



The mPulse+ analyses a wide variety of metal alloys in just one second.

Latest advances in portable elemental analysers

Aluminium is one of the most commonly recycled materials in the world. From scrapped drinks cans to end-of-life jets, aluminium is increasingly recycled and reused as raw material for new products. Therefore, it is becoming ever more important to not only value scrap material correctly but also identify potentially hazardous and unwanted elements, thus raising the bar for analytical instrumentation. Latest developments in portable elemental analysers make it possible to sort and analyse scrap aluminium much more effectively than in the past.

There are two sources of aluminium for the manufacturing industry: mining and recycling. Refining aluminium from bauxite ore consumes a huge amount of energy; indeed, it has been estimated – and widely publicised – that recycling scrap aluminium uses less than 5% of the energy compared to mining bauxite and refining it into metallic aluminium. For this reason, aluminium has become one of the most recycled metals in the world. Today, more than 30% of the raw material required by the aluminium industry in the USA, for example, comes from recycled material and this proportion is only likely to grow.

There are numerous commercially-available aluminium alloys, each designed for a specific purpose. Typically, aluminium alloys are used where lightness and high structural strength are required – for example, in the aerospace and automotive industries. Alu-

minium is also used in marine applications where the resistant nature of certain aluminium alloys plays an important role.

Aluminium alloys obtain their characteristic performance from alloying elements such as magnesium, silicon, copper, manganese, zinc and lithium. However, the same elements that make the aluminium alloys durable, weather-resistant and easy to machine can become undesirable when the material is recycled.

The purer the aluminium raw material, the easier it is to recycle. Typically, alloys with >99% aluminium content are considered to be 'pure' and have the highest value when being recycled.

Excellent tools for scrap yards

To control the quality of an end product, it is important to know the content of alloy-

ing elements before adding scrap material into the melt and it is equally important to protect the process from potentially hazardous materials such as lithium. Compared to sorting and identifying stainless steels and other heavy alloys, aluminium sorting has always set challenges for analytical instrumentation. Traditionally, scrap aluminium has been sorted using handheld X-ray fluorescence (HHXRF) spectrometers that provide fast and accurate analysis combined with true portability and ease of use. These instruments can be calibrated for a wide range of elements and concentration ranges, which makes them excellent tools for scrap yards where unexpected samples and exotic alloys are frequently found.

Today, HHXRF instruments are the most commonly used tools to identify and sort scrap aluminium, but there are some com-

mon limitations with the technology. Some of the alloying elements in aluminium scrap are very challenging for even the latest generation of HHXRF instruments. Magnesium and silicon, for example, emit very weak signals when excited by X-rays, which in practice means longer analysis times are needed. Even then, it is sometimes difficult to separate alloys with quite similar chemistry according to their magnesium or silicon content. This is certainly the case with the important 6000-series marine aluminium alloys for which analysis time can become a critical bottleneck in the process when high efficiency and throughput are directly proportional to the profit made.



The X-MET8000 presents the latest and most advanced generation of handheld XRF instruments by Oxford Instruments. This includes state-of-the-art silicon drift detector for superior performance on a wide range of elements from magnesium to uranium, down to 0.001%.

Meanwhile, portable instruments using optical emission spectrometry (OES) present 'the-best-that-money-can-buy' technology when the highest level of performance is required for both light alloying elements and trace-level analysis of unwanted elements. The downside of OES technology is that it is not very practical in scrap yard conditions where portability and ruggedness are required. For this reason, OES instruments are typically used in scrap yard labs rather than in the yards themselves. Optical emission spectrometry also requires careful cleaning

of the sample surface prior to taking a measurement – a task that can be challenging in the scrap yard environment. However, there's no substitute for OES when the highest level of accuracy is required.

LIBS for aluminium recyclers

Laser-induced breakdown spectroscopy (LIBS) presents the latest technology available for identifying and sorting many different alloy types from aluminium alloys to stainless steels, nickel superalloys and many more. LIBS instruments use a miniature pulsed laser to vaporise a tiny amount of the sample (typically less than one billionth of a gram), leaving a barely-visible burn mark on the sample surface. During the process, high-temperature plasma is created; when the plasma cools, each element emits light of a specific wavelength. From this information, the elements present in the sample can be identified and quantified.

LIBS has many benefits over traditional analytical equipment used to sort aluminium alloys, not least because it is extremely fast: whereas it takes typically 5-15 seconds for a HHXRF instrument to correctly identify an aluminium alloy, a LIBS analyser can make the same measurement in just one second. LIBS also provides excellent results for the most important light alloying elements – including aluminium, magnesium and silicon, which are typically very challenging for HHXRF. This means that, by using LIBS, it is not unrealistic to expect productivity to increase by a factor of three to five in real-life scrap aluminium sorting applications.

Analytical range expanded

LIBS is also safe to use and in many countries it has less stringent and troublesome user certification procedures as compared to HHXRF. When analysing aluminium alloys with an X-ray instrument, certain precautions are required to ensure that the operator is not exposed to scattered X-rays. For example, an aluminium sample should never be held in the hand when analysed using HHXRF. Being laser-based, a LIBS instrument does not

PRODUCT HIGHLIGHTS

Company

Oxford Instruments

X-MET8000

- Presents the latest and most advanced generation of handheld XRF instruments.
- Large area silicon drift detector for excellent performance down to 0.001% levels. Analyses up to 35 elements simultaneously from magnesium to uranium.
- Truly rugged and fit for purpose: IP 54 (Nema 3 equivalent) for dust and water protection.
- Point-and-shoot analysis.

mPulse+

- Designed for scrap sorting.
- Laser-induced breakdown spectrometry, so no X-rays.
- Fastest alloy sorter on the market at just one second, regardless of the alloy type.
- Functional simplicity: point, shoot, result.

PMI Master Smart

- Truly-portable optical emission spectrometer that weighs less than 15 kg.
- When the highest level of performance is required, this provides accurate analysis down to 0.001%.
- Capable of analysing carbon.
- Truly cordless with long-lasting battery pack.

emit potentially harmful ionising radiation and therefore such limitations do not exist.

LIBS expands the analytical range beyond the capabilities of HHXRF instruments by analysing elements such as lithium and beryllium. Lithium is an important alloying element in light aerospace alloys, increasing the structural strength while making the alloy even lighter than pure aluminium. When recycled, lithium can be very dangerous to the process because its reducing nature can cause significant damage to the furnace costing hundreds of thousands of dollars or even more. With LIBS, aluminium-lithium alloys can be rapidly identified, extracted from the



Oxford Instruments provides a full range of analytical instruments to cover all aluminium recycling needs: from rapid identification and sorting to detecting ultra-low levels of unwanted contaminants.

CHOOSING THE RIGHT TECHNOLOGY

I want to....	LIBS	HHXRF	OES
have a small, lightweight and portable analyser	★★★★	★★★★	★
accurately determine the full chemical composition of aluminium alloys	★	★★	★★★★
analyse penalty and trace elements down to < 0,1 % level	-	★★	★★★★
analyse samples with minimal sample preparation	★★	★★★★	★
bring the analyser to the samples	★★★★	★★★★	★
have minimum hassle with certifications and approvals	★★★★	★	★★★★
rapidly sort Aluminium alloys	★★★★	★★	★
detect Lithium in Aluminium alloys	★★★★	-	-

scrap stream and subsequently treated appropriately.

As with all techniques, LIBS has its limitations. Owing to the technology, LIBS instruments are calibrated empirically using certified reference samples. This sets certain limitations as compared to HHXRF instruments that use fundamental parameter calibrations and can have up to 35 elements analysed simultaneously with a full 0-100% analysis range. This limitation does not typically affect most applications but can become an issue when analysing very low concentrations of below 0.05%, and when spotting ex-

otic and unexpected elements is important. In these cases, HHXRF technology is the recommended option.

The requirements

For elemental analysis in scrap yards, HHXRF, OES and latest addition LIBS each have their strengths and limitations; no technology alone can meet all the requirements set by the aluminium recycling industry. HHXRF and OES are both very mature technologies, and their performance and capabilities are well known and accepted. Handheld LIBS on the other hand is a new, very promising tech-

nique that can potentially replace HHXRF instruments in large part and even expand into markets that are out of reach for HHXRF and OES today.

When choosing the right tool for the job, it is important to carefully consider the requirements. Which elements are required for analysis and at what levels? How large are the volumes? How critical is analysis speed? And are X-rays an issue? When the strengths of the HHXRF, OES and LIBS technologies are combined, even the most demanding requirements for the aluminium industry can be met – from trace-level contaminant analysis to fast and accurate identification of the alloys, and just about everything in between.

Oxford Instruments offers a full range of instruments capable of addressing the highly demanding needs of the aluminium recycling industry.



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www.oxford-instruments.com/scrap-analysis