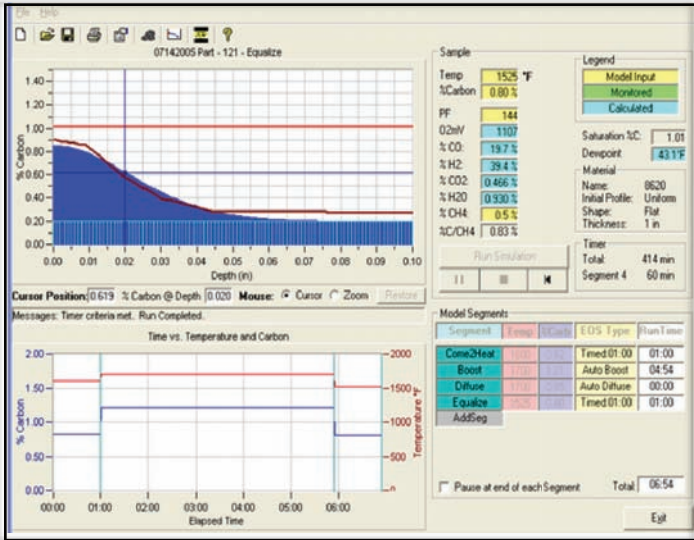# CarbCALC II™

Heat Treat Cycle Simulation Software

Software package designed to optimize a heat treat cycle using input parameters of the type of steel, temperature, atmosphere, and the specifications for case depth and carbon at case depth.
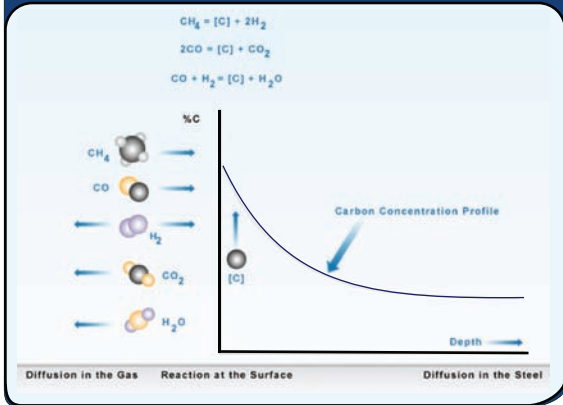
Run CarbCALC II for cycle simulation, for real-time simulation and replay analysis. Use actual data log data to run through for determining the carbon profile.
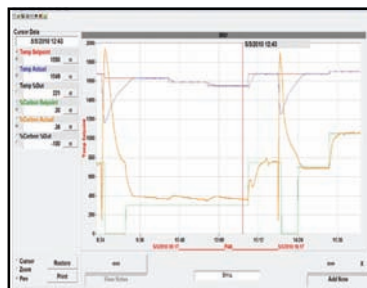
- Optimize carburizing process
- Predict precise case depth
- Computer aided design of heat treatment processes
- User entered parameters
  - Temperature and %C
  - %C at case depth
  - Alloy number (steel composition)
  - Time
  - Circulation
- Quickly perform process experiments
- Accurately predict the carbon content below the surface of the part. Input process variables for simulation
- Automatic segment calculation for Boost and Diffuse carburizing cycles based on case depth requirements
  - Let the program provide you with the time for each segment based on desired results
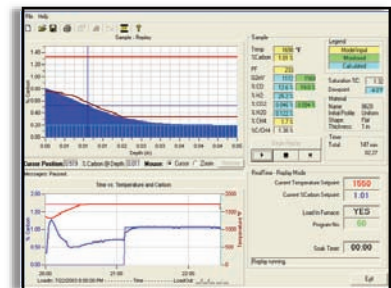 - Modify parameters and compare results

Calculated times for boost and diffuse segments. Simulation process with the total allotted time is displayed in the lower right-hand corner.

Diffusion and Transport in the Gas Phase

$$CH_4 = [C] + 2H_2$$
$$2CO = [C] + CO_2$$
$$CO + H_2 = [C] + H_2O$$

Carbon Concentration Profile

Diffusion in the Gas   Reaction at the Surface   Diffusion in the Steel

In order for carbon to be made available to the steel surface, the carburizing reactant gases (CO, CH_4, H_2) must get to the surface while carburizing product gases (CO_2, H_2O, H_2) are trying to escape from the surface. CarbCALC II uses a numerical solution to Fick's 2nd law for carbon diffusion into the steel.

Converts superdata logdata into a CarbCALC %C trend profile giving the ability to re-work free loads.

The screen image above shows the simulation real time process running.

Real-Time | **Replay** | **Simulation**

Atmosphere Control

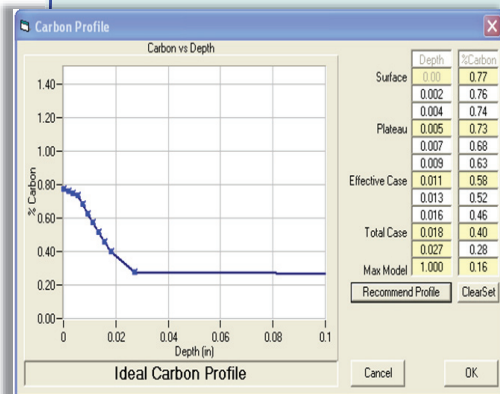# CarbCALC II™
Heat Treat Cycle Simulation Software

Simulation programs provide heat treaters with a blueprint to the end result of a cycle leading to **precise case depth** and a **consistent carbon gradient** delivering the best results. CarbCALC II allows the operators to input material type, part thickness, shape, desired surface carbon, case depth and total case and builds **boost** 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, CarbCALC II will modify the time in the boost and diffuse segments based on actual results. Data is gathered in real-time and if the steps require more or less time to reach the end of the step, adjustments are made automatically.

CarbCALC II Features

Benefits

• Ability to develop recipes for re-working
• Real-Time process monitoring
• Real-Time control and process replay
• "What if" analysis change to gauge impact of an existing process or material
• Recipe development
• Higher quality and shorter process times via process optimization
• Tools needed to empower your employees when working in heat treating

Configuration

• User Defined Furnaces
  -Ability to simulate loads in multiple furnaces
  -Configured communications and channel selection
• Alloy Database
  -Most common materials used in metal treating
  -Create new material
  -Custom profile
• User Configured Parts
• Real-time / Replay Mode

Super Systems incorporated

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