MAGUIRE®
PRODUCTS, INC.
11 Crozerville Road, Aston, PA 19014 Website: http://www.maguire.com
Tel: (888) 459-2412 / (610) 459-4300 Fax: (610) 459-2700

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The Market for Heat recovery in the plastics Industry

Plastics is an extremely large market. Here is a quote from a recent google search.

"The global plastics market size was valued at USD 522.66 billion in 2017. "

Another quote:
"In 2018, plastics generation was 35.7 million tons in the United States".
World markets exceed 130 million tons.

All of that plastic is processed one way or another by heating pellets from room temperature to about 400F, molding it, and then cooling it again.

Applying a little math to these numbers, we can conclude the cost of electricity to process all this plastic approaches one billion dollars annually.

The heating of the plastic is partially by resistance heaters. But heating also is caused by shear from the plasticizing screw, converting motor energy to heat. Pellets can also be preheated by a dryer, prior to entering the extrusion barrel. This is done by hot air heated by resistance heaters.

While all plastics are not the same, we can assume, on average, that 200F is representative of an average preheat temperature. Additional resistance heating is also applied to the extrusion barrel and screw drive motor HP supplies the rest which also represents a conversion of electric usage to heat. Preheating pellets with hot air is the easiest way to apply electric energy created by a heat recovery method that converts downstream heat to electric energy.

As for cooling... This is done with water, circulated through the mold, which is then run through a chiller. The hot side of the chiller is then cooled by a water circuit to a cooling tower, which in turn is cooled by air flow and evaporation.

In all steps of the cooling process, none of that 400F heat is recovered or returned to the process. All heating energy is wasted. Additional energy is used for this cooling process, and that is also not recovered. Total energy consumed is actually more than 100% of that required for heating only.

Plastic is a commodity, costing about $1 to $1.50 a pound on average. When buying and processing plastic, pennies matter. Typical large volume factories may process 10 to 100 million pounds a year. Each added penny/lb. adds $100,000 to $1,000,000 cost in that one factory. Electric costs for heating and cooling add about 1 cent per pound processed.
At 1 cent per pound, a typical high throughput machine might process 3,000,000 pounds of plastic per year, with $30,000 in electric costs per year. If a process could recover 30% of that, saving $9,000 annually, that would provide payback for a significant investment. A heat recovery system would not only recover heat, but would also reduce cooling costs.

In my view, the best place to recover the heat is from the hot freon that is part of the chiller system. The freon holds most of the BTU's that are pulled from the water, which has pulled the BTU's from the steel mold, which has pulled the BTU's from the molten plastic. The freon is about 140F degrees or hotter.

Assuming a proper heat to electric conversion system was made to allow radiation of freon heat to produce electricity, then that voltage could power resistance heaters which could heat a flow of air that would be directed into the hopper to preheat the pellets. Resistance heaters can accept a range of voltage, which is to say that a steady voltage rate is not required. Direct current (vs AC) is also acceptable. Once up and running all plastic molding processes are very stable. A computer would control a variable voltage in coordination with variable (or a bank of) resistance heaters, along with variable air flow, to produce the desired hot air flow.

Chillers are already purchased by processors, so that basic expense is assumed. This heat to electric technology can be added to a chiller to produce a chiller that would pay for itself by reducing power costs. Maguire Products can do the design modifications to current chiller design, produce the chillers, and effectively reach this market which is the plastics industry. We currently sell to the entire world plastic processing market. The success of this marketing effort would depend almost entirely on the proven return on investment.

A proven return will generate sales. The better the return, the faster the market would move to this new technology. A return on investment of 30% to 50% a year would produce a demand for this technology. Potential savings varies with each process machine's throughput and its corresponding electric costs.

Process machine throughput can vary from 10 to 6000 pounds per hour. However, 100 to 1000 pounds per hour is more typical. Some factories centralize the cooling

process, and in that case one energy recovery system can substitute for the higher cost of having many smaller machine recovery systems.

It is my experience that a return of 50% of capital expense will drive a decision to buy. On energy savings, due to current energy saving trends, ("Green" and "carbon footprint"), I suspect a return of 25% or less would also drive an investment decision that would reduce energy usage.

Given the wide range of process machine throughputs, the lower the investment cost, the larger the market.

As an example, our gravimetric blenders entered the market at $6,000 each. The only other product available at that time that would produce the savings, cost about $35,000. That product had sales of 50 units per year. Our lower priced product reached sales levels of 3000 per year. All due to Return On Investment. And the chiller market is a larger market than the blender market.

If energy can be recovered from the heat that is currently lost in the plastic process, this energy can be used directly to heat the plastic pellets prior to being molded. In other words, energy required at the start of the process can be recovered from the heat at the end of the process. This is, in my view, an ideal closed loop system of energy recovery. Recovery and use at the same time on the same machine.

We have the ability to produce this equipment and market to the plastics industry, world wide. The key is to have return on investment in line with customer expectations.

Stephen Maguire

President
Maguire Products, Inc.