Case Study

Metallic Contamination Identification Using a Portable XRF

Background

After a spate of metallic contamination issues, we were approached by our customer who wanted to understand the elemental composition of the various components and equipment on their primary production lines. Knowing the respective compositions, it was hoped that future contaminants could be identified and therefore atributed to a specific area of the manufacturing environment or a piece of production line equipment.

Figure 1
On-site elemental analysis of an internal component on the production line.

Approach

In order to undertake the development of an equipment composition library, any technique used needed to be portable and able to be taken on-site. There was one technique ideally suited – a portable X-ray microfluorescence spectrometer.

X-ray microfluorescence (XRF) is a non-destructive analytical technique used to identify and determine the concentrations of elements present in solid, powder or liquid samples. A spectrometer measures the individual component wavelengths of the fluorescent emission produced by a sample when irradiated with X-rays.

The portable Bruker Tracer IV-SD X-ray microfluorescence spectrometer can detect elements from magnesium through to uranium and is ideally suited to analysis of metallic objects, particularly the alloys of iron, copper and aluminium. Its portability means that it can be used to analyse components in-situ (Figure 1) as well as components that may have been removed for servicing or during a deep clean (Figure 2).

In excess of 150 separate components or pieces of equipment were analysed to create the library.

Figure 2
On-site elemental analysis of a component removed during the deep-clean of the production line.

Results

The on-site analysis of over 150 separate components or pices of equipment determined that the vast majority were chromium nickel stainless steels, mainly from the SAE 300 series alloys (Tables 1 & 2).

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Table 1

Si	Cr	Mn	Fe	Ni	Cu	Mo
0.0	14.2	1.4	72.8	8.7	0.0	2.4

Elemental composition typical of an SAE series chromium nickel stainless steel. The elemental ratios and level of molybdenum is indicative of SAE 316 stainless steel, an alloy specifically used in food and pharmaceutical manufacturing due to its resistance to certain types of corrosion.

Table 2

Si	Cr	Mn	Fe	Ni	Cu	Mo
0.5	17.9	2.1	69.0	9.5	0.4	0.3

Elemental composition of an SAE series chromium nickel stainless steel. The elemental ratios and low level of molybdenum is indicative of SAE 304, the most commonly used stainless steel alloy.

Summary

The portable XRF was taken to our customer's site to map the elemental composition of different components in the preparation and production equipment.

A total of 150+ components were analysed, the analysis determining that there were three main metallic alloys:

- Copper alloys (bronzes)
- Plain steels
- Chromium nickel stainless steels

Chromium nickel stainless steel was the most commonly used material; the analysis determining that SAE 300 series alloys were most prevalent.

A site specific database has been created which can be used as a benchmark when trying to identify and determine the provenance of subsequent contaminant metallic particles.