Successful small-scale boiler conversion

George Estcourt

Overview

- What are wood pellets?
- School boiler conversion
- Outcomes/Results
Wood pellets

- Feedstock (in order of preference)
  - Dry wood shavings
  - Wet sawdust
  - Wood chip (possible)
  - Forest residues (a long way off)

The production process

- Sieved for rocks and steel
- Checked for correct moisture content
- Hammermilled
- Pelletised
- Cooled
- Bagged
# Wood pellet specs

- Dry fuel 8% m.c wet basis
- High bulk density fuel 660kg/m³
- Low ash <0.5%
- High calorific value 19GJ/tonne
- Bagged for easy handling

# School boiler project

- Funded by RECT (Rotorua Energy Charitable Trust) supported by Solid Energy
- $60K for two years / 5 schools
- Convert from coal to wood pellets
- Automate to reduce labour
## School profile

- 150 kW to 1 MW heat plants
- Hot water radiators
- ~20-week heating season
  - Daily heating profile
    - 5 hours heating
    - 19 hours idle

## Typical school coal boiler

![Typical school coal boiler](image)
### Boiler characteristics

- **170kW**
- Underfeed stoker, approx 40 yrs old
- Low efficiency due to low boiler tube surface area, or not enough tubes
- **65% efficiency**

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### Inside the boiler

[Images of inside the boiler]
Coal grate

A:

- Fuel bed
- Coal
- Fuel + Air
- Furnace grate
- Air supply
- Underfeed stoker screw

Image of burning coal床
Boiler modifications

- New grate
- Reduced primary air
- Introduce over-fire air (secondary air)
- Grout in place

New wood pellet grate

B:

- Secondary air
- Fuel bed wood pellets
- Primary air + fuel
- Secondary/over fire air tube
- Furnace grate
- Air supply
- Underfeed stoker screw
- New stainless steel insert grate
**Challenges**

- Higher fuel consumption due to lower bulk density and lower calorific value
- Blockages of air system due to smaller, softer fuel
- Increased air for a more volatile fuel
- Change operating procedure, kindling mode
### Issues

- Instability of new grate due to poor fitting of grate
- Back pressure causing excess smoke to travel through the day hopper
- Not the best primary to secondary air split or control

### Boiler Automation

- Build second fuel bunker
- Install coreless auger to feed day hopper
- Replace or reset programmable timers

Residues to Revenues NZ 2007
### Results

- Cleaner working environment
- Almost no attendance needed by the operator, no more shoveling coal
- Cleaner flue gas emissions

### Results (cont’d)

- A carbon-neutral fuel
- Reduced maintenance on boiler
- No sulphur dioxide emissions
### Costs

- $1,500  New Grate
- $1,500  Auger
- $4,000  Steel bunker
- $3,000  Engineering and Electrical
- $10,000  Total cost

### Stage 2

- Three schools to convert this year
- Endeavour to reduce costs
- Improve on secondary air
- Improve overall efficiency
- Improve emissions
**Lake Rerewhakaaitu school**

- Small country school
- Good heat duration curve
- Central heating
- Heated swimming pool in summer
- No caretaker

**Conversion**

- No modifications to grate
- Introduce separate secondary air
  - Over-fire air manifold
  - New single-phase blower
Residues to Revenues NZ 2007
<table>
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- Vastly improved control of secondary air supply
- Reduced maintenance
- Maintained access to boiler
- Could possibly fit new system while still operating boiler
### Costs

- $500 Single phase blower
- $1,500 Auger
- $1,000 Secondary air manifold
- $4,000 Steel bunker
- $???? Engineering and Electrical
- <$10,000 Total cost

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### Questions

george.estcourt@scionresearch.com  
www.bioenergy-gateway.org.nz