HEAT TREATER CUTS HARDNESS TESTING TIME

Carolina Commercial Heat Treating improved quality and saved time and money by adopting microhardness testers that automatically generate case-depth traverses.

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An upgrade in hardness testing technology in 1994 brought about a major improvement in case-depth analysis for Carolina Commercial Heat Treating Inc. (CCHT), Fountain Inn., S.C. Compared with traditional microhardness testers, the state-of-the-art Newage system employs unique depth-measurement technology to speed testing and reduce labor requirements.

54 tests per specimen mount

One high-volume part heat treated by CCHT is a small, 2.3 kg (51b) crankshaft for an air compressor application. The customer's specification calls for CCHT to test nine of the AISI 8620 steel forgings from each basket of 500 after case hardening by the gas carburizing process.

A part is taken from each of the basket's eight corners and from the middle. A cross-sectional specimen is then cut from each crankshaft, and all specimens are molded into a single metallographic mount and polished.

Each of the nine cross sections is microhardness tested using a six-impression traverse - 54 tests per mount. Hardness values are plotted vs. distance beneath the surface of the part, providing case-depth information and verifying the precision of the heat treatment.

Former method costly

In 1994, CCHT's traditional microhardness test procedure was costly and time-consuming due to the large number of tests required. Skilled technicians had to make microhardness impressions using a prescribed load and dwell time. Then, the technician had to view the impression through

Carolina Commercial Heat Treating metallurgist and quality control manager Jack Grochowski checks the microhardness vs. case depth graph generated by an MT90 after testing a heat treated part. The Newage Testing Instruments' system automatically calculates effective case depth for up to three Rockwell-scale test values and verifies that they fall within predefined limits

the tester's microscope eyepiece and carefully measure one or both of its axes, convert the measurement to a hardness value, and record the result. This meticulous and tedious procedure was a source of error, and the skilled operators represented a high labor cost.

At this time, the Fountain Inn plant was using several standard microhardness testers, operated by two technicians, each working 1.5 shifts a day. These operators were responsible for all specimen mounting and polishing operations, as well as microhardness testing and data recording. Typically, it would take 1.5 hours to make and read a mount's 54 impressions. Another half hour was spent plotting the results.

In an effort to reduce testing costs and increase testing accuracy, CCHT evaluated a number of microhardness testing systems, settling on the Newage model M190. 'We looked at everything that was on the market and it appeared to be by far the best, so we went with it," says Jack Grochowski, metallurgist and quality control manager.

Features of new test system

The MT90's features include computer control, digital readout, motorized test cycle, motorized x-y specimen positioning table, and an unconventional test method. The new microhardness tester is based on a Rockwell-type method, but uses a very light load. The testing sequence is identical to that of any Rockwell-type tester: apply preload, apply full load, and read the depth of indentation in reference to the preload. The MT90 can be built to test in any single load: 500 gf., or 1, 2, 3, or 5 kgf. Systems also have been built to test in multiple loads of 500 and 1000 kgf. The tester at CCHT in Fountain Inn is 500 kgf.

Variation in test results increases for most Rockwell-scale testers as the load decreases. For example, a 1 kgf load would be expected to result in erratic readings. But the MT90's indenter is surrounded by a special shroud that references the specimen surface at the preload position. If there is deflection of the test specimen during application of the full load, the shroud maintains the relative position of the preload so that the test result is not affected.

Another concern was the changeover from a traditional microhardness scale to a "sort of" Rockwell scale. However, no problem was anticipated since the case depth specification was called out in a Rockwell-scale value. "When we went to our biggest customers to see if this technology was acceptable, it turned out they already had [the Newage tester] in their plants," adds Grochowski.

A phenolic mount containing polished cross sections from nine heat treated parts can be microhardness tested at one time using the MT90. The operator must first visually locate the edge and orientation of each section on the instrument's monitor. The MT90 computer can then run all nine traverses sequentially without further operator interaction. Note that different, predefined traverse setups can be used for the sections contained in a single mount.

Positive results reported

Based on more than four years of service at CCHT, the MT90 has provided great improvements in speed, accuracy, and utility. For example, the cycle for a single test, including table travel from one position to another, is around 10 seconds. And a 54-impression mount of compressor crank specimens can be tested in 13 minutes, including the time for setup and generating printouts.

To test a mount, the operator first selects the appropriate test file from the instrument's computer, and then selects the starting point for the traverse and the direction the traverse will take for each cross section in the mount, one specimen at a time. Testing is then initiated. The setup process requires about 3 minutes. The x-y table automatically positions the indenter at each test point, after which the test is run and a microhardness value obtained. The cycle repeats until the traverse is completed.

The sequence of test positions is stored in the computer file that the operator selects.

GR&R improved: Microhardness testing accuracy and overall quality have also improved significantly. CCHT's quality control department knew that results obtained using the former microhardness testers were operator dependent. "We could never get them to pass a gage repeatability and reproducibility study," states Grochowski. "The M'99 was shown to be capable using the GR&R as specified by the AIAG [Automotive Industries Action Group, Southfield, Mich.]."

In a real testing environment, the MT90 exhibits virtually no operator influence so readings remain accurate even as an operator tires during the shift. Also, there is no difference in readings between operators on different shifts, and very little difference has been noted between CCHT plants.

Cost benefits: "[The MT90] is 10 times more efficient than our old system," says the CCHT metallurgist. "We were able to take half the people out of that job and put them elsewhere. Also, we are doing three times as much work as before. Additionally, once the test is set up, the operator is able to perform other tasks since the test cycle is automatic."

Other savings result from reduced specimen polishing - the mirrorfinish needed when operators manually measured indentations is no longer required. Another bonus is the system's data storage capability. All results are stored in the computer so that hardness profiles and other reports can be generated at any time, or data from a file can be exported to a database for analysis.

Carolina Commercial Heat Treating was so pleased with its first MT90 that three additional systems were subsequently purchased. **HTP**

For more information: Details on Newage hardness testers can be obtained from Mr. Richard Miller, technical sales representative, Newage Testing Instruments, Inc., 820 Pennsylvania Blvd., Feasterville, PA 19053 Tel: 215-355-6900 Fax: 215-354-1803; email: newage.info@ametek.com website: www.hardensstesters.com.

CCHT also has facilities in Conyers, Ga.; Reidsville, N.C.; and Morristown, Tenn. Information about the company's capabilities is available from Carolina Commercial Heat Treating Inc., P.O. Drawer *1368,* Fountain Inn, *SC 29644-1368;* tel: *864/862-3516;* fax: *864/862-4466.*

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