Physical Properties and Consumer Reaction to Use of Compressed Wood Bricks in Southeast Alaska

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Abstract

In late 2008, a group of business people and entrepreneurs in southeast Alaska became aware of a compressed wood brick product that could be used as an alternative fuel in existing wood-burning stoves and heating equipment. The product differed from many others on the market in that it contained no additive to promote binding and burn characteristics. In 2009, local materials in the form of sawmill residuals and chipped material from land clearing were collected, dried, and shipped to a producer in the northeast United States. A set of returned samples was sent to the University of Alaska Fairbanks Forest Products Laboratory for evaluation of physical properties. Survey methods were used to determine characteristics of wood-burning equipment and conditions at the time of test burns and to assess consumer reactions to the product as an alternative to cordwood. The price that people were willing to pay for such a product was also evaluated. Few differences were detected between bricks made from material available in southeast Alaska and those from outside the region. In addition, the duration of burn was significantly greater for consumers using modern wood-burning stoves approved by the US Environmental Protection Agency. Consumers expressed a high degree of satisfaction with the product, but their reported fuel of choice was still traditional cordwood. Twenty-nine percent of surveyed consumers were willing to pay a price of $200 a ton for the brick product.

In 2008, the US Forest Service Alaska Wood Utilization Center and Northeastern State and Private Forestry jointly sponsored a tour of renewable-energy facilities in New England. The tour was organized in response to input from local residents who expressed an interest in viewing projects that produced and used renewable wood-energy products.

A complete description of all the facilities visited is beyond the scope of this report. The genesis of the current project, however, was a visit to BioPellet, LLC, in Berlin, Connecticut, on January 24, 2008. Thomas Engel, the owner of the facility, displayed an alternative, renewable-energy product produced using compressed dry sawdust and wood waste from secondary forest products processing plants. Typically, this material has a moisture content of 8 to 10 percent (dry basis). The end product is a brick (6 by 4 by 2 in.) as opposed to the round fire logs available throughout North America. The bricks, more commonly used in Europe, also differ from traditional round logs in that they do not include wax or other binders used in the latter product. Given a source of dry raw material from secondary processing plants (moisture content less than 12% [dry basis]), the product can be produced with minimal processing. The product produced by BioPellet is branded and marketed as a BioBrick.

The total heating requirement in degree days (65°F basis) in southeast Alaska is similar to coastal and immediately inland areas of northern New England. Given the moist climate in the region and daily low temperatures in the range of 40°F to 50°F during the summer, a demand for space heating exists even in the summer months. ‘‘Getting the moisture out’’ is a common justification for turning on the heat or building a fire. Figure 1 shows the number of heating degree days in three areas of southeast Alaska.

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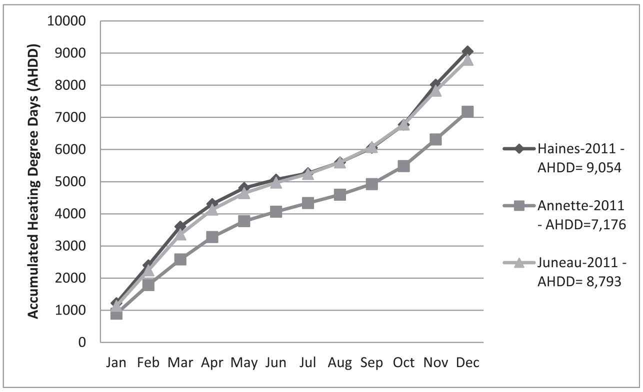

Figure 1.—Accumulated heating degree days for three locations in southeast Alaska.

As opposed to the pellet products that require special stoves, the brick product can be burned as an alternative to firewood in an existing fireplace or wood-burning unit. The advantages of the brick product are low moisture content, which results in increased heating values compared with green wood, and the need for only half the storage space required by cordwood. The moisture content of the brick product is typically 8 percent (green basis) compared with 17 or 18 percent for air-dried firewood. The lower moisture content translates into a cleaner-burning fuel with lower levels of emissions in most applications.

Two major population centers in Alaska, Juneau and Fairbanks, have winter weather conditions in which emissions from older wood-burning equipment exceed air-quality standards set by the US Environmental Protection Agency (EPA). During such periods, a ban is placed on the use of wood stoves. Although the use of a BioBrick-type product as opposed to firewood is not a total solution to the air-emissions problem, increased use of such fuel, especially during emergency situations caused by loss of electrical power, does have the potential to improve air quality compared with burning firewood with higher moisture contents. A greater reduction in emissions, however, can be attained by programs for conversion to EPA-approved wood-burning stove and furnace units.

Study Plan and Execution

The objectives of the current project were as follows:

1. Based on existing reports, identify the forms of biomass available for production of a compressed brick product on Prince of Wales Island, Alaska, and demonstrate that a brick-type product can be produced from the material.
2. Determine the physical properties of the Alaskan brick-type product.
3. Develop a sampling procedure and prepare a survey instrument to inventory burning equipment and conditions at the time of testing (independent variables) and obtain consumer response to use of the product (dependent variables).

Special problems on Prince of Wales Island

The people most interested in this project were a group of individuals and small mill owners on Prince of Wales Island. The island has a population of 5,500 people residing in 2,990 dwelling units in several small communities (US Census Bureau 2011). The economy of the island is a mix of resource-based industries, including fishing (commercial and charter), fish processing, logging, small- and medium-size sawmills, and tourism. Most products to support the population are imported from the Seattle, Washington, area and are delivered by barge or ferry.

In late 2008 and early 2009, fuel prices on Prince of Wales Island averaged from $3.15 to $3.58 per gal for fuel oil and from $2.34 to $2.37 per gal for propane (Petersen 2010). Forecasts at the time of this study by the US Energy Information Agency predicted that oil prices would continue to increase.

Forms of available biomass

The most desirable sources of raw material for compressed brick production are residuals (sawdust, planer shavings, and hogged material) from a secondary manufacturing plant. Such plants commonly use lumber that has been dried for interior use and has a moisture content of 8 to 10 percent. This type of material is not available in the study area. Given the nature of the industry in this area, production of a compressed brick product would require a facility that includes equipment to reduce particle size and a drying system. The primary source of green raw material that might be used for production of a brick product on Prince of Wales Island is sawmill residuals, as described in several previous publications (Brackley et al. 2006, Brackley and Crone 2009, Alexander and Parrent 2010, Nicholls et al. 2010, Sealaska Corporation 2010) reporting sawmill capacity and production in southeast Alaska. The Sealaska presentation estimates that 50,000 green tons of residuals are currently available. It is suggested that readers interested in added resource data check these sources. Based on these publications, the sources of raw material, subjectively ranked to reflect increasing cost, are as follows:

Source 1. Green chips, sawdust, chippable slabs and edgings, and hog fuel (a mixture of bark and sawdust) from an existing sawmill.

Source 2. Material removed from land-clearing projects and highway rights-of-way that otherwise would be moved to landfills for disposal or abandoned.

Source 3. Low-grade material that exists on logged areas currently not removed from the site. This might be in the form of utility or pulp-quality logs or tops and branches.

Source 4. Material removed from thinning of young-growth stands that is not suitable for use by the sawmill industry.

In the near term, Source 1 material and very limited amounts of Source 2 material are available. In the long term, all four sources have the potential to be utilized as a raw material for a future industry. In the present study, availability and economic considerations limited collection of material for testing from Sources 1 and 2. The initial source of raw material for a facility producing the product on Prince of Wales Island would also be Sources 1 and 2.

Raw material collection and processing

The raw material collection process was designed to obtain materials that were representative of species that exist on Prince of Wales Island as well as the forms that result from existing production facilities. Viking Lumber Company in Klawock, Alaska, provided hog fuel that consisted of undetermined ratios of sawdust, bark, and waste chips that had accumulated at the mill over a period of years. In addition, small mill owners were visited and asked to contribute slabs and edgings of specific species for inclusion in the project. Several areas that were scheduled for clearing were located and arrangements made to chip material from these sources. In addition, a heated area at the Craig, Alaska, wood boiler site was converted into a drying shed. The shed was manned and the material dried by local volunteers who expressed an interest in the project.

The first batch of raw material was shipped from Prince of Wales Island on February 13, 2009. The bricks were returned on April 10, 2009. Upon shipment of the initial raw material, collection of a second batch was initiated. This batch was shipped from the island on November 20, 2009, and the bricks were returned on February 5, 2010.

The bulk of the returned products were shrink-wrapped packages that consisted of 20 bricks per package. Each package contained bricks produced from a specific species and source material. The producer also included several packages of bricks from normal production runs that consisted of material commonly available in southern New England. For the present study, important characteristics included species composition or source material, moisture content, and energy value.

Test burn sample size and conduct of test burns

Based on advice by the manufacturer, practical considerations resulting from the amount of product that was available, and testing by the authors, it was decided that a 12-brick set would be used for each test burn. The 12-brick set was composed of bricks from a single species, material source, and production run (Batch 1 or Batch 2). Testing established that results from the 12-brick charge were comparable to a typical charge of cordwood. An inventory of 12-brick sets available for testing is presented in Table 1.

The basic instructions for starting and using the bricks, as supplied by the manufacturer (BioPellet 2011), were as follows:

1. To start the fire, ''Build a TeePee with 4 briquettes around newsprint or fire sticks and establish a strong burn.''
2. To load the fuel charge once a strong burn is established, ''Build a wall of bricks in front and over coals, packing bricks tight together and laying them [as] flat as possible.''

The supplied 12-brick set allowed use of 4 bricks for starting the fire and 8 bricks for building the wall.

Survey questions

Dependent variables.—Possible marketing scales (Bruner and Hensel 1992, 1998; Bruner et al. 2001) were reviewed, and a 5-point Likert scale was selected for the project. BDM methodology and structure (Becker et al. 1964) were selected to estimate the price that survey respondents were willing to pay for the product. BDM has several forms. In this study, the consumer was presented with a series of sequential amounts and asked to identify the price they were willing to pay.

While this project was in process, personnel at the Alaska Wood Utilization Center were also conducting a project to evaluate conditions and attitudes of Alaska residents relative to use of wood energy (Nicholls et al. 2010). Survey information and unstructured comments from that project were used as part of the basis for the survey questions in this brick project.

The satisfaction responses focused on the following brick-related characteristics:

1. *How well did the bricks burn?* Starting and maintaining a fire are skills that were once second nature to people who used firewood. Given a population less familiar with wood burning, starting a fire and getting it to burn at a sustained rate can be a frustrating experience, especially if the material is not well dried.
2. *What was the quality of the heat?* The traditional wood stove produced an abundance of radiant heat. Modern stoves have been designed to produce heat in both radiant and convection forms. ''There is nothing like a good old-fashioned wood stove to provide heat'' or some variation thereof reflects many people's view of wood heat quality.
3. *Was the length of burn satisfactory?* Use of firewood requires additional work and effort to keep the appliance charged. In the context of this survey, the tester was comparing the length of the burn with those normally associated with their equipment and fuel type.
4. *How did the brick hold up in handling?* A previously reported finding (Nicholls et al. 2010) was that burning firewood was considered to be a ''messy process'' in that it was necessary to constantly clean and remove dirt, bark, splinters, and similar material from areas where firewood was stored and moved to the burning unit.

Independent variables.—In preparing the survey form, we recognized that survey participants would have a wide range of heating equipment, including heating stoves, furnaces, and fireplace inserts, most of which do not meet current EPA standards. It was also recognized that exiting housing codes in Alaska communities often require that

Table 1.—Burn sets shipped and returned by batch number and material composition.[a]

Composition	No. shipped			No. returned		
	Batch 1	Batch 2	Total	Batch 1	Batch 2	Total
Red alder	8	—	8	6	—	6
BioBrick	10	8	18	6	10	16
Hog fuel	13	34	47	6	34	40
Western red cedar	1	—	1	1	—	1
Sitka spruce	6	—	6	6	—	6
Western hemlock	6	—	6	6	—	6
Alaska yellow cedar	8	—	8	7	—	7
Total no. of test sets	52	42	94	38	44	82

[a] Response rate was 87 percent.

homes have backup or additional sources of heating. These other sources of heat could influence test results. In addition, homes would certainly have differing levels of insulation.

Tests would be conducted at the user's convenience and with the user's equipment. Our plan was to use one 12-brick set as a test burn. Given a range of stoves, some of them small and with limited firebox size, test burns might vary slightly from the instructions. Conditions interior and exterior to the building would also have an impact on testing. The project team was aware that many factors could have an effect on the results. They also had many ideas that would create a more controlled test, and it was decided that the detailed testing instructions and the collection of detailed data of testing procedures would become a burden to the consumer and a cause of unnecessary frustration. We agreed to keep the data collection form short (no more than two pages, with the final version only one page) and simple.

Each participant would be supplied with two 12-brick sample packs. Each test set would include a copy of the basic fire-starting instruction prepared by BioPellet (2011) and a survey form. Survey forms were coded so that testers were not aware of the production batch, species, or source of material of the 12-brick test set. Test sets fit nicely into a US Postal Service large fixed-rate box. Upon return of the survey forms, brick characteristics were matched with the code on the returned forms and entered into the response database. A copy of the survey form is included in the Appendix.

Selection of population for sampling

The characteristics of the survey population required that a potential tester satisfy a set of both necessary and desirable conditions. Obviously, to participate in the project, each tester had to have a wood-burning unit. Desirable characteristics included several years of experience using firewood in home-heating applications. Project personnel also felt that sampling should be confined to southeast Alaska to minimize costs associated with the distribution of samples.

Given the necessary and desirable conditions, an e-mail was be sent to employees of the US Department of Agriculture and members of the Society of American Foresters (SAF) located in southeast Alaska. Many of the SAF members are from the private sector. The e-mail informed the recipient of the project and requested that individuals interested in participating supply a current mailing address. The original e-mail also stated that final selection of participants would be based on a random process until the required number was achieved. All contact with potential respondents was conducted by Robert Gorman. Any information distributed for analysis was devoid of personal identifying information.

Forty-seven of the individuals expressing an interest in the survey were randomly selected to receive samples. Randomly selected participants were matched against randomly selected test burn sets. Each participant was mailed two boxes by priority post. As previously noted, each box contained one test burn set of 12 bricks, burning instructions, and a survey form. All shipments were prepared on March 13, 2010, and shipped soon thereafter. A total of 94 boxes (94 test burn sets) were distributed for testing.

After 5 weeks, 82 of the survey forms had been returned (response rate of 87%). Several of the sample forms were incomplete and could not be used in all phases of the analysis. Table 2 reports locations where tests were conducted based on returned survey forms.

Table 2.—Locations where tests were conducted based on returned survey forms.

Location	No. of returned survey forms	% of total forms returned
Craig	4	4.9
Haines	2	2.4
Juneau	18	22.0
Kasaan	2	2.4
Ketchikan	14	17.1
Klawock	4	4.9
Petersburg	6	7.3
Sitka	16	19.5
Thorne Bay	2	2.4
Wrangell	8	9.8
Yakutat	6	7.3
Total	82	100.0

Physical properties of southeast Alaska bricks

The high heating values of bricks produced from material collected on Prince of Wales Island are reported in Table 3. The moisture content of sampled bricks was measured just before the shipment to the survey participants. Batch 1 bricks had been stored at the US Forest Service warehouse in Sitka, Alaska, for approximately 8 months. Batch 2 bricks had been stored in the same warehouse for approximately 1 month. The moisture content of Batch 1 bricks average 11.3 percent (total weight basis). Batch 2 bricks had an average moisture content of 13.3 percent (total weight basis).

Consumer response to test burns

Given the small sample size, the basic criterion for analysis using χ^2 was violated (Sheskin 2004). Given this problem, Fisher's exact probability test was used to test satisfaction response with respect to burning characteristics and heat quality between bricks produced from various species, compositions, and batches. Blank cells were not allowed in this testing procedure, and it was necessary to modify response matrices to eliminate any blanks. This test provides an estimate of the probability of the difference between sample groups being based on randomness (Sheskin 2004, Vassar College 2012). Thus, a high probability value is an indication of randomness as opposed

Table 3.—High heat values and net heat values adjusted to moisture content at the time of shipping for testing.[a]

Source of material	High heat value (Btu/lb)	Heat value adjusted (12.2% green basis)
Hog fuel	8,537	7,495
Sitka spruce	8,395	7,371
Red alder	8,533	7,492
Western hemlock	8,547	7,504
Western red cedar	8,360	7,340
Alaska yellow cedar	8,907	7,820
Average	8,547	7,504

[a] High heat values are based on sample data reported by Dr. Andy Soria (University of Alaska Fairbanks, Forest Products Laboratory, Palmer, AK, personal communication, 2009).

to a difference between tested groups. The lowest levels of probability were from tests comparing hog fuel bricks with other bricks.

Results

Figures 2 through 10 provide histograms and a visual view of consumer responses. In general, consumers were satisfied with the tested products. Based on a visual

Figure 2.—Consumer response relative to burning characteristics of Batch 1 and Batch 2 bricks.

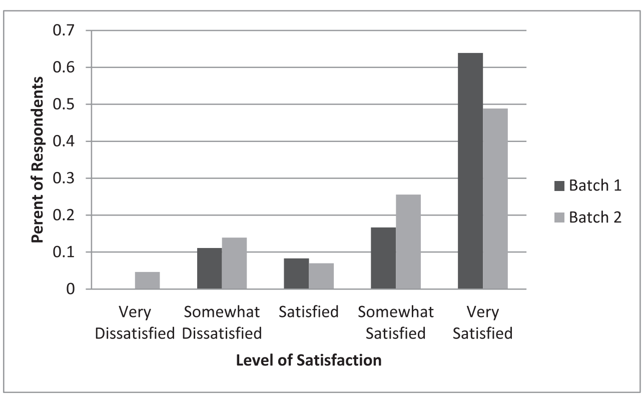

Figure 3.—Consumer response relative to quality of heat from Batch 1 and Batch 2 bricks.

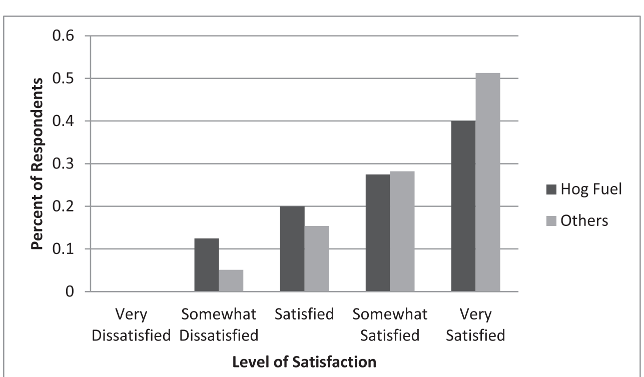

Figure 4.—Consumer response relative to burning characteristics of hog fuel bricks and bricks from other materials.

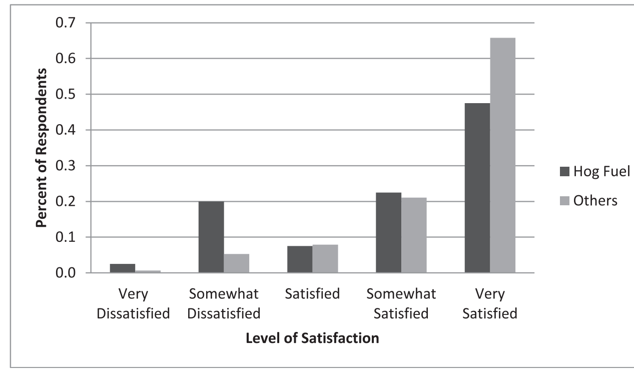

Figure 5.—Consumer response relative to quality of heat from hog fuel bricks versus bricks from other material.

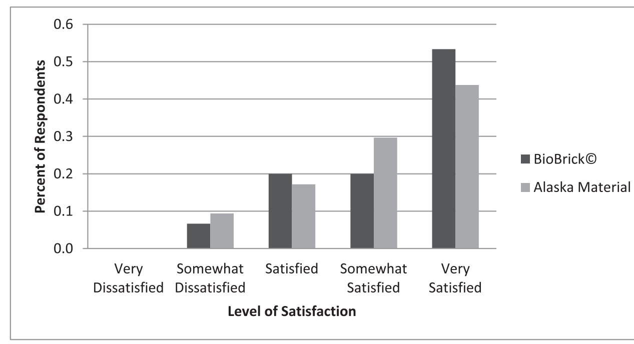

Figure 6.—Consumer response relative to burning characteristics of BioBricks versus bricks from Alaskan material (including hog fuel).

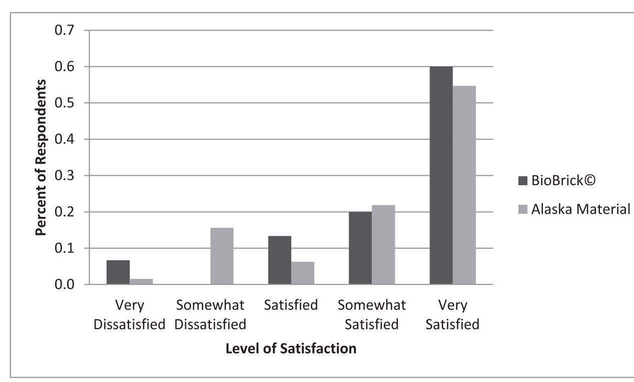

Figure 7.—Consumer response relative to quality of heat from BioBricks versus bricks from Alaskan material (including hog fuel).

inspection of the figures, there was a slightly lower level of satisfaction from bricks made from hog fuel.

Impact of burning equipment

Seventy-three respondents provided information about the type of equipment (newer EPA-approved vs. older, non–EPA-approved) used to conduct the test burn. Forty-five percent of respondents indicated they did not know if the equipment was EPA-approved. Figure 11 presents average burn times by reported stove types. Reported burn times for

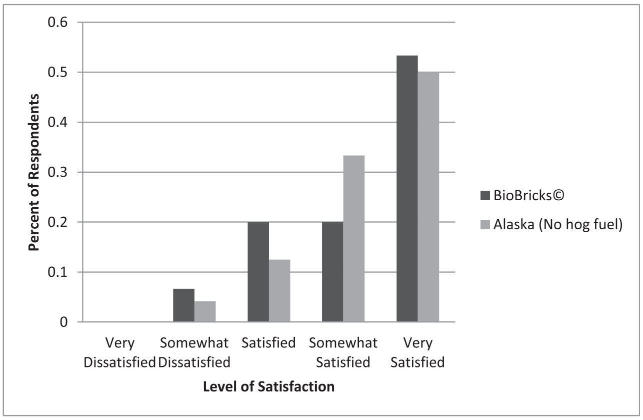

Figure 8.—Consumer response relative to burning characteristics of BioBricks versus bricks from Alaskan material (excluding hog fuel).

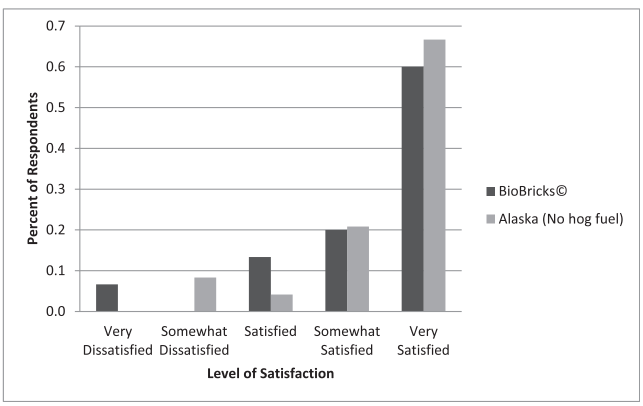

Figure 9.—Consumer response relative to quality of heat from BioBricks versus bricks from Alaskan material (excluding hog fuel).

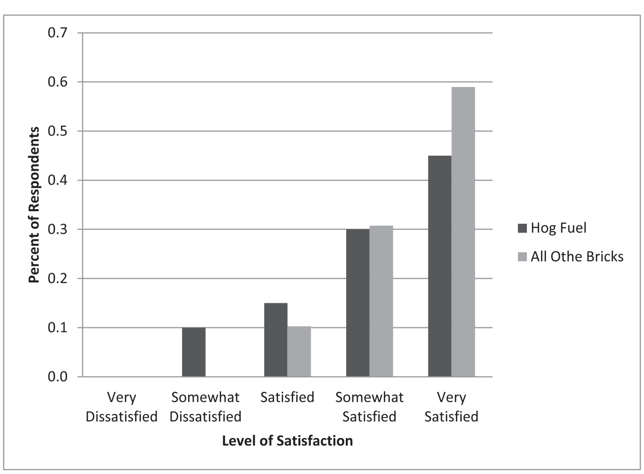

Figure 10.—Consumer response relative to integrity of hog fuel bricks versus all other bricks.

EPA-approved equipment were 60 percent higher than those for non–EPA-approved equipment. Two *t* tests were used to evaluate the difference between burn times. In this analysis, it was assumed that any stove reported as ''unknown'' was a

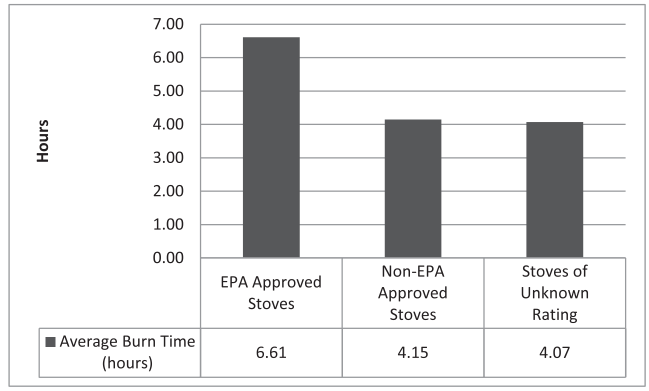

Figure 11.—Average reported burn times for US Environmental Protection Agency (EPA)–approved stoves, non–EPA-approved stoves, and stoves of unknown approval rating.

non–EPA-approved unit. In the first test, a significant difference in the variances of the two samples was found. The two highest values reported for EPA-compliant stoves were eliminated from the test. Dropping the extreme high values resulted in a reduction of the mean for EPA-approved stoves from 6.61 to 5.57 hours. The elimination of the two highest burn times also resulted in no significant reduction in the time variances of the two sample groups. Regardless of the test applied, a significant difference was found at the 95 percent level between the reported burn times.

Impact of burns on home temperature

Testers were asked to supply living-area temperature at the start and completion of testing. It was recognized that this temperature would be for a single location within the home, perhaps the most commonly used living area, and would not reflect the total temperature change throughout the home. Regardless, based on data from 78 respondents, the average increase in living area temperature was 4.9°F.

Product preference and consumer willingness to pay

Respondents clearly preferred cordwood for heating. This information is reported in Figure 12. Almost 60 percent of respondents identified cordwood as the product of choice for home heating. When considering only respondents with a preference for cordwood or bricks, two of every three respondents preferred cordwood.

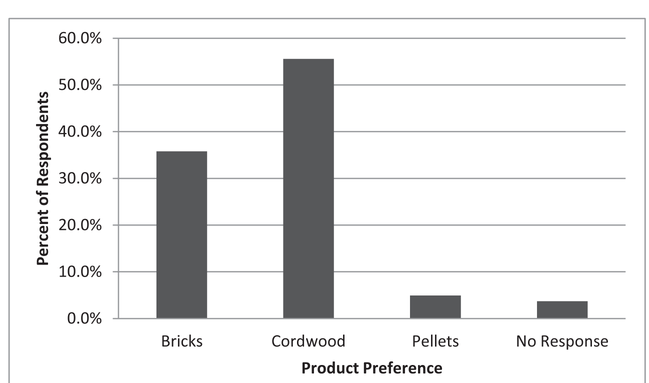

Figure 12.—Fuel preferences of respondents.

Thirty-five percent of respondents stated a preference for the brick product. The average price these respondents were willing to pay for bricks was slightly higher than the price those expressing a cordwood preference were willing to pay ($159 vs. $140 per ton). The prices that all respondents were willing to pay, regardless of preference, are reported in Figure 13. Only 3 percent of respondents were willing to pay $250/ton. Nearly 75 percent of respondents were willing to pay up to $150/ton.

Discussion

Regardless of how the data were partitioned, we found very little difference in the consumer reaction to brick groups based on species, material, or production batch. However, a visual difference was found in many histograms that suggests lower levels of satisfaction for bricks produced from hog fuel, but given the small sample size and the reported probability analysis, these visual differences cannot be considered as significant.

Respondents with relatively new, EPA-approved stoves reported longer burn times. We have made no attempt to search the literature and determine if other studies are in agreement with this trend.

Finally, regardless of the levels of satisfaction with the brick product, respondents indicated a preference for cordwood. Sixty percent of the respondents in this project are located in communities and rural areas with populations under 10,000 people. Numerous ad hoc comments were included on the survey forms. Eighteen percent of respondents indicated that the price they were willing to pay for the brick product was related to the local availability of cordwood and nonmonetary factors. The low cost and the availability of cordwood in an area where waste material from logging operations is abundant, or instances where landowners were willing to allow harvest of small volumes of firewood for personal use, were stated as considerations when responding to preference and price questions. A number of respondents also noted that cutting and processing firewood was a family activity and that they enjoyed the exercise involved.

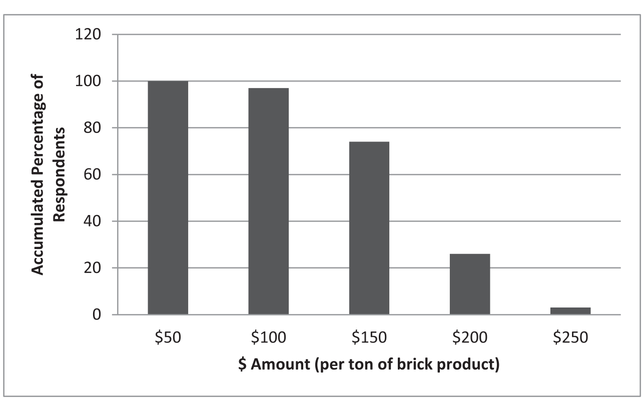

Figure 13.—Accumulated percentage of respondents who would pay the stated price for a brick product.

This project survey collected information from US Forest Service personnel and members of the SAF who currently have wood-burning equipment and traditionally have used cordwood as a primary or secondary source of home heating. The survey reflects information collected from a population having a positive view of wood and wood products. The survey population did not include members of the general public currently burning cordwood.

Looking forward and assuming increasing costs for fossil fuels, it is possible that the availability of a shrink-wrapped, competitively priced product that can substitute for cordwood might induce non–wood-burning consumers to purchase wood heating equipment for burning product. Analysis of this market is beyond the scope of the current project, however, and represents a topic for future research.

Literature Cited

Alexander, S. J. and D. J. Parrent. 2010. Estimating sawmill processing capacity for Tongass timber: 2007 and 2008 update. Research Note PNW-RN-565. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 15 pp.

Becker, G. M., M. H. DeGroot, and J. Marschak. 1964. Measuring utility by a single-response sequential method. *Behav. Sci*. 9(3):226–232.

BioPellet, LLC. 2011. Stovefill—How to burn your BioBricks. http://originalbiobricks.com/howtoburn. Accessed December 27, 2012.

Brackley, A. M. and L. K. Crone. 2009. Estimating sawmill processing capacity for Tongass timber: 2005 and 2006 update. Research Note PNW-RN-561. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 15 pp.

Brackley, A. M., D. J. Parrent, and T. D. Rojas. 2006. Estimating sawmill processing capacity for Tongass timber: 2003 and 2004 update. Research Note PNW-RN-553. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 15 pp.

Bruner, G. C., II and P. J. Hensel. 1992. Marketing Scales Handbook—A Compilation of Multi-Item Measures. American Marketing Association, Chicago. 1,315 pp.

Bruner, G. C., II and P. J. Hensel. 1998. Marketing Scales Handbook—A Compilation of Multi-Item Measures. Vol. 2. American Marketing Association, Chicago. 1,045 pp.

Bruner, G. C., II, K. E. James, and P. J. Hensel. 2001. Marketing Scales Handbook—A Compilation of Multi-Item Measures. Vol. 3. American Marketing Association, Chicago. 1,651 pp.

Nicholls, D. L., A. M. Brackley, and V. Barber. 2010. Wood energy for residential heating in Alaska: Current conditions, attitudes, and expected use. General Technical Report PNW-GTR-826. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 30 pp.

Petersen, K. H. 2010. Craig wood-fired boiler—A case study of a renewable energy project. University of Alaska Fairbanks. 67 pp.

Sealaska Corporation. 2010. Wood biomass energy status and options for southeast Alaska. http://www.pinchot.org/uploads/download?fileId=620. Accessed January 31, 2012.

Sheskin, D. J. 2004. Handbook of Parametric and Nonparametric Statistical Procedures. 3rd ed. Chapman & Hall/CRC, Boca Raton, Florida. 1,193 pp.

US Census Bureau. 2011. State & County QuickFacts. http://quickfacts.census.gov/qfd/states/02/02198.html. Accessed March 22, 2012.

Vassar College. 2012. VassarStats: Website for Statistical Computation. http://vassarstats.net/. Accessed March 22, 2012.

Appendix

BIO-BRICK BURN SURVEY

Location:______________________________

Date of Burn:______________________________

Type of Wood Burning Appliance:______________________________

Sample Number:______________________________

What do you NORMALLY burn in your Wood Burning Appliance (i.e. wood stove)?______________________________

Is the wood stove EPA approved? Circle one: Yes No Don't know

Circle if the wood stove is: **catalytic** burner, **non-catalytic**, or **other**: describe)______________

Are you using wood as a primary source of heat? Circle one: Yes No

How many cords of wood do you usually burn annually?______________________________

Do you have another heat source in the house? If so circle which: Diesel Propane Electric Other

(if other please indicate:______________________________)

Degree of insulation in the house? Circle one: excellent, good, fair, poor (circle 'fair' if unknown)

Outdoor Temperature at beginning of burn:______________

Indoor Temperature at beginning of burn:______________(when bricks are put on coals)

Indoor Temperature one hour after burn begins:______________

Beginning Burn Time :______________(when bricks are placed on coals)

End of Burn Time: ______________(when bricks are no longer identifiable in stove)

Answer the following questions by circling the answer that most closely reflects your opinion

	Very Dissatisfied	Somewhat Dissatisfied	Satisfied	Somewhat Satisfied	Very Satisfied
How well did these bricks burn?	1	2	3	4	5
Rate the quality of heat?	1	2	3	4	5
Was the length of burn satisfactory?	1	2	3	4	5
How did these bricks hold in handling?	1	2	3	4	5

Would you purchase these types of bricks to burn in your home? Yes No

How much would you be willing to pay for a cord equivalent of these types of biobricks?
(one cord equivalent equals one ton of bricks or 50 bundles of 20 bricks each)
$100 $150 $200 $250 $300

If all wood products were available in your community and the price were comparable, which would you prefer? Cord Wood Bio-Bricks Pellets Chips