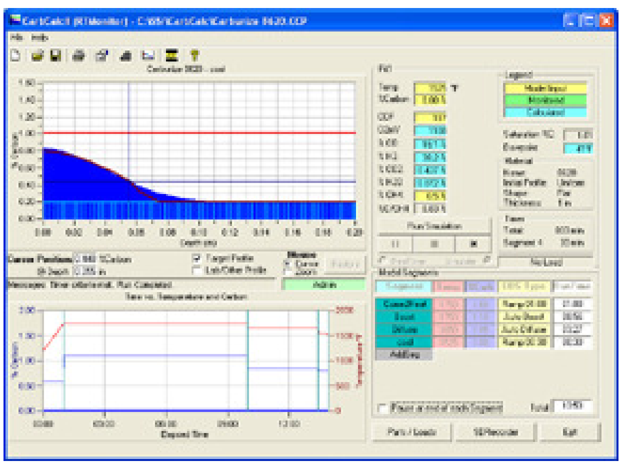
HOW TO OPTIMIZE YOUR BOOST-DIFFUSE CYCLE

Carburizing specifications have become more stringent requiring more precise control during heat treating. *Effective case* specifications are tight and there is a heightened awareness related to the *carbon gradient* on finished parts. There are many reasons influencing the tighter requirements but years of experience along with technology and data analysis gives manufactures more tools to evaluate field results and dial in required carburizing results.



To minimize the total time to carburize to a given case depth, processes are developed using a boost-diffuse methodology. The boost phase of the program is setup to introduce a high carbon potential at a high temperature. The high carbon potential produces a significant buildup of carbon on the part and using the higher temperature, it increase the activity and develops a deep case. The diffuse step which typically immediately follows the boost phase is a lower carbon potential and typically a lower temperature. This decreases the surface carbon and allows the carbon to diffuse deeper into the part. The combination of these processes produce a controlled carbon gradient to deliver the correct properties in the part.

There are numerous factors that go into determining the most economical steps for boost diffuse carburizing. Limitations on furnace capabilities, parts and desired results usually influence the best parameters.

In order to perform a boost diffuse cycle, proper furnace controls must be used to control atmosphere, temperature and time. Most furnaces today are equipped with in-situ atmosphere equipment to ensure that the desired carbon potential is met during these steps. It is also helpful to have a programmable controller that can manage both temperature and carbon setpoints along with the specific time at each step.

So, how do you determine the best possible process to run? Today, control technology and simulation are brought together to deliver precise control with the highest level of accuracy. Modeling software such as CarbCALCII can be used not only to come up with the best boost diffuse model, but it can be used to control the process. When defining the desired carbon gradient, the programmable control uses this carbon curve as the direction. Computer modeling will provide you with the proper times for boosting and diffusing leading to a program (recipe) which is best suited to delivering the desired results.

Simulation programs provide heat treaters with a blue print to the end result of a cycle leading to precise case depth and a consistent carbon gradient delivering the best result. CarbCALCII allows the operators to input material type, part thickness, shape, desired surface carbon, case depth and total case and builds the boost time and diffuse time based on the desired temperature and carbon potential. Using the *Auto Boost* and *Auto Diffuse* segments, the program completes these steps. Auto Boost will complete when the amount of carbon above the desired carbon blueprint (aka *carbon gradient*) is equal to the deficient carbon. The Auto Diffuse segment ends when the carbon above the carbon blueprint is depleted. This provides you the time to run each segment for these steps of the cycle.

Additional segments can be added for heat-up and cool down or additional steps necessary based on equipment and part requirements. "What-if" analysis can be performed by changing temperatures or carbon potential to see the effects on the overall cycle. When used in control mode, CarbCALCII will modify the time in the boost and diffuse segments based on actual results. Data is gathered in real-time and if the step requires more or less time to reach the end of the step, it is adjusted as necessary.

As seen in the November 2009 edition of:

Industrial Heating

THE INTERNATIONAL JOURNAL OF THERMAL TECHNOLOGY