During a 3-D model review of the plant, interference between the already-installed columns and a process conveyor was flagged.

conditioning costs. No chlorofluorocarbons, hydrochlorofluorocarbons, or halons are used in the heating/cooling, refrigeration, and fire-suppression systems.

More than 25% of the construction materials for the plant are composed of recycled content. By sourcing locally for as much of the construction-related materials as possible, GM was able to support the local economy while reducing the amount of fuel that otherwise would have been needed for materials transport.

Only 550 other buildings worldwide have been LEED-certified, and of those only a third are at the gold level. The GM plant is the largest and most complex LEED-certified manufacturing plant. Not included in the certification are the paint and stamping shops, which were previously contracted and constructed.

Kami Buchholz and Patrick Ponticel

Aspex helps detect, characterize micro debris

OEMs and vendors around the world, with those in Germany leading the way, are discovering that manufacturing debris as small as a few microns can wreak havoc on the performance of precision assemblies, resulting in everything from clogged fuel-injection systems to malfunctioning electronic sensors.

In their efforts to fight contamination at the micron-level, manufacturers have experimented with a variety of testing and quality-control approaches, including gravimetry and optical microscopy. Both methods can detect particles larger than 25 µm (980 µin). But manufacturers have discovered that even smaller particles can still lead to major product failures.

There is another limitation to such conventional methods: they cannot determine the elemental composition of particles. To prevent contamination, it is important to know the composition of a particulate so that its upstream source in the manufacturing process can be located and eliminated.

Finally, to be of use in a production environment, the ideal detection and identification system must lend itself to automation. Manufacturers demand a solution that can process high volumes of production samples, using established cleansing and filtering methods, on a 24/7 unattended basis.

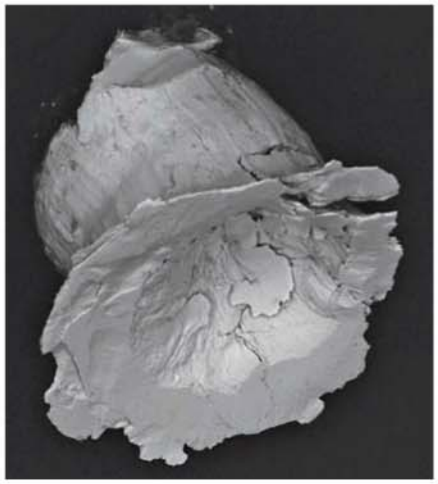
Initially, manufacturers focused their "micro-attention" on diesel-injection systems. But, with the ever-increasing tolerances on precision components and increased use of electronic sensors, the need for automated contamination analysis is becoming widespread across the factory—in the production of everything from brake systems, powertrains, compressors, and transmissions to diesel components, steering cylinders, and electronic sensors.

Working in conjunction with several leading OEMs and vendors in the United States

The Aspex AQC system integrates scanning electron-beam and energy-dispersive X-ray technologies with automated control and statistical analysis software. The system is capable of identifying and characterizing debris as small as 0.1 µm (4.0 µin) and Germany, **Aspex** developed an automated solution to factory-floor microanalysis integrating scanning electron-beam and energy-dispersive X-ray technologies with automated control and statistical analysis software. The system is capable of identifying and characterizing debris as small as 0.1 µm (4.0 µin).

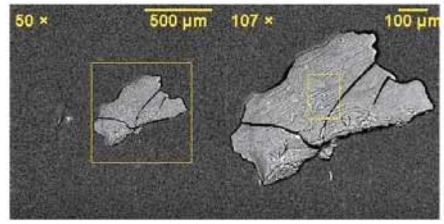
While zero contamination remains the ideal vision, manufacturers are just beginning to understand what levels of cleanliness are acceptable for different components. They are utilizing the Aspex AQC system to develop a process of continuous improvement that allows the cleanliness effort to improve as information is generated and studied over time.

The process begins with the testing of baseline samples from all phases of manufacturing—from the receipt of materials through final assembly. This step determines the representative sizes, shapes, and compositions of debris particles. The technique of passing a cleaning fluid through a membrane filter is the estab-



This low-alloy-steel particle of 120 µm (4700 µin) diameter was found in a diesel-injection nozzle. Forensic examination of various components in the system after rinsing led to the conclusion that the debris originated in the high-pressure pump.

lished method for ensuring a representative population of residual particles. Samples can also be obtained from other



This is an example of a "killer" particle as displayed on the Aspex AQC system. More than 1.0 mm (0.04 in) in diameter, it was found in a steering cylinder. Utilizing its energy-dispersive X-ray capabilities, the system was able to identify the particle as a piece of hard rubber containing sulfur and residual steel particles. The particle is from a coated spring mechanism inside a connector.

fluids such as motor oil, gasoline, and hydraulic fluid.

The Aspex ASC system incorporates a dedicated interface that performs time-consuming micro-navigational searching, measuring, and elemental analysis in a completely unattended manner.

One of the first applications was in a new high-pressure common-rail diesel-injection system. The technology was developed by German engineers attempting to build diesel engines with improved fuel performance, reduced hammering, and enhanced acceleration. With these improvements came new challenges, including new types of system failures. Using ASPEX AQC, quality-control engineers determined that microcontamination was causing many of these failures.

VDA, the leading German automotive trade association, together with other regulatory bodies in Europe, is evaluating a new set of specifications on particulate cleanliness. Once these are finalized they are expected to become new **ISO** standards for all important aspects of cleanliness analysis. This will allow precise purchasing specifications to be established by manufacturers. The new ISO bin size table, including size histogram tables, is available at http://www.vda.de/en/vda.

David C. Castaldo of ASPEX and **Bernhard Heneka** of RJL Micro Analytics wrote this article for *AEI*.

New materials spur manufacturing concerns

OEMs have offset the weight ramifications of safety regulations with ever-higher levels of standard equipment via various light metals and new alloys. But the introduction of new materials has brought manufacturing considerations.

"To reap the full financial benefits of this production solution, manufacturers need to ensure that their tools and metalworking fluids are able to cope with the pressures of machining tougher metals," said Charsten Wienbreyer, metalworking specialist with **Shell Lubricants**. "If not, they risk facing long periods of unscheduled stoppages and high levels of component and equipment damage."

One significant method of protecting against these risks is by using a high-performance, fit-for-purpose metalworking fluid, he said. Metalworking fluids play an important role in the smooth and efficient running of all automotive component manufacturing equipment as well as the successful formation of the finished part. The extreme temperatures, high level of chipping, and long, continuous operational hours of metalworking processes such as deep hole drilling, turning, and broaching place multiple demands on the fluid.

"Manufacturers need to ensure that their tools and metalworking fluids are able to cope with the pressures of machining tougher metals," said Charsten Wienbreyer, metalworking specialist at Shell Lubricants.

"It must provide lubrication, flushing, and cooling properties not only to protect the tool part from accelerated wear but also the finished part from surface damage and deformation," said Wienbreyer.

For decades, many fluids were formulated using chlorine because it provided required performance, even in low temperatures, protecting the tool and part against wear and damage. But with the banning of chlorine for such applications in the early 1990s, fluids are now developed using different Extreme Pressure (EP) additives.

"These allow them to meet specific operational requirements, providing operators with greater performance," said Wienbreyer. "Increasing the strength of the metal that is being machined will in turn lead to an increase in cutting duration, temperature, and chipping.

In general terms, there are four types of fluid used in metalworking: neat oils and soluble oils, each in synthetic and semi-synthetic form. Selection of the appropriate fluid depends on a number of variables specific to the cutting process and type of metal being machined. These include the size of metal chips, cutting speed, duration, and tolerance.

"A high wetting, anti-weld and anti-corrosion, water-miscible metalworking fluid such as Shell Adrana A 2859 is required during deep hole drilling to flush chips from the cutting area and stop them from welding to the drill tool or part being drilled. A specialty product, such as Shell Sitala B 5801, with high resistance to water hardness and increases in pH levels, is required to meet the challenges of machining magnesium alloys," said Wienbreyer.

Wienbreyer and his team advise automotive OEMs and suppliers in auditing the cutting process and identifying fluid demands: "This helps to determine the required EP rating, wetting, cooling, anti-corrosion, and flushing performance of the fluid.

Stuart Birch