

Using treated municipal wastewater in a linerboard mill—legal, political, and technical issues

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ABSTRACT: *When plans to expand production at an antiquated mill were jeopardized by an inadequate source of process water, the mill explored the possibility of producing first-quality linerboard using treated municipal wastewater. This paper outlines the legal, technical, and political issues encountered in developing a plan that would allow the mill to use effluent from a municipal wastewater treatment system. The technology is available to make reuse of municipal wastewater feasible, as evidenced by the closed-loop delivery and discharge system described in this report. Nevertheless, legal and political concerns make the implementation process arduous and time consuming.*

KEYWORDS: *Board mills, Connecticut, design, effluent treatment, feedback control, liner boards, reclaimed fibers, water reuse, water supply.*

The Rand-Whitney Group owns and operates a paperboard and folding carton plant in Montville, CT. The mill has been in operation for nearly 150 years and employs approximately 200 people. Because of the antiquated equipment and the small scale of production, the mill does not earn profits, and the owner seriously considered shutting it down.

As an alternative to closing the mill, the owner investigated the possibility of upgrading the plant's equipment and increasing the production at the mill site to attain certain economies of scale. The owner determined that there was a readily available supply of old corrugated containers (OCC) within a 400-km radius of the existing mill and a vi-

able market for linerboard produced from OCC.

During the early stages of development for the new linerboard mill, it became apparent that there was no readily available supply of process water. The existing mill is not serviced by a municipal water supply. Instead, water from the Oxoboxo Brook is diverted to produce paperboard and folding cartons. The flow of water through the Oxoboxo was inadequate to satisfy the process-water requirements for the planned 400-ton/day linerboard facility.

Rand-Whitney identified two alternatives for obtaining a sufficient volume of process water: drill wells into an aquifer beneath the existing mill or use treated effluent from the town's wastewater treatment facility. Tests showed that the volume and quality of the water in the aquifer was adequate for producing linerboard. The owner also learned that it would need to obtain permits from the state of Connecticut and the federal government to divert water from this aquifer. However, the authorities probably would not grant such water-diversion permits within the next 24 months.

After concluding that the aquifer was not a viable alternative, the owner evaluated the other alternative—the reuse of treated effluent—by first identifying mills that were using or planning to use treated effluent as a source of process water.

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The next step was to determine how the use of treated effluent would affect the design, development, construction, and operation of a paper mill as well as the quality of paper produced.

The literature indicated that the reuse of treated effluent was technologically possible. A review of publicly available information revealed that a mill in Pomona, CA, was using treated effluent. The literature also identified a project to develop a mill supplied with wastewater in Tacoma, WA. Attempts to confer with the operators of the Pomona mill were unsuccessful, but representatives of the project in Tacoma were willing to discuss the topic. Representatives of the Tacoma mill stated that they were no longer developing the mill to use treated effluent as process water. They did, however, provide numerous practical suggestions regarding the permitting process and the construction of the new mill.

The mill owner conferred with the town's Water Pollution Control Authority (WPCA) to discuss methods of using treated effluent from the town's wastewater treatment facility as process water for the new mill. During these conferences, the owner and the town developed a unique and environmentally benign process that evolved into a closed-loop system between the town's water-treatment facility and the new mill. The closed-loop system provides one path for water supply and another path for effluent discharge.

Technical issues

The town's existing treatment plant was built in 1974 to treat 5300 m³/day of domestic sewage to a level of 30 parts per million (ppm) of biochemical oxygen demand (BOD) and 30 ppm of total suspended solids (TSS). The treatment plant has worked well for the past 18 years, with the existing mill contributing about 20% of the flow and 50% of the BOD loadings. The existing

I. Standards for treated water

	Concentration limits, mg/L	
	Maximum average	Maximum
Turbidity	4.9	100
Color (in platinum units)	47.5	100
Total hardness (as CaCO ₃)	76.3	200
Alkalinity to methyl orange (as CaCO ₃)	126.6	175
Iron (as Fe)	0.192	1.0
Manganese (as Mn)	0.177	0.5
Silica (soluble, as SiO ₂)	14.66	100
Total dissolved solids	353.66	500
Free carbon dioxide (as CO ₂)	10.33	20.66
Chlorides (as Cl)	54.5	109
Sulfates	53.3	106.6
Sodium	83.3	200
pH	6-8	6-8

mill has a permitted capacity of 475 m³/day—with loadings of 525 kg/day of BOD and 114 kg/day of TSS—to discharge to the treatment plant. With these loadings, the effluent from the treatment plant has averaged 7 ppm of BOD and 7 ppm of TSS.

The quality of effluent from the treatment plant was deemed to be acceptable for use as process water in the new mill. With further investigation, the owner and the town were able to agree on standards of water quality that the treatment plant could deliver. The treated-water standards specified in the Water Supply Agreement are listed in **Table I**.

The treatment plant was underdesigned at the time of the planned mill expansion, primarily because of the addition of a new correctional center in the town. The new treatment facility is a sequence batch reactor with a design of 13,627 m³/day, with an effluent quality of 10 ppm of BOD, 10 ppm of TSS, and 5 ppm of total nitrogen.

This new treatment plant will allow the WPCA to use the old treatment plant as part of the pretreatment for effluent generated by the new mill. With this in mind, the town has agreed to build on the mill site two dissolved-air flotation (DAF) units, with the sludges from these

units going back to the mill for disposal. Then, a decanted effluent line will be installed to the treatment plant, where the existing DAF unit and three aeration basins and two secondary clarifiers will be used as part of the pretreatment process.

The water-reuse modification to the treatment plant includes pumping effluent from the chlorine contact tank, which has a capacity of 852 m³, through 50- μ m mechanical filters, then to pressure sand filters. After this, the water will be rechlorinated and pressure pumped to the new mill, where it will be used for the complete process, including boiler water, sprayers, and papermaking. After pretreatment with the two DAF units at the new mill, used water will return to the treatment plant through the decanted return line, into the original treatment plant for additional BOD removal, then mixed with the town's flows in the sequence batch reactor, back to the chlorine contact chamber, to start its trip once more.

During its trip through the new mill, approximately 1090 m³/day of water will be lost to evaporation and absorption into the product. This represents treated effluent that would have been discharged to the Thames River. Thus the loading to the river will be lower after the new plant begins operations.

Political issues

The decision to implement a closed-loop system for the delivery and return of effluent from the WPCA's treatment plant to the new mill required the town to build two pipelines and a pretreatment facility. The town estimated the cost of purchasing and installing the pipelines and the pretreatment facility at US\$ 2.7 million. Rand-Whitney agreed to pay approximately US\$ 2.2 million to the WPCA to connect to the new treatment plant, US\$ 1 million per year in local taxes, and US\$ 0.4 million per year in sewer-use charges. In addition, the implementation of the system for reusing treated effluent would save the 200 jobs at the existing mill and create new jobs for the construction and operation of the new mill.

The WPCA and the mill owner held a public meeting to present the construction plans for the new mill, the pipelines, and the new pretreatment facility. The WPCA and the mill owner also presented a financial analysis and an analysis of the projected environmental impact. In a special referendum on this issue, the citizens of the town approved all of the plans presented by the WPCA and the mill owner, authorizing funds to construct and install the pipelines and the new pretreatment facility. The strength of voter support on this referendum (a seven-to-one margin in favor of the project) helped the mill owner and the WPCA during later discussions with the town's elected officials about other aspects of the project.

Legal issues

Introduction

The proposal for the reuse of treated effluent in the operation of the new mill meant that the mill owner and the town would be entering into a relationship that would break new

ground in the state of Connecticut. Because clean water is generally available throughout New England, there is minimal experience with the reuse of treated effluent and very little legal or regulatory guidance in this area. Counsel for the mill owner examined the environmental laws of the federal government and the state of Connecticut; the rules and regulations of the U.S. Environmental Protection Agency and the Connecticut Department of Environmental Protection (DEP); existing project finance documentation relating to the delivery of water, steam and coal; and the 1993 Proceedings of the American Water Works Association Water Reuse Conference.

During this review process, the mill owner determined that, while existing project-finance documentation would provide a good model for documenting the treated-effluent-supply relationship, this documentation should be augmented to address issues unique to the use of treated effluent. The project-finance documentation addressed the basic issues concerning supply of materials to a project. The mill owner and the town had to establish the quantity of the material, minimum quality standards, the schedule for delivery, and the allocation of responsibility and risk of loss associated with the use of treated effluent. By reading the report on the papermaking facility in Tacoma, WA, and conversing with the individuals who had prepared the report, the mill owner and the WPCA were able to identify further health and environmental issues concerning the reuse of treated effluent in a paper mill.

Issues identified

A due-diligence review by counsel for the mill owner led to identification of four issues (business and legal) that must be addressed when preparing a contract involving the reuse of treated effluent at a paper mill. The issues should be framed in

terms that enable major financial institutions to assess the project's acceptability for financing. The issues are:

- Quantity and quality of treated effluent
- Delivery of treated effluent
- Exposure to treated effluent
- Permitting.

Quantity and quality of treated effluent

The mill owner (Rand-Whitney) and the manufacturer of the paper machinery (Beloit Corp.) determined that a continuous flow of process water of approximately 5300 m³/day was necessary to operate the mill in accordance with its business plan. With this minimum quantity of effluent established, the owner and the machinery manufacturer met with the WPCA to examine the plans and specifications for the existing treatment facility and the plans for construction of the new treatment facility.

The WPCA agreed to analyze the influent stream to the existing treatment facility to determine its dependability. The WPCA determined that the major contributors of influent to the treatment plant were the existing mill and the citizens of the town. Since the owner controls the existing mill—and since the amount of effluent generated by the private citizens of the town is relatively stable—the mill owner and the WPCA were able to convince the bank group and its independent engineer that it was very likely that the town would be able to provide at least 5300 m³/day of treated effluent.

To support this position, the WPCA has agreed, pursuant to the Water Supply Agreement, to provide an annual capacity report, which will indicate the current permitted capacity for the treatment facility and include one year's historical information about the average daily vol-

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ume of effluent treated at the treatment facility.

In addition, the town and the WPCA agreed to grant the mill owner access to any other facility that the WPCA uses to treat the town's effluent from time to time. The owner and the institutions that are financing the new mill were concerned that the town could close the existing treatment facility and construct a new treatment facility at another location, or join with other towns in the region to establish a centralized treatment facility.

The town has further covenanted in the agreement to restrict other uses of the existing treatment facility. All of the effluent from the town's residents and from the industrial enterprises within the town are commingled at the WPCA treatment facility. As a result, it is possible that a new use from an industrial enterprise could contaminate the effluent with a substance that would prohibit the WPCA from delivering the required 5300 m³/day of treated effluent meeting the minimum quality standards.

Consequently, the town has agreed that, for every new industrial source for the discharge of effluent, the town will analyze the effluent to be delivered from such discharge point and provide the mill owner with the results of such analysis. If the owner and the town determine that this new effluent stream is likely to contaminate the effluent treated by the town, then the town will determine if the treatment facility can be modified to segregate this new effluent stream.

If the town is unable to segregate this new effluent stream, the town will use its best efforts to reject the effluent stream. If the town is unable to modify the treatment process or reject the effluent stream, the town will take such reasonable actions as the mill owner shall request to accommodate the mill's requirements.

After determining that reuse of treated effluent was the only means

of providing process water to the new facility, the mill owner requested that Beloit help establish minimum standards for the successful utilization of treated effluent. The mill owner and the machinery manufacturer contacted other paper producers to determine the minimum standards for process water that are generally accepted in the paper production industry. The manufacturer also contacted other enterprises to determine if there were any contaminants that were potentially harmful to components of its papermaking machinery. The net result of this investigation was that the manufacturer established a minimum quality standard for the process water for the paper machine.

The manufacturer and the mill owner agreed that if the process water did not contain contaminants in excess of these quality levels, then the manufacturer would produce a machine that was capable of producing at least 400 tons/day of linerboard that satisfied the mill's high quality standards.

The mill owner used this minimum requirement for process water as the basis for establishing the quality of the treated effluent that the town agreed to supply to the mill pursuant to the Water Supply Agreement. During the two-month period when the owner was negotiating with the town concerning the Water Supply Agreement, the WPCA tested the effluent from the treatment facility once a week to determine the existing level of the contaminants identified in the research provided by the machinery manufacturer. The results of these tests form the basis for the standards for treated effluent set forth in the Water Supply Agreement.

The WPCA has agreed that, on any given day, the maximum amount of any substance identified by the manufacturer as being potentially harmful to the papermaking process shall not exceed two times the average test result for the initial two-month test period. The WPCA has

further agreed that during each thirty-day period, the average of such substances shall not exceed the average for the initial two-month test period. The use of a maximum daily contaminant level satisfies the WPCA's requirement for flexibility on a daily basis and the owner's requirement for certainty with respect to daily concentration levels. The WPCA's covenant to produce treated effluent that is, on average, of the same quality as the test results is indicative of the WPCA's commitment to produce the best quality of treated effluent possible.

The mill owner and the WPCA have documented the treatment process to be used at the new treatment facility, and the WPCA has covenanted that it will not change the treatment process without the mill's approval. This covenant recognizes that the current treatment process is a baseline and that the treatment process should not be altered without the WPCA and the mill owner understanding how such alteration could impact the quality and quantity of treated effluent.

The WPCA has also agreed to continuously test the effluent for turbidity and alkalinity at the point immediately prior to its delivery to the mill. All other parameters are to be tested on a monthly basis. The WPCA and the owner chose to test for turbidity and pH on a daily basis because imbalances in turbidity and pH are indicative of other limitations being exceeded.

Finally, the WPCA has indemnified the mill owner for certain losses resulting from the delivery of effluent that does not meet the standards set forth in the Water Supply Agreement. This indemnification covers losses that the owner incurs with respect to damage to its machinery and liabilities resulting from the delivery of substandard product to the marketplace. The WPCA was able to indemnify the owner because the WPCA participated in the establishment of the standards set forth in the agreement and the WPCA has

the ability to control the process for treating effluent.

Delivery of treated effluent

Presently, the WPCA has one pipeline that leaves the treatment facility and enters the Thames River. To deliver the treated effluent to the new mill, the WPCA undertook to design and construct a separate pipeline from the treatment facility to the mill. During negotiations with the WPCA, and as a result of a due-diligence review with respect to permitting and liability issues, the owner and the WPCA decided that it would be prudent to construct a return pipeline from the mill to the WPCA's treatment facility. Upon completion of the two pipelines, the treated effluent will remain in a closed loop.

During the negotiations, the WPCA also indicated that it could not guarantee that the treatment facility would be available 24 hours a day, 365 days a year, because there are certain events beyond their control (such as a system upset) that could cause the treatment facility to be shut down. To allow continuous operation of the mill, both the WPCA and the owner have undertaken to provide a 24-hour backup in the form of holding tanks.

Exposure to treated effluent

A significant difference between the supply of water to traditional projects and the supply of treated effluent to the proposed mill is the potential liability resulting from exposure to contaminated effluent. With respect to mill employees, the owner has assumed responsibility for compliance with the laws governing the health and safety of employees and other guidelines regarding exposure of its employees to hazardous materials. In practice, this means that all process-water pipelines will be color-coded to indicate which pipelines contain treated effluent and which pipelines contain potable water. With respect to the general public, the mill owner and the WPCA

have undertaken to develop a closed loop from the treatment facility to the mill to minimize any possibility that treated effluent could contaminate other water sources and therefore expose members of the general public to any substances in the treated effluent.

Furthermore, the WPCA and the mill owner have established an interconnection point at the boundary of the mill property. On the WPCA's side of this interconnection point, the utility has full risk for any damages that may result from the provision of treated effluent or the handling of treated effluent. On the mill side of the interconnection point, the mill has this responsibility. However, the WPCA maintains responsibility for effluent delivered to the mill if that effluent does not meet the treated-effluent standards set forth in the Water Supply Agreement or if liability associated with such effluent has attached prior to the interconnection point.

Finally, the mill owner was concerned about contamination with respect to members of the general public resulting from the use of the mill's linerboard. For example, the linerboard is used to make corrugated boxes, which are then used as packaging material for a variety of industries. As mentioned previously, some of the treated effluent is absorbed into the linerboard. As a result, any substances or contaminants associated with the treated effluent theoretically would be absorbed into the linerboard as well. If the mill produced linerboard that had been contaminated with a toxic substance in the effluent—and this linerboard then came into contact with members of the general public—the mill owner would have a legal obligation to pay any damages resulting from such contamination.

The potential risk, although minimal, would have a disastrous effect on the mill owner and the bank group. The WPCA recognizes that this is a potential problem and has

agreed to indemnify the mill owner for any damages resulting from such use of effluent that does not meet the treated-effluent standards set forth in the documentation.

Permitting

The due-diligence review conducted by the mill owner and the WPCA indicates that there is very little regulation in the state of Connecticut with respect to the reuse of treated effluent. Essentially, there were three permitting issues that needed to be addressed to proceed with this project. First, the NPDES (National Pollution Discharge Elimination System) permit for the WPCA needed to incorporate discharges to the mill instead of the Thames River. Second, the DEP determined that the discharge of effluent from the mill to the WPCA at the wastewater interconnection point was a discharge point, and therefore the mill needed to obtain a single-point discharge permit for that interconnection point. Finally, the owner and the WPCA needed to obtain permits to allow construction of the pipeline.

Conclusion

Cooperation is a crucial element in any agreement involving the reuse of treated municipal effluent. This agreement was possible only because all of the participants—the town, the WPCA, the DEP, Beloit, and Rand-Whitney—were able to cooperate, to discuss issues openly, and to determine which entity had the best ability to control risk. Risks were then allocated in accordance with those discussions.

Planning for the treatment process and the permitting process is absolutely essential. A significant reason for Rand-Whitney's ability to obtain financing for this project was the advance work performed in cooperation with Beloit and the town. By the time that the bank's attorneys and engineers became involved, they were presented with a thor-

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oughly developed treatment process, and the permitting process was nearly complete.

Testing and quality control are important preventative measures. Before entering into a treated-effluent supply agreement, it is necessary to establish a baseline for the treated effluent by testing at regular intervals for an extended period of time.

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