Wastewater Treatment Residuals (WWTR) at Forest Product Mills as Non-Waste Fuels

1. Generation and Management

In 2008, 23 percent of WWTR were used in boilers as a critical source of energy for mills. Use depends on fuel availability, cost of alternative fuels and the capacity of the boiler to use alternative fuels. For example, if a mill has a surplus of hog fuel/bark, it will not need the makeup energy from other onsite residuals such as WWTR.

Over 90 percent of WWTR are processed in some manner to ensure fuel product specification needs are met. The primary preparation is dewatering with belt filter or screw presses. This results in the delivery of a material to the boiler that is ready to burn according to the specifications of the mill's biomass boilers which are uniquely designed to handle a wide range of fuel qualities and moisture contents.

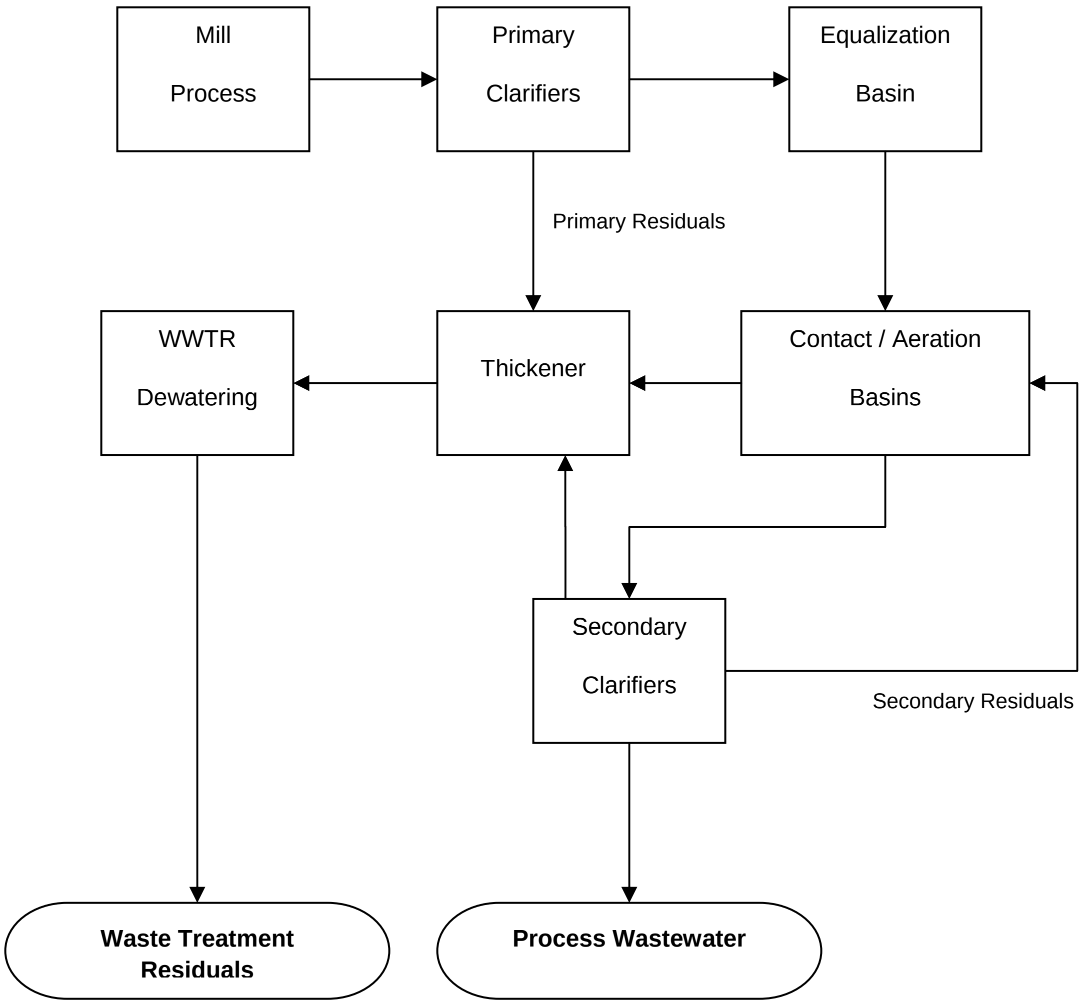
Two types of residuals are generated by mills. Primary residuals are generated on a continuous basis. They are typically conveyed directly from the clarifiers to dewatering equipment, dewatered, mixed with hog fuel (with bins and metered conveyors or in piles with a front end loader) and conveyed to boiler in a continuous or semi-continuous process.

Secondary WWTR are generated depending upon the type of secondary treatment in use. In some instances, the residuals are generated continuously (such as for activated sludge); in others (such as aerated stabilization) residuals are generated far less frequently. For activated sludge systems, like with primary residuals, wastewater is decanted from the secondary clarifiers, and residuals are removed from the bottom of the clarifiers and sent directly to be dewatered.

When aerated stabilization residuals are burned, they are normally staged for a time to allow free water to drain. This would occur on a concrete pad on another surface, in a fabric tube or any other manner that allows free water to drain back to WWT system. Additional dewatering is accomplished with screw presses, belt presses or other similar devices.

When WWTR are not immediately used as fuels, they are stored in piles like other biomass materials such as bark and hog fuel because they have similar Btu and content properties. Because of their similar properties, WWTR are blended with other fuels to obtain the optimum overall fuel properties and consistency prior to introduction into the boiler to produce stable combustion conditions. WWTR, with the other fuels, are delivered to the boiler in the same manner as other biomass fuels primarily via conveyor belt, but often using a front end loader. As mentioned, in most instances storage is minimized and the fuel is prepared, conveyed, blended with other fuels and burned in a continuous or semi-continuous process.

A typical configuration for management of primary and secondary residuals is shown on the following diagram.



These facts demonstrate that WWTR destined for energy recovery in a mill boiler is not a solid waste because it is not discarded and is managed to enhance its fuel qualities and stored and burned like other biomass residuals.

2. **Reliability in meeting steam demands of the manufacturing process**

Multi-fuel boilers at pulp and paper mills are designed to burn a wide variety of biomass-based materials with different fuel characteristics and moistures. For example, typically, hog fuel ranges from 35 – 60 percent moisture content. However, during certain times of the year, very wet bark (which can be as high as 70 percent moisture content) is used as a fuel. The moisture content of WWTR when burned is in the same range as biomass hog fuel and similar in terms of biomass content and thus fuel value.

A typical mill with an activated sludge system may have combined primary and secondary WWTR content as follows: Water - ~60%; Wood fiber - 8-20%; other Biomass - 12-16%; Paper fillers - 14-20%;

WWTR are produced at a steady and regular rate at pulp and paper mills as clarifier solids streams and thus are a steady, reliable, and necessary part of the fuel stream. Clarifiers exist for the purpose of removing the largely paper fiber solids from the wastewater as the first step in WWT. As noted earlier, depending on the type of wastewater treatment process in place, some mills have both primary and secondary clarifiers. Fiber also carries over to secondary treatment systems where it builds up with time and is then removed and handled in a similar manner to clarifier solids. Removal of WWTR from secondary treatment systems, polishing ponds and other areas downstream of clarifiers is necessary to maintain treatment system performance and it is scheduled appropriately to achieve this objective. Timing is unique to the system configuration, pulp mill performance and other site specific factors.

Thus boiler operators at mills can plan for that portion of the Btu needs that comes from WWTR when determining the mix of fuels to use at any given time (hog fuel, other biomass residuals, or fossil fuels). Relative amounts of WWTR, hog fuel and other fuels feeding a given boiler depend on the particular site equipment scenario of the mill: dewatering equipment, WWTR properties, and boiler design.

For all the above reasons, WWTR is a reliable source of fuel. In fact, WWTR is used as the primary fuel (and in some cases as the only fuel) in fluidized Bed Combustors (FBC) in the US. In fact, one of the best performing boilers used to set the MACT floor for carbon monoxide from FBC burns only WWTRs.

3. Material Specifications

WWTR Btu/lb values range from 3,300 to 9,500 (on a dry basis) depending on whether it is derived from primary or secondary wastewater treatment, type of pulp and paper mill and the quantity of clay or other inert materials present. As noted, dewatering of WWTR is a regular practice to ready the material for combustion. In the rare cases when dewatering does not occur, the WWTR meets the combustion specifications to efficiently burn in the biomass boiler when mixed with other fuels. Using additional energy to dewater WWTR becomes counterproductive to the energy balance of the mill.

4. Off-site WWTR Management

According to AF&PA's 2008 member survey, WWTR were managed in a number of different ways: 23 percent were burned for energy, 16 percent for land application, and 13 percent for other beneficial uses (such as raw materials for other processes – roofing felt, flower pots, potting soil, etc.).[1] Thus, more than half of WWTR are managed for beneficial use. When burned for energy, WWTR are almost entirely managed on site. However, when used for other purposes, WWTR are shipped off site usually in trucks. As shown in the diagram above, WWTR are generally dewatered prior to management – including when shipped off site to reduce transportation costs and ease the handling of the material.

[1] Of course, the NHSM Rule only addresses whether materials are wastes when combusted. Management of WWTR for other purposes is not relevant to a determination whether they are solid wastes when they are managed as fuel to be burned for energy recovery

5. Contaminant Levels in WWTR

As presented to OSW in June, the chart below shows that there is a range of values for select contaminants in WWTR but the variability ranges from 2 to 5 times between the mean and the 90^{th} percentile confidence interval across the samples (see mercury as example shaded in orange). This is no different than many other materials used as fuel such as coal that are derived from natural materials which have inherent variability. The level of contaminants in no way affects the performance characteristics of WWTR as a fuel.

Wastewater Treatment Residuals Select Constituent Variability for Available Test Data

	BTU (BTU/lb)	Hg (mg/Kg)	Cl- (mg/Kg)	As (mg/Kg)	Be (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Pb (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Se (mg/Kg)
Number of Samples	94	82	93	77	53	82	84	77	84	84	55
Mean	5800	0.040	361	1.15	0.206	0.376	11.35	4.94	381	23.08	0.177
Std. Dev.	1548	0.063	661	1.18	0.106	0.366	6.96	2.55	291	33.17	0.168
T-distribution factor	1.296	1.296	1.296	1.296	1.299	1.296	1.296	1.296	1.296	1.296	1.299
90% Confidence Interval	7,807	0.123	1217	2.68	0.345	0.850	20.37	8.24	758	66.07	0.395