SLUDGE BURNING
IN A CIRCULATING FLUIDIZED BED BOILER

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ABSTRACT

Boise Cascade's Rumford, Maine mill is an integrated pulp and paper mill making over 1600 tons/day of coated and uncoated printing and magazine papers. The mill generates approximately 100 tons/day of primary and secondary sludge from the mill's wastewater treatment plant. Following startup in 1990 of two new 415,000 lbs./hr. circulating fluidized bed boilers, the mill began evaluating the possibility of burning sludge in these boilers to reduce landfill disposal costs, landfill space requirements, and to recover any heat value in the sludge. New screw presses were required to accomplish improved sludge dewatering, and those were installed in 1992. Following the startup of the first screw press in November, 1992, a sludge burning trial was initiated.

This paper presents Boise Cascade's experience with sludge burning in the fluidized bed boilers, evaluates emissions of criteria air pollutants with and without sludge burning, and reviews some of the problems encountered during this project. Graphs are presented illustrating the drastic reduction in the volume of material landfilled following the screw press startup, and conversion to sludge burning. The program to date indicates that the sludge burning project fits well with the mill's plans regarding waste minimization, pollution prevention, and improved raw material utilization.

BACKGROUND

In 1990, two new multifuel boilers began operation at Boise Cascade's Rumford, Maine pulp and paper mill. These boilers were licensed by the Maine Department of Environmental Protection to burn up to 572 MMBTU/hr. of any combination of coal and biomass, and up to 400 MMBTU/hr. of biomass only. Following the boilers' startup, mill management began explaining the feasibility of burning mill sludge in these boilers as part of the biomass fuel stream.

Since startup of the mill's wastewater treatment plant in 1976, the mill had disposed of its sludge in the Farrington Mountain landfill site located three miles from the mill. However, at the rate the landfill was being filled, the permitted disposal space available in 1990 was estimated to last only another seven years. Primary and secondary sludge were mixed in the mill's primary clarifier, and the 100 tons/day mixture dewatered on existing vacuum filters. These vacuum filters had been in operation since 1976, and at times, were not adequate to maintain the primary clarifier at a satisfactory level (4 feet or less of sludge). In addition, the vacuum filters only dewatered the sludge to 18 - 20% solids. The sludge was so wet and fluid that it was normally impossible to fully load trucks with the material, inflating the trucking costs to the landfill site. In order to manage landfill costs, extend landfill life, minimize leachate generation, and as a prerequisite for burning sludge, the mill needed drastically improved sludge dewatering.

To develop a plan for making sludge burning a reality, a team was assembled including operators, managers, supervisors and engineers. It was agreed by the team that in order to burn sludge, the solids content had to be increased considerably. The team decided a screw press installation would be a necessity for the project to go forward. Several manufacturers were consulted to determine the beneficial features of their screw presses. It was determined that three screw presses would be required to provide adequate water removal capacity for current and future mill operations. Following several trials and consultations in 1990 and 1991, a capital project was initiated to install three new screw presses in the existing filter building. The project was approved in early 1992, and three screw presses were placed on order.

Air Permit Modification

Another key element for sludge burning was a modification to the Air Permit to clarify that the mill sludge would be considered part of the biomass feed to the Cogen boilers. The plan to begin sludge burning was reviewed in advance with the Maine D.E.P. Air Bureau. The boiler system was evaluated for (a) its capability in keeping emissions of criteria pollutants at existing levels with the addition of sludge to the fuel mixture, and (b) the boiler's ability to destroy dioxins during the combustion process. The evaluation of the boiler systems determined that the precipitators and ash hoppers had adequate capacity to handle the suspected increase in ash circulation, and a literature review provided evidence that the 1600 - 1630^{o}F combustion zone temperature in the Cogen boilers would be sufficient to destroy dioxins present in the sludge. Following the presentation of these findings to the Air Bureau, the Air Permit Modification was issued by the Bureau in April, 1992.

The Screw Press Project

Following the approval of the screw press project, engineering began the detailed design of the screw press installation. The somewhat tedious task of installing one screw press outside the sludge dewatering building, and operating this press while an existing vacuum filter was being removed and replaced with a screw press, was simplified by redesigning the filter building to include two additional levels. This would allow the existing vacuum filters to remain in operation while the new gravity tables were being installed on level 3, and the new screw presses were installed on level 2.

The screw press installation continued through the summer of 1992. Operator input throughout the design and installation was key to the smooth completion of the first screw press in the fall of 1992.

Sludge Burning Trials

The first screw press was started up in November, 1992. Following a startup period, the press was soon producing 40%+ dry sludge. At this time, a sludge burning team was assembled to implement a trial of sludge burning in the circulating fluidized bed multifuel boilers. Since the only method of feeding biomass to the boilers was through the biomass conveyor, hog, and blowing system at the woodroom, plans were made to truck the sludge from the effluent treatment plant to the bark reclaim pile. At the reclaim pile, the sludge could be mixed with a bucket loader to a 1:4 mixture of sludge and hog fuel, and fed onto a reclaim conveyor and into the hog and blowing system. Eventually, whole tree chips were identified as the preferred material to mix with sludge at the reclaim system, and was implemented as an enhancement of the sludge mixing phase of the project.

Following a planning period in which the logistics of sludge movement and mixing was finalized, a 48 hour trial was carried out over the 1992 Thanksgiving weekend. The trial proceeded satisfactorily. Following the trial, the team reconvened to review several issues related to the trial, including:

* Blow line pressure issues related to sludge
* Density and moisture content of the sludge
* Sludge mixing issues
* Boiler erosion
* Steam production
* Boiler emissions

Based on the discussions among the team members, and a review of trial data, it was decided that the sludge burning trials should be continued. A week-long trial was scheduled for the week of December 14th. That trial led to a month long trial in February of 1993. During the February trial, the Cogen system burned 46% of the sludge generated by the mill. Prior to the trial, a metal coupon was placed in the boiler to evaluate if any increase in boiler erosion occurred while sludge was being burned. No increase in plate wear was observed. The boiler emissions exhibited no statistically significant increase during the sludge burning trial. During this period, as the second and third screw presses came on line, the operators were able to increase the sludge solids content from the screw presses to 50% and above.

Following the month-long trial and completion of the evaluation, results indicated that sludge burning was compatible with the overall goals of the biomass handling and Cogeneration boiler systems, namely:

1. The biomass handling system had adequate capability to process all the wood and bark generated on-site, and some purchased biomass, as well as effluent treatment plant sludge.
2. Boiler steam generating capability was not impacted.
3. Sludge was a net contributor of heat to the boiler system.
4. No increase in boiler wear was incurred due to sludge burning.
5. Dioxin was destroyed in the combustion process based upon a literature review.
6. Boiler emissions of criteria pollutants were not increased by sludge burning.

Following the February trial, plans were made to begin sludge burning on a sustained basis in May.

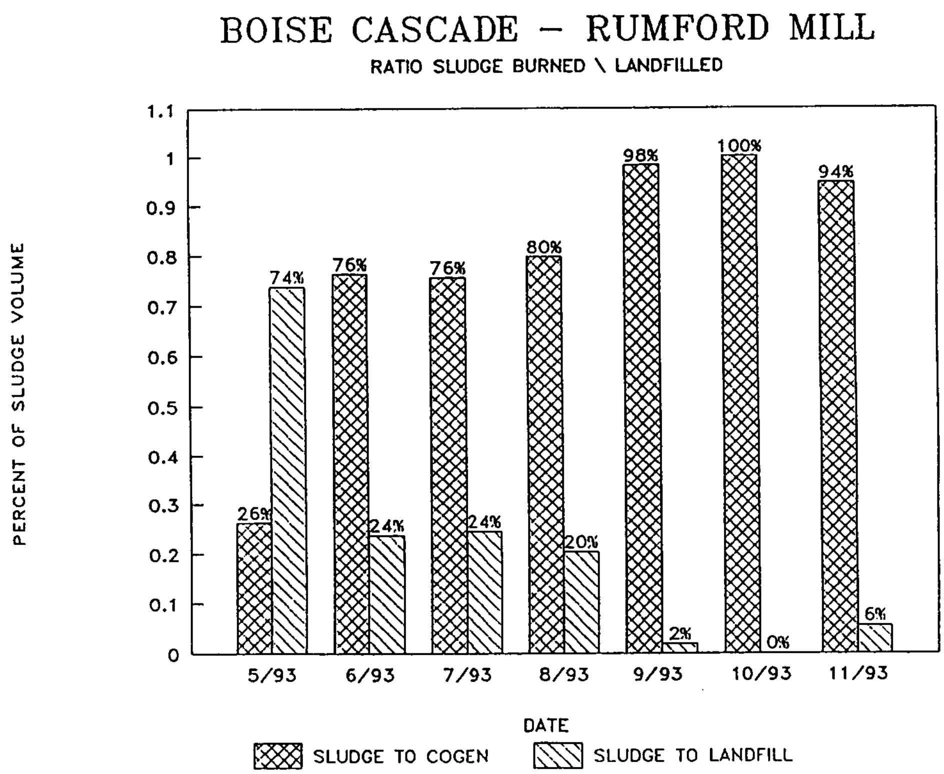
Sludge Burning Results: May - November, 1993

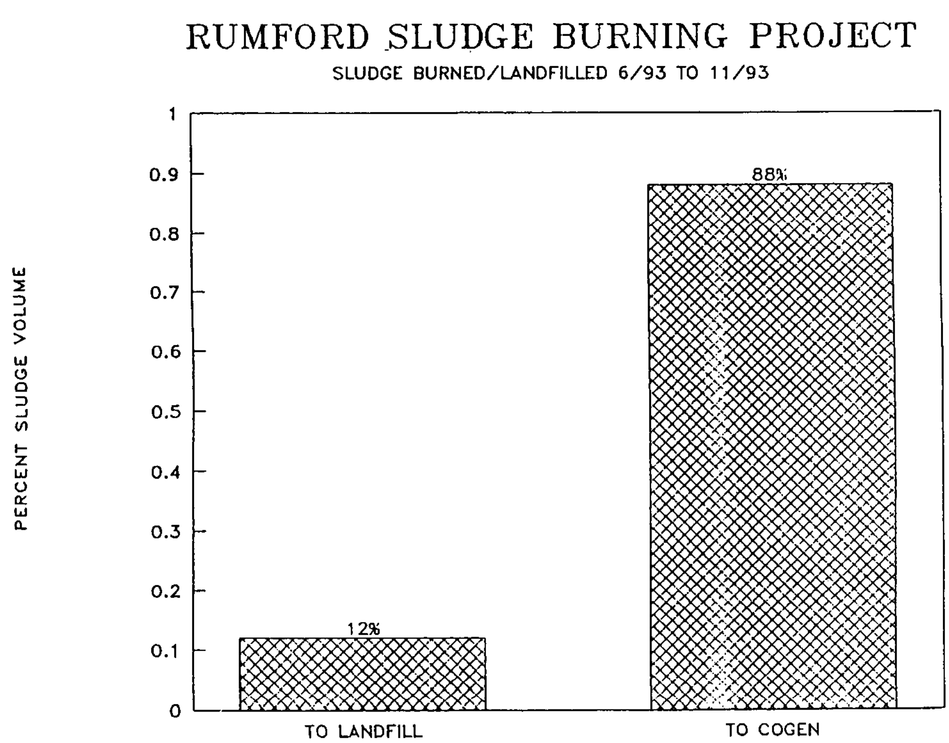
The attached graph shows the amount of sludge burned as a percentage of sludge generated since May. During the May - November period, the percent of the total sludge burned has increased from 26% in May to 100% in October. During this lengthy trial period, the goals of the biomass and Cogen system continue to be met. However, it has become apparent that improved mixing of the sludge and wood/bark will be required to make this project viable over the long-term. The mill team is now working on optimizing sludge burning through improving the sludge/wood/bark mixing.

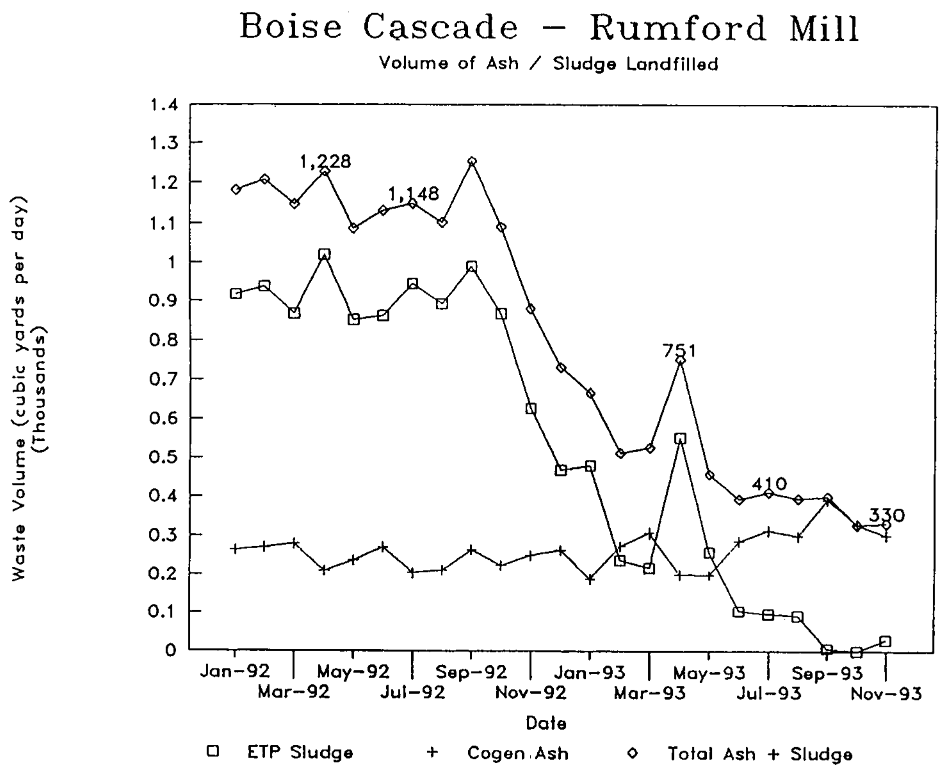
Conclusions

1. Papermill sludge can be burned in amounts up to 200 tons/day at 50% solids in Boise Cascade's multifuel Cogeneration boiler system.
2. The boiler system's pollution control equipment effectively controls emissions of criteria pollutants while sludge is being fired as a component of the boiler fuel.
3. The screw press installation allowed the sludge burning project to proceed and also significantly reduced the cost of solid waste disposal at the Rumford mill.

4. Metering of the sludge feed would be the most effective means to improve system performance at this time based upon operator feedback.
5. Sludge burning is an effective pollution prevention strategy, and has significantly extended the life of the landfill, reduced trucking operations/ cost, and reduced leachate generation.






Boise Cascade – Rumford Mill
Volume of Ash / Sludge Landfilled
Waste Volume (cubic yards per day)
(Thousands)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1,228
1,148
751
410
330
Jan-92
Mar-92
May-92
Jul-92
Sep-92
Nov-92
Jan-93
Mar-93
May-93
Jul-93
Sep-93
Nov-93
Date
ETP Sludge
Cogen Ash
Total Ash + Sludge