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Robert Sawatzky, Joinery Instructor
BCIT School of Construction & the Environment
3700 Willingdon Avenue
Burnaby, BC
V5G 3H2

Re: Ash management options for wood waste boiler

Dear Mr. Sawatzky:

Recently you contacted SYLVIS on behalf of the BC Institute of Technology (BCIT) for advice on options for managing the ash produced by a wood waste biomass boiler system currently under consideration. SYLVIS understands this boiler system is intended to supply district heating for buildings on campus, using wood waste generated by BCIT's joinery and carpentry programs as a fuel supply to replace natural gas.

Background

SYLVIS has reviewed an initial report prepared by BCIT evaluating the quality of the available wood waste. Approximately 250 tonnes per year of source-separated clean wood waste pieces will be available for use as fuel in the boiler system, which includes approximately 32 tonnes per year of saw dust and wood shavings captured from the two workshops. The wood waste and dust/shavings may contain pieces or residues of manufactured fiberboard constructed with organic resins and glues, but will not contain treated lumber doped with heavy metals or creosote. The planned boiler installation will include a chipper to convert the larger wood waste to small pieces of uniform size (0.5-1.5 cm) which will be burned with the dust/shavings. The wood waste will have nails and staples removed prior to disposal and the chips will be subject to magnetic decontamination prior to burning. The process is overall expected to produce approximately 1.0-1.5 tonnes of ash per year, which will consist of separate fly and bottom ash streams that may be combined or left separate for management. This ash will contain mainly unburned carbon and non-volatile minerals (e.g. calcium, potassium, phosphorus), with small quantities of trace elements and trace organic constituents.

A number of management routes are available for wood-derived ash of this type, depending on ash quality and available opportunities. These options include:

- Application to land as a soil amendment;
- Use as an amendment within the existing BCIT composting system;

- Application to land as a soil amendment;
- Use as an amendment within the existing BCIT composting system;
- Use as an additive in the manufacture of Portland cement; and
- Disposal in landfill.

The viability of these different management routes depends upon the properties and constituents of the ash stream, local conditions, and the capacity for meeting environmental requirements.

Ash as a Soil Amendment

Ash management in BC may fall under a number of regulatory systems depending on the management route selected. Land application of certain types of ash (i.e. fly ash captured from gaseous emissions) is permitted under the Code of Practice for Soil Amendments to provide benefits to soil properties. Other types of ash (e.g. bottom ash, or combined fly/bottom ash) must be specifically permitted for land application. Such permitting often closely follows the requirements of the Code of Practice. Other management routes may require specific environmental permitting (e.g. use in compost, Portland cement).

Both fly and bottom ash can improve soil conditions for crops or cultivated timber when applied to land. Land application of ash is typically dependent upon providing adequate liming value and nutrients, as well as meeting of soil loading limits of ash constituents such as:

- Trace elements (e.g. copper, lead, cadmium, arsenic), and
- Trace organic constituents (e.g. dioxins, furans, polycyclic aromatic hydrocarbons).

SYLVIS plans and oversees land application of several types of residuals in BC, and is currently developing large-scale land application options for hog fuel ash used in power boilers at a pulp and paper mill in Prince George. A land base for application of BCIT's ash could plausibly be located within a practical distance of the BCIT campus that would be appropriate for beneficial reuse of the ash from the proposed waste wood boiler. Candidate land might include campus gardens, sports fields, grass lawns or other urban areas, in addition to more traditional pasture, forest and crop land.

Ash as an Amendment in Composting Systems

Ash that is high in carbon (incompletely burned) can provide needed carbon, bulking/aeration and pH moderation in composting or vermicomposting processes. The addition of bulking agents such as course high-carbon ash helps to keep organic wastes aerated, and the addition of charcoal can in itself act to reduce odors from stabilizing wastes. Use of ash in this fashion is more common in eastern Canada and the U.S. where a larger number of wood-fueled energy systems produce this ash (e.g. wood processing, paper mills). BCIT has indicated in conversation that it operates a vermicomposting facility on-campus. This facility might benefit from ash addition to its vermicomposting process and provide a beneficial management option for the future wood ash stream. Further study of the vermicomposting facility and the final ash properties would be required to better develop this management route.

Ash as a Cement Additive

Some types of wood ash can potentially be used as an additive during production of Portland cement. Ash used in this fashion can be used in place of other types of ash (e.g. coal fly ash) or other inputs to the process (e.g. limestone). There are a number of large cement kilns located in the lower mainland region, and Lafarge has already shown interest in sustainably-sourced materials with a pilot program of using biomass to replace coal for heating fuel at one plant in BC. The use of biomass ash in this fashion is therefore a plausible management option, but as yet is not a common practice in the province. Additional study and liaison with potential cement kiln operators would be needed to further pursue this option.

Disposal of Ash to Landfill

As a final management solution for biomass ash, the material could be disposed of in a landfill permitted to accept wood ashes. Wood ash landfills exist in BC, some of them dedicated facilities associated with large ash producers such as pulp mills. Standard municipal solid waste or construction and demolition debris landfills may possess permit provisions for accepting wood ashes. While a feasible ash management option, landfilling of ash would not allow for the capture of any environmental re-use benefits for the ash material. In addition landfill tipping fees may be relatively high and require long transport distances, depending location of a suitably permitted landfill.

Summary

The available management options for ash will depend on the final ash properties, which themselves depend upon the quality and contents of the wood waste and the combustion conditions. The wood waste proposed for use in this system contains low trace element concentration, comparable to raw wood. As these elements are largely retained during combustion ash from burning this material would likely also contain trace elements at levels that would make it suitable for land application or the other options listed. Trace organic constituents like dioxins and furans tend to form during combustion at a rate dependent upon the constituents of the wood and the firing temperature. The proposed wood waste has a chlorine-to-sulfur ratio below 2, which indicate low potential for dioxin formation. However potential for dioxin formation exists, particularly in wood taken from logs transported in seawater. Some of the wood waste and dust/shavings will likely contain residues of organic glues and resins. At the suggested combustion temperature (approximately 850 °C), these organic compounds will likely be largely destroyed. The use of source separation and ferromagnetic screening during chipping will help ensure that foreign objects are not entrained in the final ash stream.

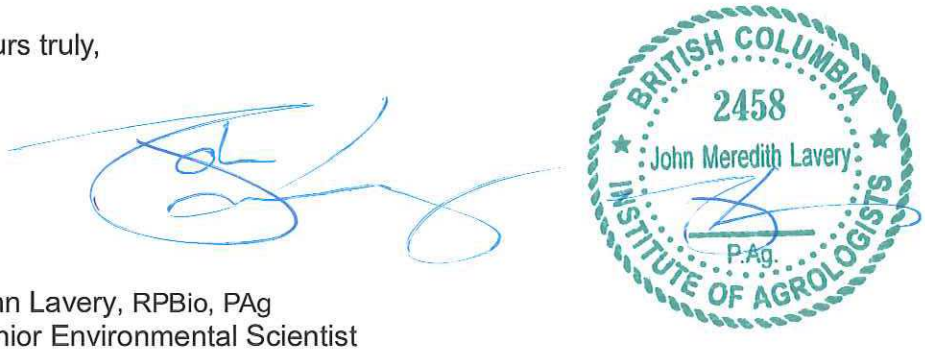
Future Analytical Requirements

All ash properties, including constituents, will need to be measured for each ash type once ash production begins. Properties measured should include trace elements, trace organic constituents, plant macro- and micro-nutrients, soil liming value, cementitious constituents, foreign objects/sharps, and bulk properties. Knowledge of these ash properties through direct measurement is critical in order to better define appropriate ash management option(s).

Conclusion and Next Steps

Wood ash, particularly from source-separated and relatively clean wood fuel streams, has proven potential for beneficial use in a variety of contexts, including use as a soil and compost amendment. Recent experience with other ash producers in BC suggests similar utility for ash in this province. The ash produced by the proposed wood waste-fired boiler system at BCIT will likely also have potential and scope for beneficial use. SYLVIS is available to provide additional consultation on BCIT's ash management options and to perform detailed characterization and evaluation of the ash stream(s) once boiler operation commences. SYLVIS is also available to assist in developing full-scale options for management. Please be in touch once ash production has commenced to further our discussion of management options.

Yours truly,



John Lavery, RPBio, PAg
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