Contaminant Particle Identification and Elimination

The Particle Contamination Problem

Most industries have problems with particle contamination from time to time in their processes. They can have many sources, such as cross-process contamination, corrosion products or be of biological origin. They can appear unexpectedly and be on product surfaces or mixed into solids, liquids or gases.

In manufacturing industries, the process of identifying the source of particle contamination is vital to eliminating the problem. This can be achieved by isolating, characterising and identifying the particles. At LPD Lab Services we have extensive experience in these processes both from our own manufacturing on-site and performing this type of work for external customers from a wide range of industry sectors.

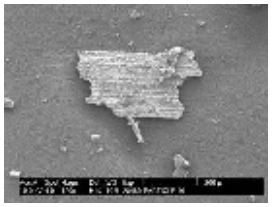

Fig.1. An example of a metal oxide particle containing distinctive machining track marks in the oxide layer (scale bar 200 µm).

Particle Identification

This technical note highlights the main steps involved in the identification process and determining the source of the contamination, which is summarised in Figs. 2 and 4.

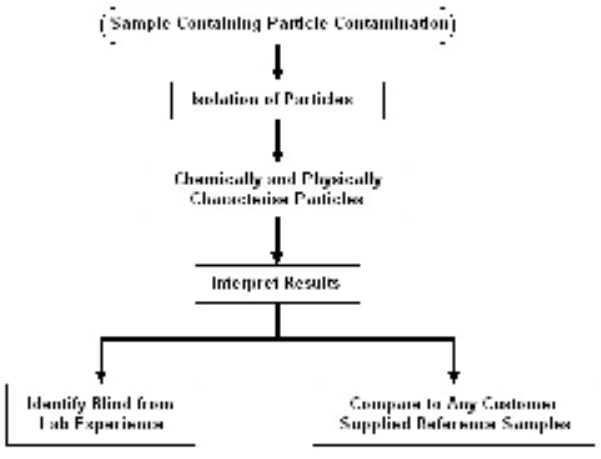

Fig.2. Flow chart explaining the particle identification process.

Isolating then characterising the range of particles present is the first step to eliminating the issue. The particles are usually characterised by a combination of analytical techniques, for example SEM/EDX, FT-IR and optical microscopy determined by the chemical nature and precise characteristics of the particle itself.

Once this has been performed, the next stage is to identify the likely source. The particles can be type matched against reference potential sources of particulates in a customer's process or identified 'blind' using the laboratory's experience. In both cases the laboratory provides potential reasons for the generation and characteristics of the particles. This is of particular importance when the particles are discovered further down the process and they may have changed from their original form in the process, for example by heating or mechanical abrasion.

Where multiple categories of particles are identified, these can be counted and sorted into a Pareto plot to allow the most significant or process damaging particles to be tackled first (Fig.3.).

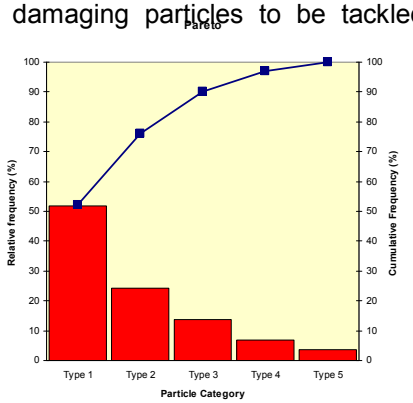

Fig.3. An example of a Pareto plot identifying the frequency of each type of particle and ideal for prioritising particle elimination actions.

(* denotes UKAS accredited test)

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– a unique combination of analytical equipment, techniques, and investigative experience

Particle Tracking to Source

The laboratory is normally able to speculate where the contamination *may* have come from. However, the seriousness of the problem or industry / regulatory requirements often warrants conclusive tracking back to a specific source. Generally the method used by the laboratory is summarised in Fig.4.

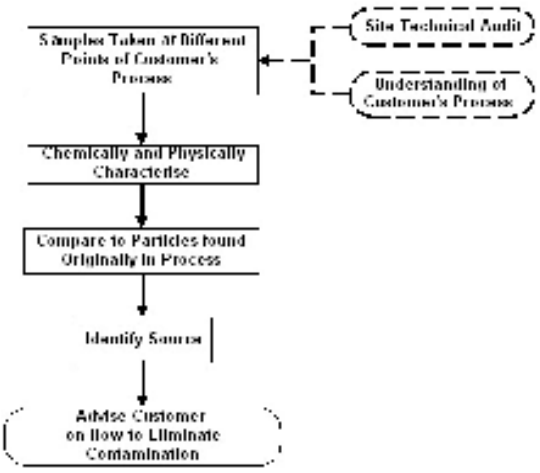


Fig.4. Flow chart explaining tracking the contamination source and the elimination Process.

Confidential detailed discussions can be conducted with the customer to provide further information about each stage of the customer's production process. This often yields recommended places to take reference samples for type matching against. These may be sampled by the customer at various stages back through their process, or by an onsite site technical audit by the laboratory staff. Site technical audits themselves often lead to sensible recommendations such as how to reduce contamination risks and enable the laboratory to provide a fast and effective turn-key solution to contamination control and elimination.

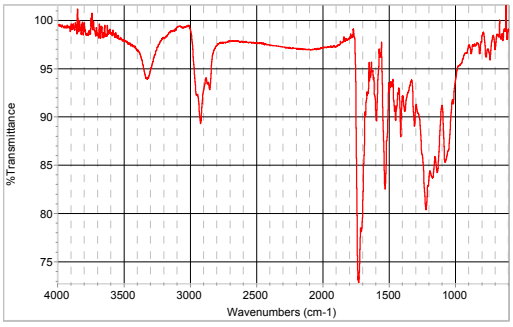


Fig.5. Example FT-IR spectrum of organic particulate contamination identifying it as cosmetic fragments from make-up.

Contamination Elimination

The reference samples taken from strategic points in the customer's manufacturing process are then physically and chemically characterised, using similar methods to those used to identify the original contamination.

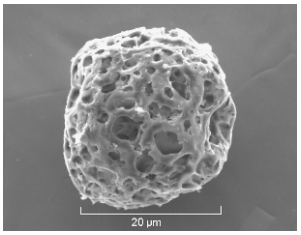
This can lead to rapid elimination of possible candidates and identify the source, such as decaying pipework or gaskets or contaminated feed material.

LPD Lab Services can then advise the customer of further actions they should take to contain or eliminate the problem with a view to minimise the chance of this particulate contamination reoccurring.

Case Study - Pollen Grain Contamination

The image shows a particle on the surface of a metal grid on an electron gun from a cathode ray tube. The gun had failed for an electrical insulation leakage between adjacent gun lenses and during dismantling of the gun, a few fine particles were seen in the gap between these grids.

Fig.6. An SEM image of a graphitised pollen grain contaminant particle.



SEM / EDX analysis showed it to contain mainly carbon, with small amounts of oxygen and sulphur.

The composition and appearance identified it as a charred pollen grain. The component had been dried in an oven at 140°C after a wash process and the particles had emanated from the air intake of the oven. The solution was to fit a filter to the fan system to prevent future contamination ingress by this means.

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Find out how we can help solve your problems in process improvement, process control and materials analysis

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