Elemental *advice*

Jack Davis, president of I Squared R Element Co., Inc., shares some strategies for getting the most out of your heating elements and heat processing systems.

Jack Davis.

Jack Davis has had a lot of experience with heating elements. The president of I Squared R Element Co., Inc., in Akron, N.Y., started out with Carborundum Co. in 1961, in what was at that time Carborundum's Globar division (now owned by Kanthal). After just a few years, Davis decided he could do better, and in 1964, he and his partner, Stan Matys, founded I Squared R Element to make silicon carbide heating elements.

From the beginning, however, it wasn't just about making a product to sell. Davis and Matys, both engineers, wanted to solve problems. They focused on providing fast deliveries, high quality elements, advice on improving furnace performance and element life, and a free furnace design service, which included heating element recommendations, transformer specifications, element spacing and electrical schematics. Today, the company still offers these services and more for both its silicon carbide elements and its molybdenum disilicide line, which it introduced in 1993.

"I'm an engineer to begin with—I know how to design furnaces that will work," Davis says.

It's no surprise, then, that a lot of people approach Davis for heating element advice. *Ceramic Industry* recently sat down with Davis and asked him to share some of his expertise with our readers.

What have been some of the biggest innovations in heating elements used in the ceramic and glass industries?

Over the years, we've improved the quality of the elements, and that has increased their lifespan. For instance, in the Pilkington process for making flat glass, where the glass is "floated" on a molten tin bath, one year of element life used to be acceptable. Now the elements last 10 to 15 years.

The element arrangements have also become more flexible. When silicon carbide elements were first offered in the '30s they were only 12 in. long and $^3/_8$ in. in diameter and required water-cooled electrical connectors. The elements were mounted horizontally, passed straight through the hot chamber and were supported by the walls, and the electrical connections were made on opposite ends. We now offer three-phase elements, spiral elements with electrical connections on the same end, right-angle elements and U-shaped elements. The elements can be hung from the roof, protruded from the floor, cantilevered from the sidewalls, or hung on the walls or door.

Additionally, by improving the quality—and especially the density, because a denser body provides increased strength—we can now make longer elements. In the '60s, a 105-in.-long element (2667 mm) with a 72-in. (1830 mm) hot section was the limit; we've recently made some elements that were 169 in. (4300 mm) long with a 130-in. (3300 mm) hot section for the glass industry, which has enabled companies to increase the size of their finished products.

What are the important factors when specifying heating elements for a new furnace or kiln?

Temperature and atmosphere, the type and size of the parts being processed, the type of furnace (continuous or intermittent) the door placement, and the characteristics of the power supply—these are all important considerations. If someone approaches us and says they're thinking about building their own furnace, we'll send them a form with about 64 questions related to their product's size and process requirements. With that information, we can recommend a heating element arrangement that is customized to their specific needs.

How can ceramic and glass manufacturers prolong the life of their heating elements?

Temperature control is very important—the higher the temperature, the shorter the element life. Normally companies don't have the option of running at a lower temperature, but controlling the temperature fluctuations can be a big help. One of the biggest improvements over the last 30 years has been in controls. Forty years ago, most electric furnaces had magnetic contactors. Now, most new furnaces have silicon control rectifiers (SCRs), which

An I Squared R Element employee works on a hot molybdenum disilicide element.

provide an even, oscillating power to the element. This eliminates the large element temperature variation as the power is turned on and off. The power supply and temperature control (SCR) to a furnace can be changed without changing the elements, so more sophisticated power control is a relatively easy upgrade. Atmosphere control is also important, and modern devices exist for this as well.

The higher the temperature in a furnace or kiln, the shorter the element life.

Some companies are using the wrong type of elements for their process. For instance, switching from metallic to silicon carbide elements, or in some cases from silicon carbide to molybdenum disilicide, can often provide an increased element service life and a corresponding decrease in heating element operating costs. And then there's the maintenance of the furnace itself. If the insulation in the furnace has deteriorated, cracked or shrunk, then the elements also have to work harder because they have to overcome all the increased heat losses. So there are times when you should rebuild a furnace to save on energy and replacement element costs.

Are any developments currently under way that might improve the heat processing technologies of the future?

Modern molybdenum disilicide and silicon carbide elements can handle the temperature requirements of most materials that are in common use today, i.e., up to 1750°C (3182°F). Silicon carbide is relatively inexpensive and has a very low coefficient of expansion; it doesn't sag when it gets hot. Molybdenum disilicide is ideal for high temperatures, but the cost of the material has risen substantially in the last six months—from $14/lb to $44/lb—and I don't see it going in the other direction. I think the main reason for the price increase is higher demand, because molybdenum is also used as an additive in steel processing. But even with that price increase, if the elements are giving you one to five years of life, the element operating cost is usually quite low. (To compute the element operating costs, take the initial cost of the elements and divide it by the total hours of use.)

Today's heating elements are available in longer, stronger versions and in different shapes. Give me your problem and see if I can't solve it—I like problems.

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