

New Wear-Resistant Sintered Materials from Tenneco to Reduce Reliance on Cobalt for Engine Applications

SOUTHFIELD, Michigan, March 04, 2020... An innovative new material from Tenneco Inc.'s (NYSE: TEN) Powertrain business group delivers wear-resistant performance with greatly reduced cobalt content, helping engine manufacturers mitigate the limited availability and price volatility of cobalt. Demanding high temperature applications that typically rely on cobalt to provide wear resistance in high temperature ranges, such as heavy-duty turbocharger wastegate bushings, EGR valves, and high performance engine valve seats will benefit from the new material. Using an alternative sintered steel formulation, trials have shown that the cobalt content in Tenneco's sintered materials can be reduced significantly without compromising wear resistance.

"Potential material shortages and controversy around cobalt mining, coupled with extreme price volatility, mean we must reduce our dependence on cobalt," said Gian Maria Olivetti, Vice President Global Engineering, Tenneco Powertrain. "While it remains the most effective material to combat wear in dry running valve seat applications and other components subjected to big temperature ranges, we have used our extensive experience in powder metallurgy to develop a low-cobalt sintered formulation alternative that delivers similar wear properties to the best current materials."

The application temperatures for bushings in EGR valves, turbocharger wastegate systems or exhaust-gas valves can range from below 0°C up to 1000°C, and it is this wide variation that makes the tribology challenging, as Jens Wellmann, Tenneco Powertrain product manager for turbocharger components, explains. "Especially in the lower temperature range up to ~400°C high-cobalt materials can outperform the typical non-cobalt materials. The first question we had to answer was: 'What is the explanation for high-cobalt material's low wear rates?' And the second question was: 'How much cobalt is effectively needed to produce that effect?'"

Tenneco's research started from two well-proven existing sintered products; FM-8100, an iron-based cobalt-free sintered material, and FM-T95A, a cobalt-based (54% Co by weight) sintered material comparable to the cast materials used for tribological applications. Between these two extremes, a total of five materials with varied cobalt content were evaluated for wear performance across a range of temperatures. Investigation of the worn specimen showed that the cobalt-containing Tenneco sintered materials formed a wear-reducing tribolayer at lower

temperatures than the cobalt-free one. This early forming of a stable tribolayer gave the answer to the first question.


Comparing the samples, the same effect was examined on 17 to 35 percent Co materials, which provided the answer to question 2. Based on these results, a new material was developed, designated FM-T88A, a sintered steel with 17 percent Co, which met production and quality requirements, including the manufacturability and mixing of the metal powder, the sintering process, machinability and quality assurance.

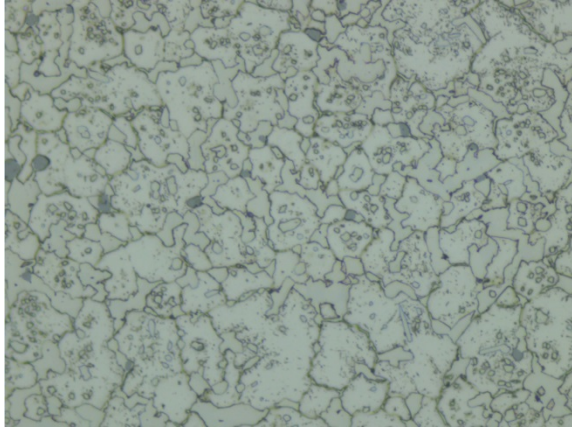
To verify the results of the initial tests, collaborative trials were conducted with a major global vehicle manufacturer comparing the wear resistance of FM-T88A against series production materials. This was undertaken in a test rig which simulated the installation and loading of a turbocharger wastegate bushing running at temperatures up to 800°C.

“The results showed that at 200°C, FM-T88A displays a significantly reduced depth of wear compared to a cobalt-free material and is at a comparable level of wear resistance to the high-cobalt material,” says Wellmann. “At all other temperatures the new material’s performance closely mirrored the high-cobalt materials.”

“With 50 percent of the cobalt mined globally now used in batteries for electrified vehicle powertrains, demand for the material is growing year on year,” said Olivetti. “By minimizing the levels of cobalt used in our wear-resistant high temperature sintered materials, we can help our customers mitigate the limited availability and price volatility of cobalt while still delivering robust products.”

IMAGES:

	<p>As a response to limited availability of cobalt and price volatility, Tenneco’s Powertrain business group is developing wear-resistant materials with greatly reduced cobalt content. High temperature applications such as turbocharger wastegate shaft bushings and EGR valves are currently reliant on cobalt use to provide wear resistance in high temperature ranges and will benefit from the new materials. © 2020 Tenneco Inc.</p>
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Micro structure (x500) of Tenneco's newly developed sintered steel material FM-T88A with 17 percent cobalt content

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About the new Tenneco – the future Powertrain Technology company

Following Tenneco's expected separation to form two independent companies, an Aftermarket and Ride Performance company (DRiV™) as well as a new Powertrain Technology company, the new Tenneco will be one of the world's largest pure-play powertrain companies serving OE markets worldwide with engineered solutions addressing fuel economy, power output, and criteria pollution requirements for gasoline, diesel and electrified powertrains. The new Tenneco would have 2019 revenues of \$11.45 billion, serving light vehicle, commercial truck, off-highway and industrial markets.

Safe Harbor

This release contains forward-looking statements. These forward-looking statements include, among others, statements relating to our strategies and plans to separate into two independent public companies. Forward-looking statements are subject to a number of risks and uncertainties that could cause actual results to materially differ from those described in the forward-looking statements, including the possibility that Tenneco may not complete the separation of the Aftermarket & Ride Performance business from the Powertrain Technology business (or achieve some or all of the anticipated benefits of such a separation); the possibility that the separation may have an adverse impact on existing arrangements with Tenneco, including those related to transition, manufacturing and supply services and tax matters; the ability to retain and hire key personnel and maintain relationships with customers, suppliers or other business partners; the risk that the benefits of the separation may not be fully realized or may take longer to realize than expected; the risk that the separation may not advance Tenneco's business strategy; the potential diversion of Tenneco management's attention resulting from the separation; as well as the risk factors and cautionary statements included in Tenneco's periodic and current reports (Forms 10-K, 10-Q and 8-K) filed from time to time with the SEC. Given these risks and uncertainties, investors should not place undue reliance on forward-looking statements as a prediction of actual results. Unless otherwise indicated, the forward-looking statements in this release are made as of the date of this communication, and, except as required by law, Tenneco does not undertake any obligation, and disclaims any obligation, to publicly disclose revisions or updates to any forward-looking statements. Additional information regarding these risk factors and uncertainties is detailed from time to time in the company's SEC filings, including but not limited to its annual report on Form 10-K for the year ended December 31, 2019. In addition, please see Tenneco's financial

results press release for factors that could cause Tenneco's future performance to vary from the expectations expressed or implied by the forward-looking statements herein.

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