

BIOLOGICAL DESTRUCTION OF HAPS FOR CLUSTER RULE COMPLIANCE

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ABSTRACT

Longview Fibre Company determined the cost-effective means of complying with Cluster Rule regulations for the destruction of Hazardous Air Pollutants (HAP's) at the Longview, Washington mill is to utilize existing waste treatment plant capacity. A long-term pilot-scale study revealed design criteria necessary to accomplish HAPs destruction within the existing waste treatment plant. This paper describes the modifications to the waste treatment plant to meet the Cluster Rule requirements for HAPs destruction. HAP's collection and pretreatment requirements are also discussed.

INTRODUCTION

Longview Fibre's Longview mill is located approximately 103 km (64 river miles) upstream from the mouth of the Columbia River in southwest Washington State. The mill produces Kraft liner and paper grades and corrugating medium. Pulp is supplied from two 1000 Tonne/Day Kamyr digesters augmented by batch digesters and washer lines. Seven evaporator sets, five limekilns and four recovery furnaces provide chemical recovery support for the pulping operations. Two 364 Tonne/Day OCC plants and a bleach market pulp repulper complete the fiber supply for 12 paper machines. The infrastructure includes five power boilers, six steam turbine-generators, one gas turbine-generator with Heat Recovery Steam Generator, power distribution facilities rated at 150 megawatts (continuous), and raw water clarification with partial filtration. Effluent treatment uses primary clarification followed by pure-oxygen based secondary treatment with annual daily average throughput of 208,200 Cubic Meters/Day {55 Million Gallons per Day (MGD)}.

Like all other pulp and paper mills in the United States, the mill became subject to MACT I regulations promulgated by the EPA as directed by the Clean Air Act Amendments of 1990 on April 15, 1998. This "Cluster Rule" mandates Maximum Achievable Control Technologies (MACT) be employed in the collection and destruction of Hazardous Air Pollutants as defined by Congress in the Clean Air Act and subsequent amendments. The "Rule" specifies multiple options and timetables which a mill might use to assure compliance with the 1990 Clean Air Act amendments. Each mill is subject to the regulation and must determine for itself how to achieve compliance pending concurrence by the appropriate regulatory body have jurisdiction for enforcement of the regulation.

HAPs collection and destruction from the pulping and recovery portions of any mill's operation carries an April 16, 2001 compliance deadline. Controls on dilute streams like washer line hood vents and unwashed pulp handling equipment carry an April 17, 2006 compliance date. The industry is embarking on an expensive journey toward improved environmental stewardship.

Mill personnel commenced implementation discussions shortly following publication of the first cluster rule proposal in the Federal Register. Many options surfaced during those discussions for meeting the rule requirements. Discussion continued well past publication of the "final" rule in the Federal Register. As the EPA issued clarifications following "final" publication, further revisions to the compliance plan were formulated and evaluated.

The mill decided cost-effective compliance with the pulping and recovery portion of the regulations would be to capture a minimum of 3.6 Kg/Tonne pulp {7.2 pounds of Hazardous Air Pollutants/Air-Dry Pulp Ton (HAP's/ADPT)} and destroy 3.3 Kg/Tonne pulp {6.6 pounds of HAP's/ADPT} in a Dedicated Control Device (DCD). This paper discusses the rationale behind that decision and outlines the modifications made to mill processes and the secondary treatment plant to accomplish that task.

RATIONALE BEHIND CHOOSING A BIOLOGICAL OPTION

Background

Mill personnel operated a pilot-scale treatment plant before publication of the rule to evaluate probable effects of various operating modes and micronutrient products on the secondary treatment plant. The secondary treatment plant was generating an excess of filamentous bacteria. We sought a cost-effective solution to the problem [1]. That experience became the basis for operating a second pilot-scale study to determine if HAP destruction in the secondary treatment plant was feasible and under what operating conditions. The second pilot study provided information sufficient to justify and install equipment in the mill and at the secondary treatment plant to collect and destroy Hazardous Air Pollutants biologically as outlined above.

Before authorizing the second pilot study, mill management commissioned a task group consisting of technical staff, operating supervision from affected areas, environmental staff, engineering staff and a consulting engineering firm to meet regularly with them. The group's task included evaluating each of the options presented in the rule for compliance, determining technical requirements and estimating economic impact. Each meeting revealed the many interpretations possible under the wide-ranging and comprehensive set of regulations included in the rule. Discussions were limited to HAPs collection and destruction. The mill is not subject to that portion of the rule pertaining to chlorinated compounds as the mill's four-stage bleach plant is permanently shutdown in favor of purchasing bleached market pulp.

Regular meetings were scheduled. Each session ended with a set of marching orders for the participants preparing for the next meeting. One-by-one, we brought each option available under the rule to the table for evaluation. We considered compliance with the 2001 and 2006 requirements simultaneously to prevent the first solution from adversely influencing solutions meeting the second set of requirements. Each option was addressed by looking at projected operating expenses, capital requirements and potential product quality and process improvements

that might be realized if the option were pursued to attain compliance. One option never considered in this venue was the "fatal" option – permanent shutdown.

The group determined that the existing weak and strong Non-Condensable Gas (NCG) systems were generally compliant. Routine inspections required under the rule to check for leaks and adding a few sources to the collection systems brings about compliance there. Implementation proceeds in this area. A new semi-chemical pulping plant installed between initial and final publication of the rule attained compliance within the 60-day window called out in the rule. Only the mill's strong NCG system is subject to compliance by the 2001 date, being the Low Volume High Concentration vent control system. The weak NCG system must be in compliance by the 2006 date as it is the basis for the High Volume Low Concentration vent control system.

The mill operates a steam-stripper sized to separate sulfur-bearing gases from blow heat condensate and evaporator foul condensate and a turpentine condenser/decanter system to remove turpentine from the blow heat condensate before it goes to the primary clarifier. The biomass in the secondary treatment plant does not tolerate turpentine well, exhibiting reduced activity whenever the turpentine concentration rises to 12 mg/l in the secondary treatment plant influent [2]. Recovered turpentine is burned for fuel in two of the power boilers along with the weak Non-Condensable Gases (NCG's). The strong NCG's are normally combusted in one of the limekilns to recover the sulfur.

Collection/Destruction Decision Process

The rule offers several alternatives to each mill regarding the collection of Hazardous Air Pollutants in fouled condensates. These include:

- 1) capturing all named streams,
- 2) capture all the LVHC and HVLC collection stream condensates plus those containing 65% of the total HAP mass from the rest of the named streams, or
- 3) capture any of the named streams totaling 3.6 Kg/Tonne (7.2 lb./ADPT) of HAPs on a mass basis {5.55 Kg/Tonne (11.1 lb./ADPT) for bleach mills}.

The "named streams" requiring control are condensates from the following systems – Digester, Turpentine recovery, Feed-stage vapors and vacuum systems on evaporators, Low-Volume-High-Concentration (LVHC) and High-Volume-Low Concentration vent collection systems [3].

There is a provision in the rule that allows for replacing foul condensate in pulp washing and screening operations with clean condensate and in so doing avoid requirements to destroy HAP's in the vents from these operations. Cleaning and reuse of foul condensate results in water conservation and eliminates the necessity of ducting large volumes of air to combustion devices or installing scrubbers or filters on each vent. This provision, the "Clean Condensate Alternative" is one way of meeting the 2006 compliance requirements.

The rule offers five alternative emission limits for destroying the collected HAP's.

The first alternative, combustion, offers four choices:

1. Introduce the HAP's with the primary fuel or into the flame zone of a boiler, limekiln or recovery furnace,

2. Thermal oxidation with minimum residence time of 0.75 seconds at a minimum temperature of 871.1° C (1600° F),
3. Thermal oxidation with an outlet HAP's concentration of 20 PPMV at 10% oxygen (dry basis) and
4. Any device reducing total HAP's or methanol concentration by 98%.

These are also the control standards for pulping system vents, treating the High Volume Low Concentration and the Low Volume High Concentration gaseous vent streams.

The second alternative is to use a biological effluent treatment system to reduce HAPs by 92% by weight. The HAP's to be treated must be hard piped directly to the biologically active portion of the system below the water level and has been dubbed the "Hard Pipe Option". 100 percent uptime is required using this alternative

The third alternative is any method to destroy total HAPs by 92 weight percent in a Dedicated Control Device (DCD).

The fourth alternative offered is treat the condensates to destroy HAPs at a rate of 3.3 Kg/Tonne (6.6 lb./ADPT) for unbleached mills {5.1 Kg/Tonne (10.2 lb./ADPT) for bleached pulp mills} in a DCD.

And the fifth alternative is using a control device to reduce outlet HAP concentration to 210 PPMW for unbleached mills (330 PPMW for bleached mills) [3].

The Hazardous Air Pollutant condensate collection systems themselves must be closed, meeting a variety of specifications including no detectable leaks (500 PPMV above background VOC). Directing any system vents to a vent collection system leading to incineration under the first destruction alternative listed above is also a requirement. The Low Volume High Concentration (LVHC) system must be in compliance by April 16, 2001 and the High Volume Low Concentration (HVLC) system must comply by April 17, 2006. [3]

Elimination of Alternatives

The task group faced a difficult job. The mill is a complex operation. The pulping, recovery and utilities infrastructure spreads over approximately 75 hectares (190 acres). The rule contains many individual provisions in each of the options, some aimed at equipment configurations existing on the mill site and some not. Just sorting through the various options for applicability on the mill site took several months [3].

The evaluation of alternatives took place both serially and in parallel in that each collection alternative was matched with each disposal alternative to arrive at the cost-effective option. In addition, all consideration of collection and treatment of HAP's with a 2001 timeline included probable effects on the collection and treatment requirements with a 2006 timeline.

On the collection issues, collecting all the named streams and the HVLC/LVHC condensates plus 65% of total HAP's alternatives proved to be too cumbersome, too expensive or both. The mill layout has evolved over 73 years. There is no power island, concentrating recovery furnaces, limekilns, weak liquor evaporators, power boilers and powerhouse into one integrated system in a unique location. Instead, the various pieces of equipment are located where room

was available at the time of installation and where it made sense to install it given the long range plans at the time.

By way of example, to collect all the HVLC/LVHC condensates for treatment involved pumping two 252 ml/sec (4 gpm) condensate streams some 230 meters (750 feet) across the mill to the logical collection point for little if any HAP capture. Most of the volume is fresh water used to seal barometric legs on the transport lines. The estimate of HAP's returned for capture was approximately 450 gr./day (1 lb./day) from these two streams combined. This was deemed not a cost-effective way to comply. This one example by itself eliminated capturing all the named streams and HVLC/LVHC condensates plus 65 percent of the remaining HAP's.

Choosing the clean condensate alternative amounted to committing to meet the 2006 timeline in 2001 or installing a steam stripper designed to recover methanol. That stripper must be large enough to separate methanol from a flow of foul condensate roughly 252 l/sec (4000 gpm) for disposal in an approved combustor, limekiln or boiler. The installed cost and annual operating expense for steam made the latter option unacceptable. The clean condensate alternative had no affordable timeline so it too became unacceptable. This process only left one acceptable option – collect a minimum of 3.6Kg HAP's/Tonne pulp (7.2 lb. HAP's/ADPT).

The disposal options presented similar evaluation dilemmas. In order to combust HAP's, primarily methanol, the stream must be concentrated up to the azeotropic concentration in order to maximize steam recovery and conversion efficiency. This gets us back to a steam stripper or an alcohol still of large size and great operating cost. It also presents storage problems if the resulting product is not handled as vapor to the burner throat on a real-time basis. Technical difficulties with expensive solutions abound. We eliminated combustion as a disposal option.

We evaluated the so-called "Hard Pipe" option as a primary disposal method. Its primary advantage (low cost) required keeping it under consideration through the end of the evaluation process. The biggest drawback presented by this option is the requirement for 92 percent BOD removal 100 percent of the time in the waste treatment plant used for destruction. Any day with less than 92 percent BOD removal would be a violation as we read the rule. Corporate policy demands we not violate any governmental regulation knowingly. The low residence time of our secondary treatment system guarantees days with less than 92 percent BOD reduction. This occurs following a mill shutdown and subsequent restart due to low effluent temperatures slowing biological metabolism. We relegated the hard pipe option to backup status for use during normal mill operation.

The third, fourth and fifth emission limits listed under destruction options above are really three different ways to account for the Hazardous Air Pollutants destroyed and show compliance through Dedicated Control Device operation. The dedicated control device could be a combination of a steam stripper and combustion method or a biological device dedicated solely to the purpose of HAP's destruction. The biological device cannot be the final effluent treatment before discharge. The accounting methods are equivalent. For instance, 3.3 is 91.667 percent of 3.6. The 210 PPM by Weight is equivalent to 92 percent of the expected outlet concentration of a well-run steam stripper (2625 PPMW). The rule seems to offer all these alternatives to provide each affected operation with an compliance option that will fit.

The task group worked their way through all of the above and concluded that using existing excess waste treatment capacity would be most cost effective. Management agreed but

commissioned the pilot plant study to prove the concept before committing to that course of action. The final report written for management in June of 1999 listed the following conclusions.

1. Aerobic destruction of HAPs (methanol) at the 92% level is possible 100% of the time given certain operating conditions.
2. Retention time under oxygenation should be at least 4 hours.
3. Dissolved Oxygen in the Dedicated Control Device effluent should be above 1 PPM to avoid generation of Hydrogen Sulfide gas in the reactor vessels.
4. Micronutrient addition to the DCD mixed liquor may be of benefit. Positive changes to the biomass occurred during that portion of the trial but may have been caused by other factors.
5. Ammonia addition to the mill system as a macronutrient may not be necessary.
6. Primary clarifier effluent addition to the reactor is recommended at the 30 to 40% level.
7. The DCD biomass will be different from the biomass in the main plant. Few if any higher life forms were observed in the "B" plant.
8. DCD operation will have a beneficial effect on the main plant. Filamentous bacteria will be better controlled and main plant biomass will settle better.
9. Steam stripper performance is critical to the success of the DCD. Stripper feed temperature and steam supply improvements must be made.
10. Black liquor and turpentine in the feed to the DCD must be minimized. Instrumentation and control improvements at the steam stripper are recommended. A means to divert stripper discharge water elsewhere during excursions putting these two products in the stripped water is mandatory.[4]

The task group's focus turned to designing changes to the mill operating equipment which would meet the criteria stated in the recommendations. Modifications required to meet the criteria were studied as each interim data report from the pilot plant study was issued. Substantial progress in engineering and funding occurred during this time.

The modifications identified for mill equipment include:

1. Correcting turpentine condenser configuration and operation to maximize separation of turpentine in the decanter following the condenser.
2. Supplying adequate heat to the steam stripper feed condensate to maximize sulfur compound and turpentine separation from the foul condensate.
3. Modifying the multiple effect evaporators to separate as much HAP-laden condensate from the feed-effect vapor condensate and the vacuum system on each evaporator as possible given the capacity constraint of the existing steam stripper.
4. Modifying existing continuous Kraft sawdust cookers to allow pocket feeder cleanout steam to be included in the LVHC vent collection and disposal system.
5. Resupplying the demineralizer heat exchangers with ambient temperature water to reclaim waste heat from the steam-stripped condensate before treatment in the DCD to maintain optimum biological activity and health.
6. Piping the steam stripped condensate around the primary clarifier to the secondary treatment plant.
7. Modifying Kamyr foul condensate return systems to minimize emulsifying the turpentine going to the decanter.

These modifications are directed at improving HAP's capture rates, bringing individual sources into compliance with the rule (capturing cooker feed valve pocket vent steam) and conditioning the steam-stripped condensate to optimize the biological destruction process.

Modifications to the secondary treatment plant include:

1. Isolating the unused oxygenation tankage from the mill effluent treatment system to create the DCD.
2. Converting two of the seven existing clarifiers so that either can be used as the DCD clarifier and the other as a mill effluent clarifier.
3. Modifying the two clarifiers' discharge system in item 2 so the clarifier in DCD operation will overflow back into the mill effluent treatment system for retreatment while the clarifier used to clarify mill effluent retains its normal overflow scheme.
4. Modifying the two clarifiers' Recycled Activated Sludge system so the clarifier in DCD operation will supply the DCD oxygenation capacity while the clarifier used to clarify mill effluent retains its normal flow scheme to the mill effluent treatment system.
5. Installing separate oxygen flow and vent controls on the isolated oxygenation tankage.

DISCUSSION OF WASTE TREATMENT PLANT MODIFICATIONS

Figure 1 shows the waste treatment plant flow as installed in 1977 with modifications made in 1991. The original installation included the five clarifiers shown in the lower right as one clarifier and distribution tower. The 1991 modification added a second distribution tower and two more clarifiers shown in the lower left. The secondary treatment plant shown in Figure 1 consists of a pure-oxygen-based activated sludge plant with oxygen supplied by a 45.5 Tonne/Day (50 Ton/Day) cryogenic oxygen plant at 97% purity. Oxygen is mixed with effluent from the primary clarifier and Return Activated Sludge from the Secondary clarifiers in the UNOX® basin. The biomass takes up food, oxygen and nutrients, converting them to Carbon Dioxide, water and protoplasm in the Unox basin.

The Unox basin consists of three trains of three cells each, operating in parallel. The incoming clarified effluent from the primary clarifier is cooled in a once-through cooling tower to assure operation in the thermophobic range (less than 40° C (104° F)). The operating trains equally share effluent flow between them. Oxygen and Return Activated Sludge are added to the first cell of each train in service from the 5 original clarifiers. Return Activated Sludge from the other 2 clarifiers is routed to the second cell in each train. All material, gas and liquid, passes co-currently through the train with vents provided on the 3rd cell of each train to exhaust Carbon Dioxide released by the biomass in the basin.

Each cell is 20.12 meters (66 feet) square inside wall dimension with a nominal depth of 4.56 meters (15 feet) yielding water volume of 5550 cubic meters {1.466 million gallons} in each train. The system as originally designed handles an average of 208,200 Cubic Meters/Day (55 MGD) and removes 25,900 Kg of BOD/day (57,000 lb. BOD/day) on two trains. The nominal residence time of mixed liquor (effluent plus Return Activated Sludge) is under 53 minutes.

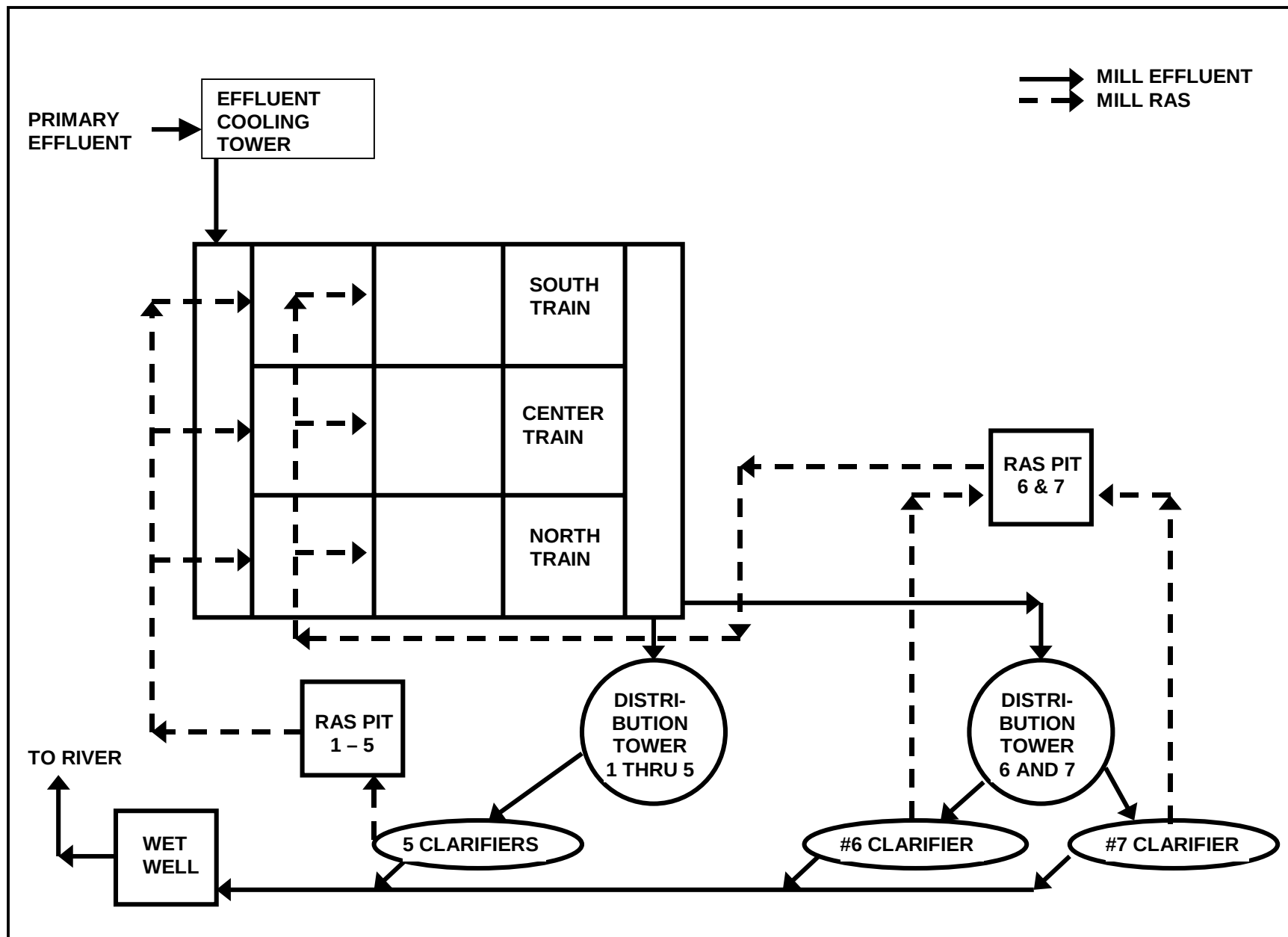


Figure 1. Secondary treatment plant as installed.

The Unox basin effluent flows to the seven secondary clarifiers where the biomass settles out for return to the basin. The clarified effluent overflows the clarifiers and pumps return it to the Columbia River for discharge. Each secondary clarifier is 47.25 meters (155 ft.) in diameter and holds 7039 Cubic Meters of liquid (1.88 Million Gallons) at overflow depth. The seven clarifiers provide a nominal mixed liquor residence time of 4.0 hours. The plant has performed very well operating well below NPDES permit requirements on a continuing basis [5].

Figure 2 shows the modified flow scheme designed to convert the south train to a Dedicated Control Device. The figure shows Number 6 secondary clarifier in use as the DCD clarifier. Mill effluent flows through the cooling tower into the center and north trains for treatment with Return Activated Sludge provided by clarifiers 1 through 5 plus number 7. Steam-stripped condensate is fed into the south train (the Dedicated Control Device) for treatment with Return Activated Sludge from number 6 (or 7) clarifier only. Dilution water (clarified primary effluent) is added to the steam stripped condensate before it enters the DCD. The effluent from the DCD is directed to #6 clarifier only with the clarified overflow from #6 being added into the Return Activated Sludge from #7 for return to the center and north trains for treatment as mill effluent.

DCD Equipment Specifics

Piping

The project involved running a large number of long piping runs of various sizes. The runs included 30-inch, 18-inch, 12-inch, 10-inch and 8-inch 304L stainless steel pipe in wall thickness ranging from 5 gauge to schedule 40. The 30-inch was used between the south train and the 6/7-clarifier distribution tower to carry mixed liquor. The pipe size was determined by the necessity of maintaining the capability of using the south train as a mill effluent train to back up the other two in case of emergency. We also used 30-inch pipe in the RAS pump pit on the suction header for the RAS pumps.

The 18-inch line was installed to transport RAS between the RAS pumps and the south train from either 6 or 7 clarifier's pump. 12-inch pipe was used to distribute RAS between the first and second cells on top of the south train and to carry the combined flow of steam-stripped condensate and dilution water into the train. We provided a bypass to the center and north trains for this combined stream to provide the flexibility of converting to the "Hard Pipe" option if the need arises. We ran approximately 1250 feet of new 10-inch line and utilized about 300 feet of existing 10-inch stainless to deliver steam-stripped condensate to the DCD from heat exchangers used to preheat demineralized water headed for feedwater hotwells.

The supply lines to the demineralizer were also changed to assure adequate temperature control of the steam-stripped condensate entering the DCD. We used evaporator condenser cooling water to supply the demineralizer prior to this project. We now use ambient temperature mill water to supply the demineralizer after heat-exchanging it with the steam-stripped condensate.

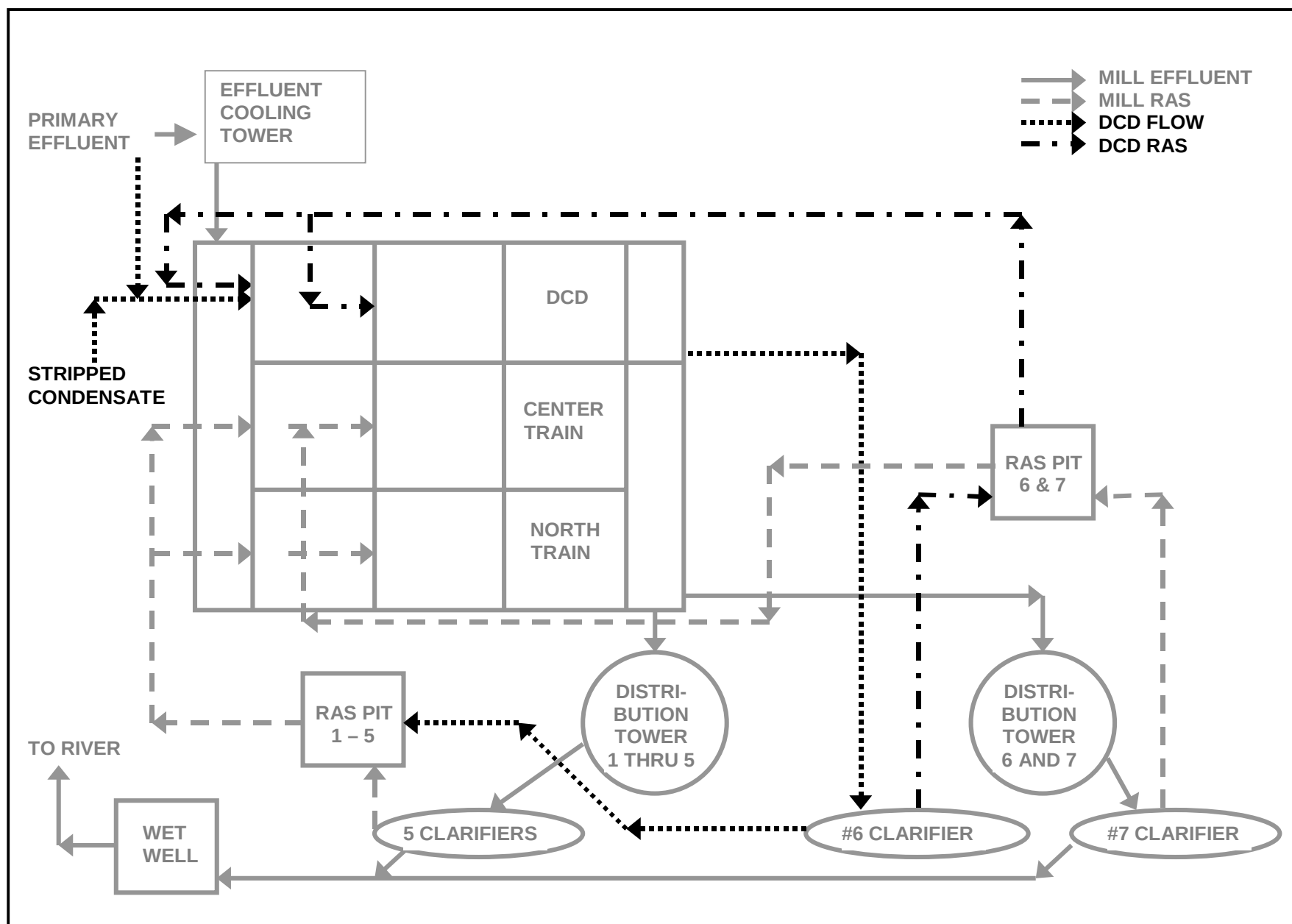


Figure 2. Secondary treatment plant modified with DCD.

Pumps

The conversion required the installation of four new pumps with motors and replacement of two pumps, one larger and one smaller. The list of new pumps includes:

- 1) dilution water for the stripped condensate before processing in the DCD,
- 2) two clarifier effluent pumps to divert clarifier overflow from the effluent wet well to the RAS line from 6 and 7 clarifiers back to the north and center trains and
- 3) a new RAS pump as an installed spare for 6 and 7 secondary clarifiers.

The steam-stripped condensate pump at the stripper discharge was enlarged to provide the necessary head to push steam-stripped condensate to the DCD instead of the sewer. The smaller pump, identical to the new RAS pump mentioned earlier replaced one of the two RAS pumps in 6 and 7 clarifiers' RAS pump pit. The two RAS pumps are VFD driven based on operator-selected flow. The two new clarifier effluent pumps are also fitted with Variable Frequency Drive regulated by the clarifier launder ring discharge level.

The RAS pump selection presented a unique specification problem for the design engineer. We had to fit three pumps into a footprint previously occupied by two, retaining one of the original two. We also needed to maintain approximately half the capacity of the original pump so the spare could function as a RAS pump for the clarifier being used to clarify mill effluent and yet function at a much-reduced rate when used as the RAS pump on the DCD clarifier. We selected a pump and programmed the VFD controls so that in mill effluent service, it runs at constant speed, 1180 RPM. When in DCD service, the output is limited to approximately two-thirds speed, 800 RPM. This pump has a very flat head curve. At synchronous speed, this pump pushes 378 l/sec (6000 GPM) at 10.7 m (35 ft.) of head while at 800 RPM, the pump is rated for 82 l/sec (1275 GPM) at 6.7 m (22 ft.) of head. 125 Hp 1200 RPM motors drive this pump and its identical mate. Flow requirements for mill effluent use rather than DCD use dictated motor size. **Figure 3** shows the RAS pump installation. The two new pumps are on the right. The original pump is on the left.

The clarifier overflow pumps are rated at 155 l/sec (2450 GPM) at 9.1 m (30 ft.) of head, driven by 75 Hp motors controlled by overflow weir level through Variable Frequency Drives. At synchronous speed they deliver 220 l/sec (3500 GPM). The pumps are self-priming, located at ground level, and just slightly below the elevation of the control level in the discharge trough. **Figure 4** shows the installation of these two pumps between 6 and 7 clarifiers.

The dilution water supply pump is located adjacent to the cooling tower supply pumps near the head end of the Unox basin. This pump is rated at 63 l/sec (1000 GPM) at 7.6 m (25 ft.) of head. It discharges into the pipe carrying steam-stripped condensate to the DCD. The driver is a 20 Hp 1200 RPM motor. A control valve regulates flow. **Figure 5** shows this installation. The new pump is located on the right of this picture. The pump on the left is a cooling tower supply pump.



Figure 3. DCD RAS pump installation.



Figure 4. DCD effluent pump installation.



Figure 5. Dilution pump installation.

Controls

Control of the Unox Basin and the clarifiers is through a PLC programmed to balance clarifier bed depth between the clarifiers with operator-set total RAS flow through each train. With seven secondary clarifiers, if the biomass inventory in one or two departs markedly from the average inventory, biomass carryover occurs. This carry over will result in an excursion beyond NPDES permit for Total Suspended Solids discharged from the system. Manual control was at best difficult with the five original clarifiers and all but impossible following installation of 6 and 7 clarifiers. Mill engineers designed and installed this control system. We measure RAS flows from the individual clarifiers are using ultrasonic flowmeters. RAS flows to the Unox trains use magnetic flow meters for measurement. Control valves regulate individual clarifier RAS flows and train RAS flows based on PLC outputs. Ultrasonic devices measure the biomass bed level in each of the clarifiers. Operator input and monitoring is through a PC interface. We added the controls for the DCD to this PLC.

Figure 6 depicts the graphic used to monitor and regulate operation of the DCD. Oxygen flow, RAS flow, stripped condensate flow and dilution water flow are displayed and/or controlled through this screen. By selecting a button with a mouse click, the operator can open a pop-up window that reveals the controller for any controlled variable and adjust set point, select local or remote automatic control or select manual control. Flow integration for compliance reporting purposes also resides on this screen. The system will soon be capable of feeding all information onto the plant information network for remote monitoring of the system and accumulating information for monthly reporting to the regulating agency.

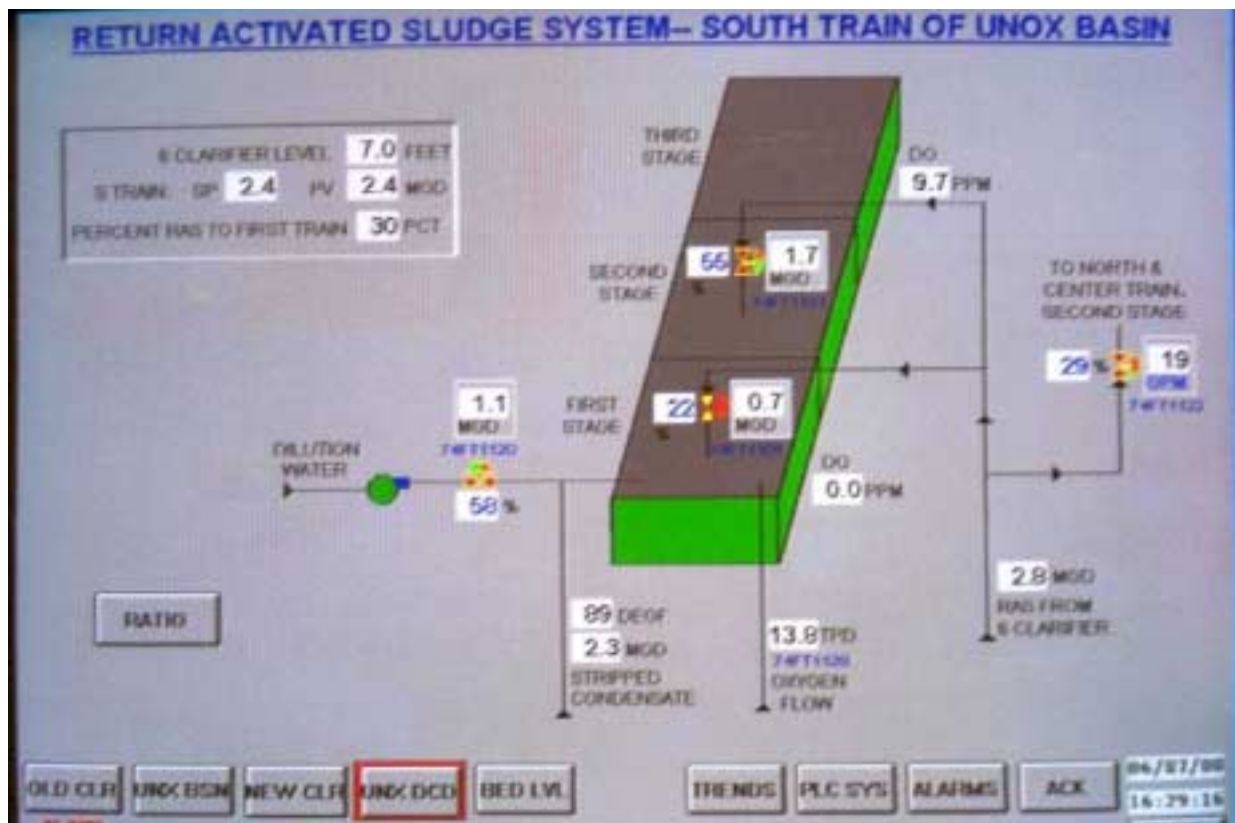


Figure 6. DCD control screen.

Daily Cluster Rule compliance determination consists of measuring the concentration of HAP's in inlet and discharge flow-proportional daily composite samples from the Dedicated Control Device by Gas Chromatograph using a Flame Ionization Detector. Analysis work required during the pilot scale work [3] justified purchasing a Flame Ionization Detector for an existing gas chromatograph in the main laboratory of the mill. Commercial analysis of samples proved to be unworkable, having to wait up to 30 days to get a result back from an outside laboratory. Concentration results from the composite analysis multiplied by integrated mass flow of appropriate streams in and out of the DCD yields mass flow of HAP's captured and destroyed.

CONCLUSION

The Dedicated Control Device started up in late March of this year. We started early to begin biomass species selection in the DCD before the mill modifications were complete. This afforded opportunities to determine what sort of response to expect from mill upset conditions with an unacclimated biomass. Upset conditions in the mill caused initial acclimation of the biomass to take longer than expected. Within 10 days, the DCD reduced incoming methanol in the steam-stripped condensate from 850 PPM to 400 PPM on a flow-compensated basis. We realized further reductions in the following months.

Testing is ongoing at the time of this writing. The environmental permitting agency for the mill has asked for a report on the efficacy of the full-scale system before authorizing use for Cluster Rule compliance for the destruction of HAP's. We need to learn some things about the system,

especially the quality of the vent gases, before obtaining authorization to operate. If the vent gases prove too rich in sulfur compounds and/or HAP's, we must install additional controls to obtain authorization to operate.

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