ENVIRONMENT

Technological Innovation

ABSTRACT

Because wood burning is a major source of fine particle emissions, particular attention is given to residential wood heating. Recy-Clone inc. has carried out a project that demonstrates the environmental and energy efficiency of fuel made from densified wood residue.

Tests conducted under the independent supervision of Forintek Canada Corp. showed that this fuel produces 50% less fine-particle emissions than conventional logs.

As well, the logs are made from wood residue that would otherwise end up in a landfill.

Densified wood logs have many other advantages: the product is uniform, easy to store and energy efficient.

ATMOSPHERIC EMISSIONS

DENSIFIED LOGS REDUCE THE IMPACT OF RESIDENTIAL WOOD HEATING

HIGHLIGHTS

Technology

- Process uses wood residue from the primary and secondary wood processing industries;
- Thermal extrusion process allows the lignin in the wood to act as a natural binder;
- No petroleum-based, chemical or other additives.

Environment and Energy

- Reuses industrial wastes;
- Uses a renewable energy source;
- Reduces fine particle emissions from wood burning (33% to 58%);
- Improves fuel quality and energy efficiency (20% to 35%);
- Reduces the use of virgin resources for residential heating (every tonne of densified wood is equivalent to 12 mature trees).

Economy

- May reduce wood consumption because of the greater energy potential.

Canada

RECY-CLONE INC.

Montréal

Agence de l'efficacité énergétique Québec
Vous économisez. L'environnement y gagne aussi.

OBJECTIVES OF PROJECT / PHASES

The objective of the project was to validate technically and environmentally the burning of logs made from densified wood residue in residential woodstoves. The tests were carried out using the standard Environmental Protection Agency (EPA) protocol, one EPA-certified stove and one non-certified stove. The aim of the tests was primarily to:

- **Measure the rate of particle emission from the logs made from densified wood residue;**
- **Measure the rate of particle emission from conventional logs standardized in accordance with the EPA protocol;**
- **Compare the particle emission rates of the two types of logs.**

A supervised test using a control group of 20 people living on Montreal Island was also carried out in order to determine their perceptions of environmental issues related to heating with wood, their wood heating profile and their assessment of logs made from densified wood residue compared with conventional logs.

BACKGROUND

Fine particles 2.5 µm and smaller ($PM_{2.5}$) are one of the key components of smog. Links have also been established between fine particles and increased respiratory problems and premature deaths. Fine particles are therefore a concern not only for public health institutions, but also for environmental departments and agencies.

Residential wood heating contributes significantly to PM_{10} and $PM_{2.5}$ emissions. According to Environment Canada's inventory of primary air contaminants for year 2000, home heating with wood was the fourth-largest source of $PM_{2.5}$ emissions in Canada. If we exclude open sources, wood heating would be the largest source of pollutants, generating almost 28% of all fine particles.

TECHNOLOGY

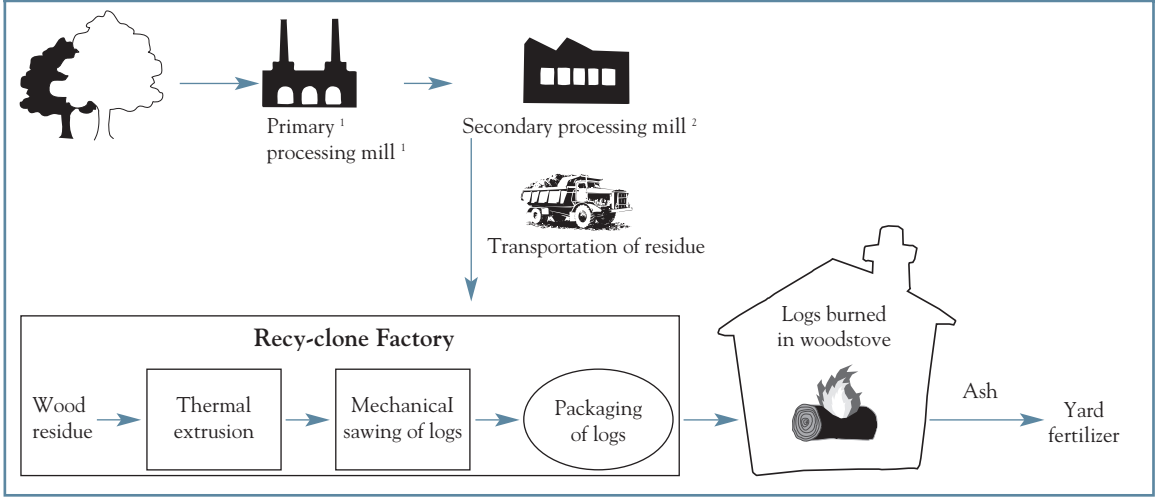
Logs made from densified wood residue are manufactured using an extrusion process and are composed of hardwood residue with a controlled particle size and moisture content. The material fed into the extruder must have a moisture content of approximately 12% or less, and a maximum particle size of 1.2 to 3 mm.

The raw material is then compacted and pressurized at a temperature range of 200 °C to 300 °C. The naturally occurring lignin in the wood acts as a binder, allowing the residue to form a log as it cools off when it comes out of the mould.

The finished product is an octagonal log about 7.5 cm in diameter. The hollow core allows the log to burn more efficiently. The product comes out of the extruder in a continuous piece and is mechanically sawn into logs between 20 and 30 cm long (depending on the client's needs). The final product has an estimated density of 1.2 (density of water = 1.0) and a low moisture content (between 4% and 6%).

This method of producing logs made from densified wood residue requires no petroleum-based, chemical or other additives.

PRODUCTION FLOWCHART OF DENSIFIED WOOD RESIDUE LOGS



1- ex.: Sawmill
2- ex.: Furniture fabrication

RESULTS

In the course of this project, three tests were conducted to measure fine particle emissions and other secondary combustion parameters of logs made from densified wood residue. The tests were done using two types of common residential woodstoves. One was certified in accordance with the U.S. EPA standard, the other was not.

For purposes of comparison, an additional test was done using standardized conventional logs in an uncertified woodstove.

Previous results of certification tests carried out in the Intertek laboratory using standardized conventional logs were also used as a reference for the combustion test performed in the certified stove.

The tests showed that densified wood logs produce fewer fine particles when burned. When the logs were burned in the certified stove, the emission rate was almost 58% lower than the rate for the conventional logs. The particle emissions rate dropped from 8.5 g/h to 3.6 g/h.

When the uncertified stove was used, the reduction in fine particle emissions was approximately 30%. The tests also showed that the smoke from burning densified wood residue logs takes 25% less time to dissipate.

The residual ash rate was also lower, at approximately 0.7% of the initial mass. The rate for conventional logs generally ranges between 1% and 4%.

The supervised test, carried out over a two weeks period, also showed that the users appreciated the densified wood residue logs as much as the traditional logs, while confirming its higher properties in term of cleanliness, reduction of smoke and residual ashes, and speed of heat releases.

MEASURED RESULTS[1]

Parameter	EPA-certified stove[2]		Non-EPA-certified stove[3]	
	Densified logs	Conventional logs	Densified logs	Conventional logs
Particle emission rate (g/h)	3.6	8.5	8.7	12.9
Burn rate (dry-kg/h)	1.1	1.0	1.8	2.9
Smoke level (0 to 3) after 30 min	1	N/A	0	2
Burn time (min)	250	238	160	60

1- The protocol in EPA Method 28 (method for effectiveness and emissions tests) was used for each burn test.
2 - Closed-damper tests. The results using conventional logs were obtained by the Intertek laboratory in an earlier test using an appliance in the same series.
3 - Open-damper tests.
N/A: Not Available

POTENTIAL AND LIMITATIONS

Potential

Densified wood residue logs:

- Are an alternative to conventional logs;
- Are more energy efficient;
- Reduce the environmental impact of residential wood heating, especially in densely populated areas;
- Produce fewer fine particles and ash than conventional logs when burned;
- Create fewer handling and storage problems (dampness, dust, mildew, vermin etc.);
- Are a tangible and accessible way of mitigating the problems associated with air quality and management of waste from the primary and secondary wood processing industries.

Limitations

- The success of densified wood residue logs depends on how they are received and accepted by consumers and distributors;
- The cost might be slightly higher than the cost of conventional logs. The associate advantages of the densified wood residue log such as the energy efficiency, ashes reduction and storage facilities are nonetheless to be dismissed.

INFORMATION

This data sheet was prepared based of the results of a project to demonstrate the environmental and energy efficiency of densified wood residue logs. The project was carried out with financial support from Environment Canada and the Agence de l'efficacité énergétique du Québec, technical support from Forintek Canada Corp. and Stove Builder International (SBI), and the cooperation of the City of Montreal.

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ENVIRONMENT
Technological Innovation

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