DARBY FUELS FOR SCHOOLS SECOND SEASON MONITORING REPORT

Darby Public Schools (DPS) completed their second season of heating the three-school campus with boilers fueled by "forest biomass" (wood chips) on June 1, 2005. It was also their second year in the role of demonstrating the efficiency and economy of such systems. The year's experience added to the positive image converting from fossil fuels to a renewable energy source is receiving nationwide. This report will briefly summarize the highlights and results of the 2004-2005 experience.

Heating Costs

DPS used 755 tons of wood chips delivered into the bin at a cost of $26,660—slightly more than $35 per ton.

Rick Scheele, DPS Maintenance Supervisor, ran the system almost exclusively on wood, using only 1,900 gallons of back-up oil. This was a pleasant surprise, in that when the system was installed it was assumed that in warm weather operators would find it more convenient and economical to use the old, oil-fired boilers. DPS found the Messersmith boiler sensitive enough to adjustment so that it was used upon occasion to simply heat hot water for warm-season events.

The only times oil was used was, when testing wood fuel of lower quality, the system was unable to reach maximum (necessary) steam pressure and back-up oil boilers were fired. This action was made necessary by a condensation problem in the high school steam line—a condition which is being corrected this summer.

Estimating cost savings during the 2004-2005 school year—a mild winter—requires some subjectivity. Historic use of oil at Darby in the years prior to biomass boiler installation was 48,000 gallons per year. Davison Distribution, the local fuel oil supplier, estimates the average price of #2 oil for the heating season was $1.85 per gallon. Had Darby used oil, they would have required several fills at intervals and prices went as high as $2.02. We estimated that had DPS heated with oil, their fuel cost would have approximated $88,800 based on the $1.85 average cost.

In the 2003-2004 Monitoring Report, it was noted that accurate measurement of usage of LP gas as related to the heating system is not possible due to metering configuration and history. LP gas was formerly used to heat domestic hot water, to start-fire the oil boilers and to heat the bus barn and a modular classroom. The 2003-2004 report estimated LP gas savings at $2,080. The savings in 2004-2005 should have been slightly greater considering reduced firing of the oil boilers.

When the system was constructed, a separate electricity meter was installed at the boiler building so that nearly all electricity used by the biomass heating system goes through that meter. Electricity use by the three-boiler oil system was unknown. The 2003-2004 monitoring report points out that electricity usage is significant in operating the system: fuel handling conveyances, fans, pumps, and air compressor. Cost of electricity for the system in 2004-2005 was about $2,035.

Considering this, and that propane savings and electricity cost about balance out, these factors were not considered further in the 2004-2005 estimate of savings.

***2004-2005 Costs*:**

775 tons wood chips	$26,600
1,900 gallons #2 fuel oil (Cost $1.29/gal, tank filled in 2003)	2,451
TOTAL	**$29,051**

***Estimated Savings*:**

Estimated cost of year-long operation on oil: 48,000 gallons @ $1.85/gal	$88,800
Less actual fuel costs	($29,051)

***Net Estimated Savings*:**

(Use of wood chips compared to fuel oil) **$59,749**

***Personnel Operating Impact*:**

Another savings which we have not quantified is in operating cost. The DPS maintenance supervisor, after two seasons of operation, estimates that the biomass system takes less than 50% of the operating and maintenance time of the old three-boiler oil system. The exception to this is those periods of testing other fuels where additional time may be required.

Conclusion:

All things considered, it appears 2004-2005 savings of $60,000 at DPS is a reasonably conservative figure.

Fuels Testing

During the heating season, DPS and RC&D agreed to test usage of other forest biomass fuels, specifically from logging slash, the residual from logging operations and normally open-burned to reduce the resulting fire hazard. The material remaining in the woods consists mostly of needles, branches, bark and some small or cull logs.

DPS made two test runs, one using "hog fuel" (product of a tub grinder) from green logging slash, and another using pellets made from the same material.

Eureka Pellets, with mills at Superior and Eureka, are interested in developing new markets for their products as well as utilizing an inexpensive, plentiful supply of raw material. The pellets provided were a special run for the test. The material was screened during the pellet-making process.

During 2003-2004, a load of hog fuel made from dry, clean lodgepole pine and Douglas fir slash (no dirt, logged over snow) was tried. Burning was satisfactory, except for an abundance of longer pieces (6 inches plus), which did not work well through the feed system. In October 2004, a second load of hog fuel made from green ponderosa pine slash was tried. This material was screened to remove the large pieces, reducing the load from about 15 tons to 8.4 tons, decreasing the proportion of solid wood to that of needles, twigs, and bark. The material also contained a noticeable amount of soil. Moisture content (MC) was 50 percent.

The boiler burned this material completely in a day and a half, approximately double the burn rate of dry chips, and clinkers formed on grates of the boiler and had to be chipped off. DPS and RC&D initially attributed this to high moisture content and soil (silica) in the fuel.

The pellet test had somewhat similar results. Moisture content was 6 percent, but clinker formation was a significant problem, necessitating cleaning the grates twice daily to keep the boiler operating, significantly increasing operating costs. A copy of DPS' summary of results is attached.

These tests resulted in a local eye opening to the phenomena of ash fusion and the influence of mineral content of needles, bark, and small branches. Samples of the fuel were tested at the Hazen Research Lab in Golden, Colorado. A copy of the results and correspondence are also attached.

Follow-up work is planned by the Forest Products Laboratory in Madison, Wisconsin to identify thresholds of usable vs. non-usable mineral content of fuels.

Preliminary conclusions drawn by DPS and RC&D, so far as operating pilot project biomass boilers, include the following:

1. There is no problem as long as the proportion of solid wood (bole-wood or large woody branches) is maintained at a "normal" level. Even chipped woods-run logging slash worked well in the past. Problems occurred when hog fuel was "screened", resulting in reduction of solid wood in the proportion.
2. Clean (no dirt), dry (less then 35% MC), optimum-sized (matchbook) chips are the ideal fuel, not only from the way they work through the conveyance system and burner, but also from efficiency of heat production. Other fuels will work, but if we want customer satisfaction, the limits need to be recognized.
3. Fuels for Schools needs to investigate and perhaps try boilers that are more compatible to other forest biomass, particularly for larger installations, such as UM-Western Montana. Hog fuel can be an acceptable fuel if produced by properly equipped, well maintained, constantly sharp tub grinders. This could potentially help reduce cost of fuel. Further testing is planned at Darby in the 2005-2006 school year.

Moisture Content of Fuel

Average moisture content of fuels used in 2003-2004 was 30%, and moisture content was not a problem. In the 2004-2005 year, although additional samples would have been useful, Darby's average MC was about 38%.

At Victor, where 30 of 37 loads were sampled (same supplier, mostly comparable fuel), average MC for the year was 33 %. From September through December MC averaged 28%. After January 1 MC averaged 44%. This can be attributed to the fact that early autumn loads are materials that have probably been cut through the summer before being chipped and hauled. After January 1, normal wet winter weather has an influence. Also, the supplier increased the proportion of post and pole plant peelings hauled to the boilers and that source was using green material recently logged.

It does not appear that the higher MC had measurable affect on increasing fuel consumption (633 tons in 2003-2004, 775 tons in 2004-2005). The first operating season began October 30, 2003, a seven-month season, while the boiler ran nine months in 2004-2005.

Our conclusion here is that MCs need to be watched, and if they begin to exceed the 35% guideline, the supplier needs to be directed toward drier fuel.

Ash Production

Ash production was very comparable to the previous year: 755 tons produced 1,080 gallons of ash—about 1½ gallons per ton of fuel burned.

Stockpiling

Despite the plentiful source of raw material for forest biomass boilers, it is becoming recognized that assurance of a readily available, economic supply of wood chips requires concentrated management. Chipping and hauling as needed through the season is fraught with difficulty, much of it attributable to climate and weather.

Fuels for Schools, DPS and RC&D agreed to try open stockpiling of a year's fuel supplies, with chipping, hauling and piling done in summer under more nearly ideal conditions. The partners in FFS are doing this as a separate study with monitored results. Results to this point are encouraging.

Future

The Darby pilot project continues to be, in the eyes of the Fuels for Schools partners, a significant success. Perhaps the largest contribution to this has been the attitude and enthusiasm of DPS personnel. Rick Scheele, Maintenance Supervisor, provides the leadership. His knowledge and understanding of the system, along with his positive attitude and energy, has allowed FFS to do things with the system that without him would have been impossible.

As an adjunct of the stockpiling study, DPS has signed on as our principal demonstration site for an additional two years. It is the intent of the partnership to continue to use the Darby boiler to test advances in biomass heating.

Demonstration

During the year, 173 visitors were conducted through demonstrations of the system by DPS. Visitors were from as far away as Craig, Alaska (Craig is now going ahead with plans to use forest biomass for heat). Every other biomass project built or underway in the northwest has visited the Darby demonstration site.

Note: Attachments referred to in this report are not available electronically. If copies are desired please contact the Bitterroot RC&D.

Bitter Root RC&D
1709 N 1st
Hamilton, MT 59840
Phone: 406-363-1444 ext. 5; Email: bitterrootrcd@cybernet1.com

Tom Coston
RC&D FFS Coordinator