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Energy Efficiency

In mid-2006, the Gas Technology Institute published a report funded by DOE's Industrial Technology Program (see also story on page 31) entitled "Industrial Glass Bandwidth Analysis". The principal authors, David Rue and Warren Wolf, had been asked to determine where in the glassmaking process, and by what means, energy could most effectively be saved.

With the help of a survey completed by many GMIC member companies, numerous personal interviews and coauthor James Servaites, they carried out the project. The resulting 40-page document gives the industry a clear and "actionable" path forward to substantial energy saving opportunities. The report can be downloaded (at no charge) from the GMIC website at www.gmic.org/pubs.html.

The theoretical minimum amount of energy required to melt glass ranges from 2.2 to 2.8 MMBtu/ton depending on the type of glass (container, 2.2; fiber, 2.3; pressed and blown, 2.3; flat, 2.8), the method being used and the varied steps involved.

Conclusions from the study, however, suggest the following "state of the art" for the melting process (in MMBtu/ton): container, 3.4; fiber wool, 2.8; fiber textile, 3.8; flat glass, 4.7; specialty (pressed and blown), 5.6. Average energy use is substantially higher.

The analysis reveals some interesting (and varied) opportunities for energy efficiency improvements. Rue and Wolf quantify, for each sector, the current average energy used and the practical minimum (which assumes the application of reasonable, currently available technologies). This is further broken down into areas of activity: mixing, melting/refining, forming and post-forming. With the exception of fiber wool, the melting/refining phase is the most energy-intensive.

For each sector, they analyze the energy reduction potential if it were to move from current average, to state of the art, to practical minimum.

One observation that should require further analysis is that, with the exception of flat glass, the potential savings in moving from current average to state of the art, is at least *three times* the retrievable energy realized in moving from the latter to practical minimum. (The analysis at this point is cost-insensitive.)

Fiber textile has the largest potential energy savings per ton of production, with container, flat and fiber textile following in descending order. However, if we look at the higher production rate for container glass, we see that it would yield the largest overall reduction in energy use by moving to state of the art (20 TBtu/yr) or practical minimum (another 6.5 TBtu/yr).

Bottom Line It

The bottom line for the glass company looking to introduce meaningful energy savings is to determine the cost/benefit ratio for making each of the above moves, and, of course, taking into consideration normal repair and rebuild schedules and permitting considerations.

The report provides some guidance in this area as well, identifying a variety of technologies that would be likely to reduce energy intensity. It rates them by sector as to the maturity of the technology, whether a rebuild is required, the cost of implementation and the energy savings benefit. Pull this together, and we begin to see a pattern and some areas that clearly deserve more attention.

Batch and cullet preheat, and exhaust gas heat recovery are relatively immature technologies (2–4 on a scale of 1–10), yet offer the highest energy savings benefit (6–8 on the same scale). Oxy-fuel, while involving a higher cost of implementation, is mature for most of the industry, and is rated 5.

Waste heat recovery has been identified by GMIC members as a priority. We are developing programs to explore state-of-the-art technologies and to pursue further development opportunities with technology supply companies.

Our challenge to the glass support industry: Show us cost-effective equipment to implement batch and/or cullet preheat.

Do It

State of the art means just that—where we are (or could be) today. Rue and Wolf propose areas that we should consider for improvement beyond current state of the art: advanced melter designs, rapid refining processes, alternative raw materials, exhaust gas thermochemical recuperation, fluxes including lithium and steam, heat recovery from cooling glass, higher strength glass, and glass composite or hybrid materials.

The rest is up to us. Which of these is likely to be developed by an individual company or university carrying out expensive and risky research on its own? Which could be addressed realistically by a coalition or consortium? Time will tell, but do we have the time?

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