Approaches to Energy Pellet Cost and Quality Optimization

Omar F. Ali and Alexander A. Koukoulas *

As the global demand for biomass-derived energy pellets continues to expand, industry focus is expected to quickly migrate from project development to ways of lowering operating costs. Process optimization and the utilization of low-cost feedstocks are expected to be of special interest. This new focus will present opportunities for targeted research that can utilize low-value wood and biomass feedstocks, increase yields, and improve product quality.

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Contact information: Herty Advanced Materials Development Center, Georgia Southern University, Savannah, GA, USA; Corresponding author: akoukoulas@herty.com

The Energy Pellet Market

By 2020, the global demand for wood pellets is expected to increase over 50 percent from 2013 levels, growing from 23.6 million to 38 million metric tons per year (mty). More aggressive estimates see demand at nearly 44 million mtpy. Although the rate of growth of the pellet industry in the coming years is uncertain, there is a consensus that increased demand in both the domestic and industrial pellet markets will be a catalyst for growth.

As the industry continues to grow and mature, it is expected that the current focus on project development will shift to performance improvement and cost optimization across the supply chain. In this regard, feedstock costs to the gate of the pellet mill, which can exceed 50 percent of the variable cost of production, presents the greatest potential for cost optimization. For example, for a typical 300,000 tpy plant, a modest reduction in conversion costs of only $0.50 per ton of pellets results in a net yearly savings of $150,000.

Factors to Consider

When examining cost reduction opportunities operators should consider experimental design factors in three key process areas, as illustrated in Fig. 1: feedstock (Area 1); plant (Area 2); and process integration (Area 3). Focus on these areas with an objective of affecting continuous and sustained improvements is seen as a means of improving plant operations and maximizing return on investment.

Typically, biomass delivered to the gate of the pellet plant undergoes three very energy intensive operations: size reduction, drying, and pelletizing. Combined, these unit operations consume between 400 to 600 kWh per ton of production, and as such present an area with significant potential for optimization and cost savings. Assuming an electricity rate of $75 per MWh, a typical pellet mill would save $1.25 million per year for every 10 percent reduction in electric demand.

Similarly, minimizing fines generated during production and enhancing conversion to pellets across the pellet mill can lead to higher product yields and improved profitability. Assuming a market price of $175 per ton, a typical pellet mill would realize $525,000 per year in wood savings for each additional percent increase in overall yield.

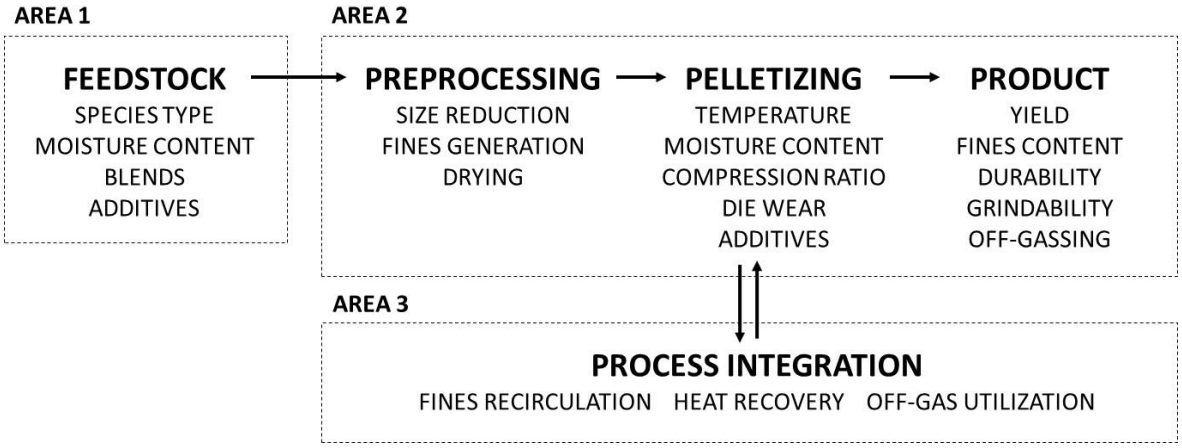

Fig. 1. Main process areas in the pellet plant and opportunities for cost reduction

Opportunities to Lower Costs

Although specific to individual pellet plants, opportunities for reducing costs include the optimization of particle size to enhance drying rates and hence lower drying costs; the recycling and reuse of unconverted fines to maximize pellet yield from costly feedstocks; the upgrading of low cost feedstock such as forestry residuals prior to pelletizing; and the processing of feedstock mixtures to rationalize logistics and take advantage of preferred pricing.

Pellet quality optimization includes assessing operational process changes specific to a pellet plant, which leads to enhanced pellet properties such as grindability, durability, calorific value, and bulk density. As an extension, this might also include advanced pellets such as those produced by torrefaction.

A plant may choose to conduct in-house trials to test opportunities for cost optimization or pellet quality enhancements, but these are always costly ventures that often lead to inconclusive results due to process variability. Moreover, plant operators are not likely to disrupt plant production to conduct optimization trials that carry the risk of negatively impacting production. In addition, trials conducted on commercial lines tend to be limited in scope to minimize risk and cost, thus placing limits on the value of the trial results.

The Need for Control

In our view, options to test new opportunities are best conducted on dedicated small-scale pilot lines where such programs can be tested at the required detail and in a controlled fashion. However, careful selection of the pilot scale equipment must be done to ensure that trial results correlate with full scale production. In addition, production of sufficient quantities of pellets under desired developed conditions to facilitate test burns might also be of importance.

Those looking to conduct pilot trials should consider a fully integrated pilot pellet facility, capable of accepting truck-loads of chips, with pellet production capabilities. Full integration with continuous operation ensures that steady-state conditions can be achieved, which provides a basis for repeatable testing and data comparison. The dryer must be capable of controlled inputs, and the pilot plant must have the capability to present milled wet feedstock of the desired size to the dryer such that drying rates can be investigated. The pellet mill should be fully automated with a wide choice from several different compression ratio dies to allow specification of the proper extrusion conditions; *i.e.* compression ratio, specific to that feedstock. Such a trial is best conducted following preliminary work with a small pellet mill whose purpose is to give guidance to the pellet making capability of the feedstock furnish and to the specification of the compression ratio die that might be needed for that feedstock. In addition, the pilot facility should be equipped with a mixing tower between the hammer mill and pellet mill to allow mixtures of feedstocks or binders added to the feedstock to be assessed prior to pelleting.

Conclusion

In conclusion, the energy pellet industry is poised for continued growth. But as the industry matures more attention will turn towards process optimization and lowering costs across the value chain. For pellet mill plant operators, access to pilot facilities that can be used to conduct trials and validate cost reduction strategies will be a vital tool in achieving cost reduction targets.

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