

Evaluation of Georgia-Pacific Palatka Effluent Improvement and Effluent Impact Studies
By L. B. Sonnenberg, Ph.D.; Millar Wilson Laboratory for Chemical Research, Jacksonville University
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Introduction

The Georgia-Pacific Corporation has conducted and documented numerous studies to improve effluent quality in their Palatka pulp and paper mill. The effluent continues to exceed limits for color, conductivity and chronic toxicity for discharge into Rice Creek despite substantial improvements in their manufacturing processes. Furthermore, chlorodioxins and chlorofurans that are likely to be remnants of older bleaching technologies have been detected in the treatment system. The author was contracted by Florida Department of Environmental Protection (FDEP) to review the documentation of G-P's efforts to improve the effluent to the degree that that it can be discharged into Rice Creek at Mile 2.4 and water quality standards can be met. The objectives were to 1) review the technical feasibility and effectiveness of actions proposed by G-P to improve its influent and effluent wastewater quality and to 2) review the impact of those actions on water and sediment quality of Rice Creek and the Lower St. Johns River mainstem. Studies were evaluated for adequacy of information, breadth of investigation, and validity of conclusions. A list of documents that were submitted to FDEP is given in Appendix A. The reviewed documents are listed in the references.

Most of the reviewed documents pertained to 1) treatment plant optimization studies proposed by Brown and Caldwell (1-14), 2) chlorodioxin/furan contamination of the treatment ponds and Rice Creek (15-19), 3) process optimization studies with a focus on saltcake disposal and effluent conductivity (20-24), and 4) Rice Creek water and sediment quality (25-28).

It should be noted that considerable effort was put forth by G-P, Brown and Caldwell, and FDEP to examine potential avenues to optimize the wastewater treatment system so that water quality standards could be achieved in Rice Creek as described in Administrative Order 039-NE. The final Technical Memorandum #3 July 15, 2010 outlines numerous technical options and their associated costs to reduce conductivity, color, aluminum toxicity, and iron. The effect of the different treatment strategies on particulates levels was also assessed. In an iterative process, additional information was provided after Requests for Additional Information by FDEP. Ultimately, the strategies examined included whole effluent coagulation and sedimentation, reverse osmosis of a pretreated final effluent slip stream, primary clarifier coagulation and sedimentation, primary solids dewatering, water treatment plant sludge dewatering, flocculation of Pond 3, ozonation of part of Pond 4, pH adjustment and filtration of Pond 4, whole effluent microfiltration, changing water supply to groundwater, reconfiguration of Pond 1 to reduce flow maxima, and dredging Pond 1. Brown and Caldwell and G-P attempted to address many potential avenues suggested by FDEP, including sequential treatments, and they answered numerous questions posed to them in a series of meetings and other communications.

Due to the complexity, variability, and evolving nature of the manufacturing process and its associated waste treatment systems, significant questions remain despite the number of investigations. In the following comments, issues of concern that are related to wastewater treatability and effluent impact

are summarized. More detailed information, including references to additional literature, is given in prior documents submitted to FDEP, listed in Appendix A.

Summary of Issues of Concern

- By considering only combined wastewaters entering the treatment ponds and not considering various process sewers as possible points of efficient and cost-effective treatment, the analysis was weakened. In the case of color, reducing it prior to the treatment plant would be particularly beneficial because of color reversion. In addition, lignin-like color might be more easily removed than biological color.
- Plans to modify the water treatment plant to improve water quality, particularly chronic toxicity, were not broached until late in the study. As a result, the assessment of the source of aluminum and its effect on chronic toxicity failures is somewhat limited, despite supporting information on older effluents provided by G-P. The planned modifications in the water treatment plant are expected to reduce the source of aluminum toxicity but evidence for the success of the modifications has not yet been obtained. A recent and thorough toxicity identification evaluation has not been conducted to verify the source of toxicity and the potential impact of the water treatment plant upgrades.
- The use of data for effluents produced from earlier mill processes to make conclusions about the feasibility of various strategies for current effluents made some assessments questionable, particularly the evaluations for saltcake disposal alternatives and chronic toxicity sources.
- While the advantage to investigating technologies that have historically produced consistent results on a full mill scale is apparent, the definition of feasibility used by Brown and Caldwell seems to limit any kind of novel or innovative technique to address the unique problems faced by G-P discharges. The ozonation studies were perhaps an exception. A full analysis of some of these alternative treatments and explanations about why they could not be applied to the Palatka mill would have benefitted the analysis. For example, discussions about different types of advanced oxidation techniques at various points, wetlands treatment of some sewers, fungi or enzyme treatments, land application of selected streams, or incineration of dewatered solids from selected streams would have been valuable.
- Two of the most important and difficult parameters to address are conductivity and chronic toxicity. To date, no effort has been made to identify the source and identity of all of the ions that contribute to conductivity in today's effluents and could affect chronic toxicity. In addition, a full toxicity identification evaluation has not been conducted on current effluents. It would seem that these procedures would produce valuable information about ways to prevent and treat wastewater so that it can be as innocuous as possible.
- It remains unclear what the effect of altering the dissolved oxygen profile by modifying aeration techniques would have on color reversion, particularly in Pond 1, or whether G-P is maintaining a 2 mg/L dissolved oxygen level as they proposed to do.
- How FDEP transparency standards correspond to the measured true color of today's G-P effluents is unknown. If this relationship is significantly different from previous effluents, as

would seem possible given the significant changes in processes and treatments, the color removal targets could be significantly different.

- The distribution of chlorinated dioxins and furans in the G-P wastewater treatment system is still not completely understood even though the high volume extraction and legacy solids studies indicated that the compounds are discharged in G-P wastewater in particulate and dissolved phases. The legacy solids study verified high levels of 2,3,7,8-TCDD/F in the pond solids and also indicated that the emergency spill basin (ESB) has the highest concentrations of dioxins. The ESB was dredged in 2006 indicating that the source of the dioxins found in 2008 is unknown and its role in contaminating Ponds 1-4 is unclear. The solids from the sludge ponds, which would seem to be a potential hot spot, were not evaluated.
- Although older methods of dioxins analysis (EPA Method 1613B) cannot detect ambient water quality standard levels of 0.014 ppq, the high volume extraction technique can. The results of the pond study indicated concentrations in the discharged effluent at or above the standard. There was no discussion as to why the method was considered invalid or the data produced from it is suspect, only that it was not an approved EPA method.
- No strategies were posed to eliminate the discharge of dioxins. Dioxin discharge was only addressed indirectly by assessments of total suspended solids (TSS) levels, which are already very low by pulp and paper industry standards. Furthermore, because the relationship between particle size/composition and dioxin concentration is not known, the actual effectiveness of TSS reductions cannot be ascertained. While the presence of high concentrations of dioxins in sludge solids has been verified, there has been no acknowledgement of dissolved phase dioxins in the effluent which are likely to be continually discharged regardless of the TSS levels.
- The fate of the discharged organic carbon-associated dioxin congeners (in dissolved or particulate phase) is unknown, but the presence of 3-4 pptr dioxins in organic-rich sediments in quiescent areas in Rice Creek (29) suggests that there is some sedimentation of these materials in the creek. Rice Creek has dioxins/furans in its sediments at 2,3,7,8-TCDD toxicity equivalences (TEQ) (based on 1998 World Health Organization toxicity equivalence factors) that are about 3 times the Threshold Effects Level (TEL) of 0.85 ug/kg, but well below the Probable Effects Level (PEL) of 21 ug/kg (30). The fate of the dioxins in saltier water, such as in the mainstem, is unknown.
- Fish dioxins concentrations were found to be acceptable for consumption according to Florida Department of Health standards of 7 pptr TCDD TEQ in 2004, and 2010 dioxin analyses of Rice Creek fish were under 1 pptr TEQ. While these levels meet consumption standards even for the draft revised EPA consumption limits (1.5 pptr), data were not available in the reviewed reports about lipids content, size, or age of the fish, which are all significant factors in evaluating bioaccumulation of dioxins. A second big unknown is how much coplanar PCBs, or “dioxin-like” compounds, are present in the fish. These compounds contribute to health risks from fish consumption and could be present in Rice Creek fish.
- The effluent standards for color and conductivity are designed to protect water and biological quality in Rice Creek. However, from an environmental standpoint, it is unclear what the targets

should be. The creek basin is hydrologically impacted by G-P operations and other water-withdrawals. In addition, much of the basin consists of flood-prone and organic-rich wetlands, the creek is tidally influenced, and it has reverse flow events. These conditions all substantially affect conductivity and color in Rice Creek even without the discharged effluent; it is unknown what the exact environmental benefit will be in reducing those parameters. See Appendix B for additional information.

- Rice Creek sediments are heavily contaminated (see Appendix B for additional information). The origins are unknown, but the mill is a potentially significant source given the history of chemical use by the pulp and paper industry and the presence of legacy compounds in their effluents. If the compounds are present in G-P effluents, their fate and effects when transported to different environments is unknown.

Conclusions

A staggering amount of study has been conducted on G-P operations and their effects on Rice Creek in the last two years, as well as many years prior to that. Georgia-Pacific has documented their numerous process stream improvements in the bleach plant and recovery cycle and their efforts to find ways to economically dispose of sodium sulfate waste. They complied explicitly with requests by DEP to examine options for optimizing the wastewater treatment ponds. While some strategies were found to be helpful in reducing problematic effluent constituents, G-P concluded that their high cost and incremental improvements prevented their implementation. Selective treatments of individual sewers or process streams were not examined, nor were additional process stream modifications. According to Brown and Caldwell, most of the technologies selected for evaluation have been demonstrated in comparable applications, applied in full-scale installations, and have been in practice for over a decade. As a consequence, substantially innovative or novel techniques were not assessed.

Information gaps remain that limit evaluations of options and impacts. The specific nature and sources of several important parameters in today's effluents (i.e., chronic toxicity, conductivity, color, and dioxins) is incompletely understood. Without this information, evaluations of options to reduce those parameters and of their potential environmental impacts are also incomplete. The possible presence of harmful legacy compounds in final effluents (in addition to dioxins) has not been ruled out so potential effects on Rice Creek and the SJR cannot be assessed. The actual impacts of different wastewater alternatives on the water and biological quality of Rice Creek have not been fully assessed, in large part because the characteristics of a pristine Rice Creek are unknown, as are the effects of anthropogenic activities other than wastewater discharge.

References

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3. Brown and Caldwell Technical Memorandum #4 , "Assessment of Combined Alternatives," May 16, 2010
4. Brown and Caldwell Technical Memorandum #3 , "Wastewater Treatment Alternatives Evaluation," May 16, 2010
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6. Brown and Caldwell Technical Memorandum # 2, "Screening Analyses of Wastewater Treatment Alternatives," January 14, 2010
7. Brown and Caldwell Technical memorandum # 1, "Screening Analyses of Wastewater Treatment Alternatives," December 4, 2009
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12. May 12, 2009, Risk Sciences "Recommendations for Georgia-Pacific Palatka Mill"
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23. "Report on Georgia-Pacific Palatka Operations Optimization of Manufacturing Equipment March 2006-March 2007" March 2007
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25. Environmental Consulting and Technology, Inc., "Rice Creek Water Quality Report" September 2010
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29. Columbia Analytical Laboratories (for L.B. Sonnenberg, Millar Wilson Laboratory), "Dioxins in Rice Creek Sediments", unpublished data, December 2009
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Appendix A: List of Documents Submitted to FDEP by L.B. Sonnenberg (PO A2981B)

1. Draft Summary Evaluation of G-P Optimization Studies 040411 [Draft Final Report]
2. LBS Comments G-P Response to DEP Request for Additional Information 121010.docx [RAI issued 12/10/10; G-P Response 1/21/11; LBS Comments 4/1/11]
3. LBS Comments G-P Response to DEP Request for Additional Information 110510.docx [RAI issued 8/20/10; G-P Response 10/4/10; LBS Comments 11/5/10]
4. G-P Wastewater Questions 8-11-10 (LBS).docx and Rice Creek WQ-ECT and Sixteen Mile Creek.xlsx (8/11/2010) [Content: General wastewater treatment, chronic toxicity, color, dioxin, conductivity, Rice Creek reference sites]
5. Wastewater Treatment Alternatives for G-P 061410.docx
6. Legacy Solids and Dioxins in G-P Wastewater 061010.docx
7. Process Optimization for Conductivity Reduction 060310.docx
8. Conductivity and color.docx (5/25/2010) [Content: FL Storet data compilation and summary of Palatka area water quality]
9. Draft Conductivity Review 101909
10. Draft Feasibility Review 103009
11. Draft Legacy Solids Review 101909
12. Rice Creek 2009.pdf(2/5/2010) [Content: Rice Creek dioxins data]
13. DEP-Questionsv110509.docx [Content: questions regarding “Legacy Solids Report” September 1, 2009, with reference to the EPA Region IV “High Volume Sampling Study Report February 20, 2009; “Conduct Engineering Feasibility Study for Treatment System Improvements” by Brown and Caldwell August 13, 2009; Process Optimization reports including references to “Production Optimization and Saltcake Alternatives” 9/1/09, “Additional Information Regarding Facility Optimization Report” 5/30/2008, “Report on Georgia-Pacific Palatka Operations Optimization of Manufacturing Equipment Mar 2006-Mar 2007; “Water Quality Monitoring Final Report”, June 13, 2008, with reference to “Biological Assessment of Georgia Pacific Corporation – Palatka operations” March 2007]
14. DEP-Questions-Info request.docx (9/29/2009) [Content: questions about dioxins, feasibility study proposal, and requests for additional information]

Appendix B: Rice Creek Supporting Information

Sediment Contamination

An extensive survey of sediment contaminants throughout the mainstem and tributaries of the LSJR from 1996 to 2003 by the SJRWMD revealed Rice Creek to be one of the most heavily impacted water bodies in the LSJR area (31,32), though the sources of the contaminants are unknown. Sediments in Rice Creek and its confluence with the LSJR have the highest TOC in the region (30-40%) except in areas that are dredged or scoured by high flow from wastewater. Numerous contaminants are present in Rice Creek sediments, many at levels that exceed Probable Effects Levels (PELs). Along with the Cedar-Ortega system, Rice Creek sediments have the highest levels of mercury, copper, nickel, chromium, manganese and vanadium in the LSJR. Low molecular weight PAHs, particularly anthracene and naphthalene, were present in 7 out of 8 samples at concentrations exceeding LMW-PAH PEL values. Rice Creek is also contaminated with PCBs; the 15 sites most contaminated with PCBs included sites in Rice Creek, the Cedar-Ortega area and Moncrief Creek. Rice Creek is notable in the sediment survey also because of elevated levels of several pesticides including total chlordane, total DDT, endosulfan, dieldrin, heptachlors, methoxychlor, lindane, kepone, and hexachlorohexanes. Chlorophenols and phthalates in Rice Creek sediments are also extremely high. Whether these compounds are present in the G-P effluents today is unknown, but historic use of biocides and other persistent, bioaccumulative, and toxic compounds by the pulp and paper industry was widespread. If historically produced dioxins are present in the wastewater treatment ponds, it is possible that other recalcitrant contaminants are also present.

Hydrology

The Etoniah Creek Basin, of which Rice Creek, Etoniah Creek, and Simms Creek are a part, ranges from west of Keystone Heights to the SJR with elevations ranging from 140 ft above NGVD in the west to near sea level near the SJR mainstem (33). An important aspect of Rice Creek and its environs is the historically modified hydrology of the entire region. Removal of surface water from Etoniah Creek, the dam on Etoniah, and the periodic pumping of groundwater into Etoniah Creek all significantly alter its hydrology from pristine (i.e., pre-1947) conditions. It is possible that hydrology of the basin is also affected by water withdrawal operations in the western part of the basin. The large channel first dredged in Rice Creek in 1954 to accommodate barge traffic to the mill is also likely to significantly affect hydrology and water quality, particularly with respect to conductivity. These conditions and the tidal nature of the creeks in the basin make it difficult to predict what the natural conditions of the creek are, especially regarding conductivity and color, two of the significant parameters G-P is attempting to reduce. These conditions also make it difficult to predict the hydrological condition of Rice Creek if there is a net removal of 23 MGD. Thus, the benefits to the ecological health of Rice Creek by removing the wastewater are not clear.