,000	4%	$ 161,000	4%	$ 422,000	4%	$ 78,000	4%	$ 113,000
Contractor's Fee	15%	$ 422,000	15%	$ 854,000	15%	$ 604,000	15%	$ 1,582,000	15%	$ 291,000	15%	$ 425,000
Indirect Cost Subtotal		**$ 1,771,000**		**$ 3,586,000**		**$ 2,538,000**		**$ 6,848,000**		**$ 1,222,000**		**$ 1,783,000**
Contingency	30%	$ 1,374,000	30%	$ 1,076,000	30%	$ 761,000	30%	$ 5,158,000	30%	$ 948,000	30%	$ 1,384,000
Fixed-Capital Cost (FCC)		**$ 6,000,000**		**$ 10,400,000**		**$ 7,300,000**		**$ 22,400,000**		**$ 4,100,000**		**$ 6,000,000**
Annual O&M Costs												
Energy/Power	$ 2,675		$ 5,314		$ 68,480		$ 55,884		$ 6,420		$ 43,870	
Power Cost ($/kwh)	$ 0.0657		$ 0.0657		$ 0.0657		$ 0.0657		$ 0.0657		$ 0.0657	
Chemical	$ 300,048		$ 193,489		$ 593,339		$ 164,670		$ 2,116,655		$ -	
Equipment Maintenance	$ 108,956		$ 229,130		$ 169,270		$ 422,388		$ 66,708		$ 37,108	
Labor ($/year)	$ 312,000		$ 312,000		$ 312,000		$ 312,000		$ 312,000		$ 312,000	
Labor Rate ($/hr)	$ 50		$ 50		$ 50		$ 50		$ 50		$ 50	
Number of Operators	3		3		3		3		3		3	
Hours per Operator	8		8		8		8		8		8	
Days	5		5		5		5		5		5	
Weeks per year	52		52		52		52		52		52	
Ion Exchange Media	$ 20,000		$ -		$ -		$ -		$ -		$ -	
Hauling Disposal	$ 282,072		$ -		$ 282,072		$ -		$ -		$ -	
Contingency (%)	$ -		$ -		$ -		$ -		$ -		$ -	
Total Annual O&M Cost, $	$ 1,026,000		$ 740,000		$ 1,425,000		$ 955,000		$ 2,502,000		$ 393,000	
Total Present Worth of Annual O&M Costs $/yr	$ 8,400,000		$ 6,100,000		$ 11,600,000		$ 7,800,000		$ 20,300,000		$ 3,200,000	
Capital Cost, $:	$ 6,000,000		$ 10,400,000		$ 7,300,000		$ 22,400,000		$ 4,100,000		$ 6,000,000	
Total Present Worth Cost, $:	$ 14,400,000		$ 16,500,000		$ 18,900,000		$ 30,200,000		$ 24,400,000		$ 9,200,000	
Average Ammonia Removed , %	97%		95%		95%		55%		97%		22%	
Average Amount of Ammonia Removed, lb /day	331		324		324		188		331		77	
O&M Costs, $/ lb of Ammonia Removed	$ 8.50		$ 6.26		$ 12.05		$ 13.95		$ 20.72		$ 13.98	
Total Present Worth Cost, $/lb Ammonia Removed	**$ 11.93**		**$ 13.95**		**$ 15.98**		**$ 44.12**		**$ 20.21**		**$ 32.73**	