thermo scientific

Automotive Part Cleanliness

A case study

The Problem:
Automotive engineers have created remarkable advances in the functionality and reliability of transmissions, fuel injection systems, power trains and braking systems. Along with the benefits introduced by these components, new challenges have presented themselves. One such case was with a Fortune 50 automobile manufacturer in which key components became increasingly susceptible to residual micron-size particulate contamination. Field failures increased as did a growing concern that their current practices of monitoring cleanliness by gravimetric testing and optical inspection were insufficient.

The Investigation:
Production Engineers at the plant began by developing a study focused on understanding the levels and sources of contamination present in their manufacturing process. The tight tolerances between moving parts and the small dimensions of a new assembly led engineers to conclude that quantity, size and shape were all critical factors in understanding what was happening in their processes. They also discovered that a steel shaving was considerably more detrimental to their component than a dust particle of similar dimensions. As a result, it was determined that elemental composition of the particulate was also a key factor in developing new standards in cleanliness.

Conclusions:
It was determined that the current practices of using gravimetric and optional methods to monitor particle contamination were outdated and could no longer provide the insight into preventing field failures. This was mainly due to the fact that not only smaller and smaller particles were causing issues, identifying the root cause of the particles was paramount in eliminating future issues.

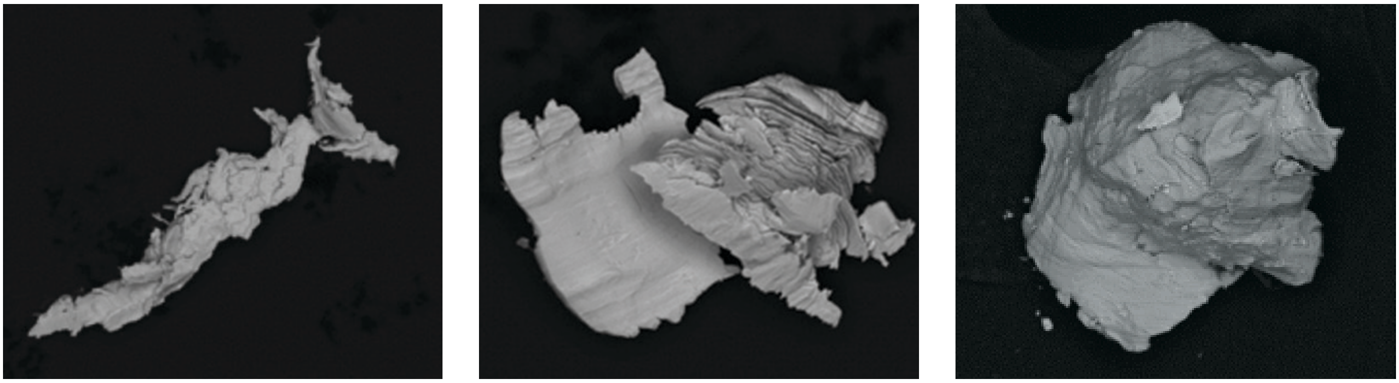

Figure 1. SEM Images of particles found on automotive parts.

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The Solution:

A cleanliness monitoring process was put in place using Thermo Scientific™ Explorer™ 4 Analyzer with CleanCHK Software. The CleanCHK system provided the means by which engineers could measure their performance against the cleanliness standard. The process used by the engineers began with collecting samples using a 47 mm diameter membrane filter with pore sizes between 0.3 and 20 µm. To ensure a representative sample was collected, cleaning fluid from each part was passed through the filter using vacuum filtration. The filters were then placed directly in the CleanCHK system using a 4-filter sample holder.

The CleanCHK reporter allowed easy management of the data produced from the analyzer. The reporting was based on the pre-set internal standards and presented in pre-determined templates, which assured reproducibility from user to user as well as filter to filter. Component specifications in this manufacturing plant are expressed today in the following format: particles present should (1) have a value less then X mg/surface area, and (2) no particle larger than X may be present, and (3) no more than X particles may be present with sizes between X microns and X microns. Compositional analysis for each particle was also monitored based on size and shape of the particles in relation to a particular chemistry. Compositional information allowed for pinpointing the issues even faster. This has helped the manufacturer to reduce field failure rates by 75%, which has led to an increase in customer satisfaction.

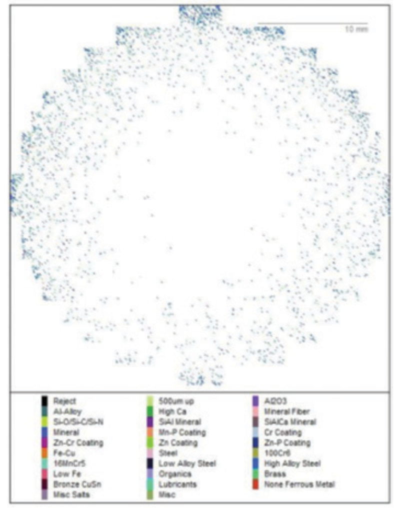

Figure 2. Particle Map.

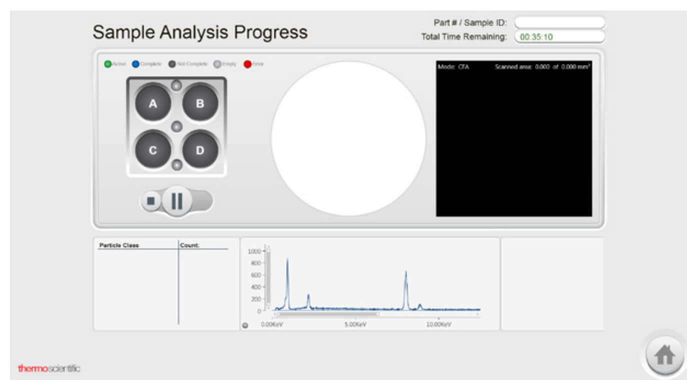

Figure 3. CleanCHK Run Screen

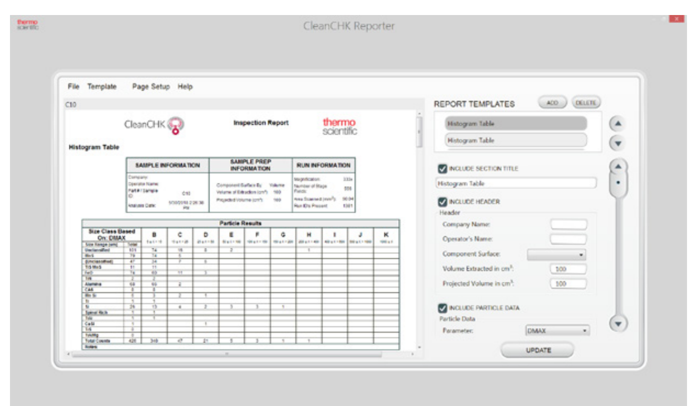

Figure 4. CleanCHK Reporter.

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