



# HOTSEAT

jackTITUS

Director of Process and Developmental  
Engineering, AFC-Holcroft

## Achieving modernization in carburizing and quenching requires an overhaul of load sizes and materials handling

**AS THE EFFORT TO AUTOMATE HEAT TREATING** has evolved, OEMs — especially automotive suppliers — have embraced the effort to move the process from the back room into the manufacturing mainstream.

Heat treating — specifically carburizing — involves a carbon-based gas and a quenching method to harden the steel. Typically, quenching has used oil, but the transition to the manufacturing floor has not yielded another fluid to the manufacturing stream. Therein lies the appeal of gas quenching. In addition to the carburizing gas and quench fluids, another barrier to integrating heat treating onto the factory floor is material handling — or lack thereof. In fact, the type of fluids used and material handling are linked.

Heat treating in the automotive and other high-production, green-energy-influenced transportation industries, is going through a transition. Although the overall number of heat treatable parts is unchanged, the number of recipes per lot of parts required is on the rise. This is because many newer automobile models are now offered with a greater number of small drivetrain configurations — primarily standard and hybrid drivetrains. These configurations require different case depths, resulting in different carburizing times. Diffusing carbon into steel is a time-sensitive process. Efficiency in this process calls for simultaneously processing as many parts as possible, leading to larger loads. In contrast, “lean and green” drivetrain production demands the processing of as few parts as possible, or singular part flow, tied to a Takt-time specific, to achieve the most efficient production. Attempting to move carburizing — especially atmosphere processing — onto the manufacturing floor is a challenging effort for three reasons: Carburizing, as mentioned above, requires more parts per load; hardening multiple parts requires a larger quantity of quench fluid to accommodate the bigger loads; and the trays and fixtures supporting the parts don’t fit neatly into the part flow that is required for automated machining centers. This mismatch actually requires more human intervention even though lean methodology is trending away from people handling parts.

Robots have been used for painting and welding (spot and continuous) for decades, but these processes lend themselves to precise positioning; car bodies are dipped and sprayed via a gantry system in a continuous flow. Car bodies are aligned on a conveyor directed through a gauntlet of welding robots. Currently, back room heat treating requires that parts be removed from the dunnage, and placed into trays — perhaps in layers which are separated by screens. More often than not, the trays, fixtures, and baskets are warped from months of processing, making precise positioning difficult.

### ABOUT THE AUTHOR:

Jack Titus can be reached at (248) 668-4040 or [jtitus@afc-holcroft.com](mailto:jtitus@afc-holcroft.com).  
Go online to [www.afc-holcroft.com](http://www.afc-holcroft.com) or [www.ald-holcroft.com](http://www.ald-holcroft.com).

In addition to part placement in fixtures, quench fluids are another major issue — both from a process viewpoint as well as a health and safety viewpoint. Quench oils can catch fire, and combustible gases must be directed to a safe location — that goes for endo gas as well as acetylene. Atmosphere furnaces have a flammable effluent and produce heat. Vacuum furnaces, although they produce little heat, also have a pump effluent, which can contain hydrogen, methane, and acetylene, plus vacuum pump oil vapor. These are not consumed in a flammable effluent, but emitted into the atmosphere.

Cutting fluids have always been a source of concern on the manufacturing floor. This is not only because they can cause a slippery surface. These fluids contain biocides that reduce foaming, harmful bacteria, and mold, and they contain rust inhibitors. The resulting potential health issues have driven manufacturing engineers to accept dry and/or hard turning/machining techniques that eliminate the cutting fluid. These also have been found to reduce or eliminate distortion after quenching by bringing the part back to pre-process dimension.

Manufacturing and plant engineers have learned to cope with effluents. However, liquids and material handling still pose the biggest headache. Water can be dealt with, but washing after oil quenching and separating the oil from the wash solution is a problem. Finding an efficient way to transport parts from the machining centers to the heat treat cell, even when it’s located nearby, poses a huge obstacle. All manner of push carts and over-and-under conveyors, have been tried, but none so far have completely streamlined the transition from machining to heat treat and back, to post processing, such as grinding and shot peening.

When all things are considered, smaller is better when integrating carburizing into the manufacturing cell, and that leads to a continuous process of small loads.

In the mid-’90s, LPC/HPGQ suppliers, in their effort to penetrate the U.S. auto market, attempted to duplicate the endo gas continuous pusher carburizer by developing in-line walking beam handling systems — with less-than-ideal results. Propane, the carburizing gas of choice then, wreaked havoc with the handling systems and doors due to the carbon precipitate. Acetylene eventually solved the soot problem, but by then users had had enough, and batch systems re-started their acceptance. But again, the larger batch loads, no matter that the furnaces produced little effluent, did not integrate well onto the manufacturing floor. Even though it was a cleaner vacuum operation, they were again relegated to the back room.

Where do we go from here? The carburize/quench process has no choice but undergo a wholesale re-thinking of its material handling and load size if it wants to be integrated into the 21st century, “factory-of-the-future” manufacturing floor. 