LAMBDA
Technologies Group

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Carburization is a heat treatment process used on gears and shafts that hardens the metal surface by increasing carbon content. Carburization time can be lengthened to increase case depth, but this can increase retained austenite, which is unstable at room temperature and reduces contact fatigue strength. The fatigue properties of carburized components, however, can be significantly improved by optimizing the carburization process and the resulting compressive residual stress profile.

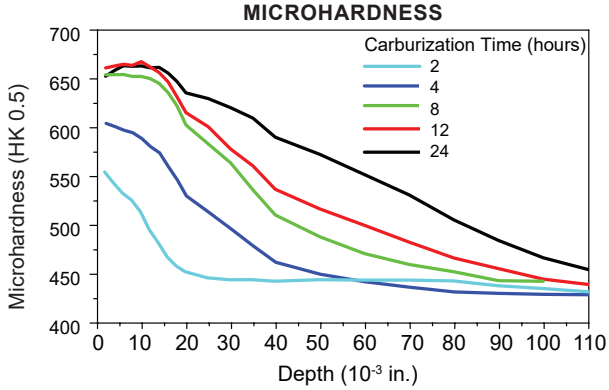
SOLUTION: Optimize the contact fatigue life of carburized gear and shaft components and minimize retained austenite by establishing parameters for an ideal carburization process and compressive residual stress profile.

- A series of simple geometry 8620 steels bars were carburized in an integral quench furnace for 2, 4, 8, 12, and 24 hours and then low-stress ground to a finish typical of gear and shaft components.
- Microhardness evaluations were performed to measure the case depth resulting from the carburization process.
- X-ray diffraction residual stress measurements as a function of depth were performed in accordance with SAE HS-784.
- Volume percent retained austenite as a function of depth was determined in accordance with ASTM E975 and SAW SP-453.
- Fatigue testing was performed on rolling contact fatigue machines specifically designed to expedite testing by minimizing the many complex variables inherent in full-scale component tests. A Weibull probability analysis was used to compare the fatigue results of each sample group.
- Fatigue life, residual stress, and hardness were comparable when carburized for 4, 8, and 12 hours. The 2 and 4-hour carburization processes resulted in the lowest austenite content, while 24-hour carburization provided the best fatigue life but the highest austenite content.

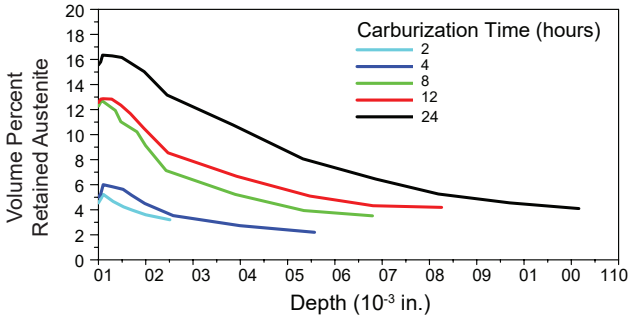
IMPACT: It was determined that, in this material, the 4-hour carburization process and the resulting compressive residual stress profile demonstrated the most desirable fatigue life while maintaining the lowest amount of retained austenite. These results could provide substantial processing time and cost savings, improved component life and performance, and minimized dimensional changes associated with elevated retained austenite content.

To optimize your carburization process, contact Lambda Technologies Group at 1-800-883-0851 or visit www.lambdatechs.com.

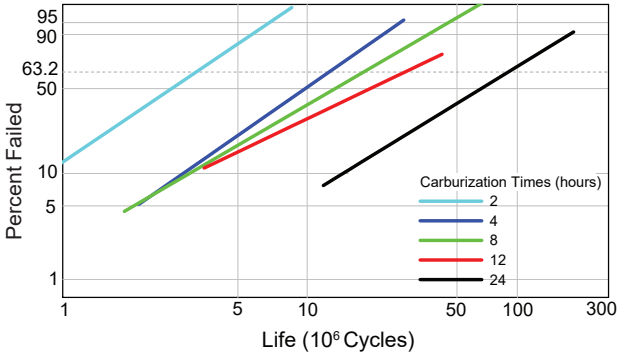
MICROHARDNESS



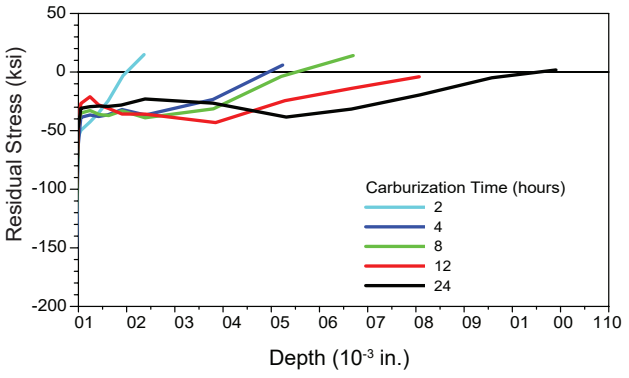
VOLUME PERCENT RETAINED AUSTENITE



ROLLING CONTACT FATIGUE WEIBULL DISTRIBUTIONS



RESIDUAL STRESS



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