HOTSEAT

jack**TITUS**
Director of process and developmental engineering, AFC-Holcroft

Orders are increasing for pusher furnaces for users planning to employ oil press quenching to control distortion.

SEVERAL COLUMNS AGO I SAID WE WERE RECEIVING indications that there was a renewed interest in pusher furnaces for carburizing … well that sure was an understatement. Recently without mentioning names the orders for pushers have exploded and yes they are for gears and associated drive components. And most will be employing oil press quenching to control distortion.

Over the months and years -- believe-it-or-not, it's been that long, -- I've written much about low pressure carburizing [LPC] and high pressure gas quenching [HPGQ] and they still are popular processes for the smaller automotive gears because our sister company has also seen an increase in their activity although not to the same degree. In our case, employing the atmosphere process, endo gas carburizing continues to be the preferred process for large truck-size and larger gears of all types but especially for spiral/bevel gears and pinions.

Material cost is always a subject for consideration and as gears become larger, weight accentuates that problem. Endo gas carburizing offers the gear designer many more heat-treat process options. For example, with LPC and HPGQ, smaller gears are more or less easily processed assuming the hardenability is appropriate, but the pinions, because of their less favorable mass to surface area, makes HPGQ marginal at best thus the heat treat cell will require the additional expense of liquid quenching; pusher furnaces can easily provide for both, press quenching the gears and oil quenching the pinions from the same furnace.

I've opined previously, as dedicated as pusher furnaces are, they remain quite flexible where quenching is concerned. Spiral/bevel gears, generally speaking, require special attention compared to just helical and spur gears due to the nonsymmetrical mass that negatively affects parameters such as flatness and bore taper not to mention tooth run-out. The unequal mass and additional surface area created by the teeth producing heat transfer variations that can only be corrected by the compressive forces generated in a quench press. Tooling cost is the perceived downside of press quenching, however, when reduced material costs of millions of gears and 24/7 production are compared to the alternative of fewer higher alloy parts processed in an HPGQ system, the capital cost and cost per part advantage is significant and accounts for the renewed interest of flexible quench pusher furnaces.

If a pusher system is destined to carburize and free quench pinions and press quench spiral/bevel gears, the discharge end of the furnace will consist of an oil quench tank, vestibule and elevator to lower the pinions into the oil. Ring gears usually will be single or double-stacked on one tray usually with spacers between each gear. If the pusher has two rows one will be dedicated for pinions and the other for gears. Gears will be pushed off into a holding chamber with its own atmosphere control to maintain carbon potential as the door opens and closes. A multi-axis robot will reach in and capture a gear from the stack and place it in a quench press. That same robot or another smaller system can then remove the spacer. If production warrants the first robot can immediately take the second gear and place it in another press. That sequence continues until all gears have been removed and press quenched. Subsequently a device moves the empty tray from the holding chamber to be cooled and reused. After each gear is press-quenched the same robot can remove the gear from the press and place it on the same tray without spacers and move to the continuous washer.

Meanwhile the pinions racked in fixtures to keep them upright having been quenched in the tank are raised and pushed off to the same washer handling the gears. If the gears and pinions require different tempering temperatures after washing, the trays can be separated into their respective tempers or into separate washers prior to tempering.

The sequence I just described may seem complicated but all of the handling motions are either pushing trays or employing very simple ducking/dog conveyors. Robots obviously are more complex to set up and train but once programmed never get sick and don't take vacations. And if all is maintained appropriately -- that is identical as possible going in -- they will be identical as possible coming out.

Pinions because they are not press quenched rely on proper support fixturing and quench oil flow uniformity to control distortion and this is where oil velocity and plenum design become important.

Beyond the control of commercial and perhaps captive heat treaters regarding distortion, are prior processing and pre-machine heat treat. Most of the gear and pinion blanks are made from forgings that many times result in microstructural banding, variations in alloy chemistry that if not corrected by normalizing will predispose a part to move unpredictably as martensite transforms in case and case.

ABOUT THE AUTHOR:

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