Delivering Value to the Aluminum Industry

Thermo Scientific XRF Portable Analyzers and GOLDD Technology Accurately Identify and Analyze Aluminum Alloys

The attractiveness of aluminum, element number 13, lies within its unique properties including its light weight, high strength, excellent corrosion resistance, good formability, high electric and thermal conductivity, reflectivity, and non-toxicity. This element can easily be alloyed with other elements to enhance its properties and is widely used in the construction, automotive, aerospace, and packaging industries, among many others.

At less than 150 years in commercial use, aluminum is one of the youngest industrial metals. It is produced by the electrolytic reduction of alumina (Al_2O_3) and the subsequent conversion into semi-finished and finished products by a variety of shaping processes such as extrusion, rolling, forging, and casting. Based on the method of shaping, aluminum alloys can be divided into two major groups, namely, wrought and casting alloys. Subsequently, finished products are incorporated into consumer and industrial goods. The aluminum produced directly from alumina is referred to as primary aluminum; however, aluminum can also be produced from scrap, in which case it is called secondary aluminum.

There are also two types of scrap in the aluminum life cycle. Scrap generated during the production of finished and semi-finished products is defined as primary scrap, while scrap generated once consumer and industrial goods have reached their end-of-life is known as secondary or post-consumer scrap.

Aluminum Scrap in the Spotlight

In recent years, there has been a strong push to increase the amount of scrap incorporated into the production of aluminum. Manufacturing aluminum from scrap has several advantages over producing it from alumina. The energy and green-house emissions savings alone are staggering (95%). The production of secondary aluminum allows businesses to comply with environmental regulations, such as REACH and LEEDs without any loss of quality. As a result, the industry is shifting toward a goal of 75% scrap integration into its production, with a substantial post-consumer scrap portion. Novelis, a major aluminum manufacturer, has announced that it plans to incorporate 80% scrap into its production by the year 2020[1].

In parallel to the growing usage of scrap, we are witnessing a growing demand for aluminum, propelled by the industrialization in emerging markets and the growth of the automotive industry. Global constraints on primary aluminum production coupled with the market developments described above are creating an increasing and significant demand for aluminum scrap.

However, the addition of scrap into the aluminum production line represents a major challenge for the industry and creates a considerable opportunity for handheld x-ray fluorescence (XRF). Compared to the clean, neatly-packaged, and well-defined alumina raw material that manufacturers are used to, post-consumer scrap represents a new variable that is thrown into the melt. The exact chemical composition of scrap, and with it the existence of hazardous elements, is unknown.

Thermo Scientific Geometrically Optimized Large Area Drift Detector (GOLDD) Technology Benefits at-a-Glance

- Rapidly identify a wide array of aluminum grades
- Achieve unrivaled light element performance
- Prevent contaminants from entering the melt
- Increase the value of your scrap
- Optimize your feed material

As a result, end-product quality, process integrity, safety, and regulatory compliance are jeopardized. There is a need to add additional check points along the process. Handheld XRF helps answer that need.

Handheld XRF – The Value Proposition

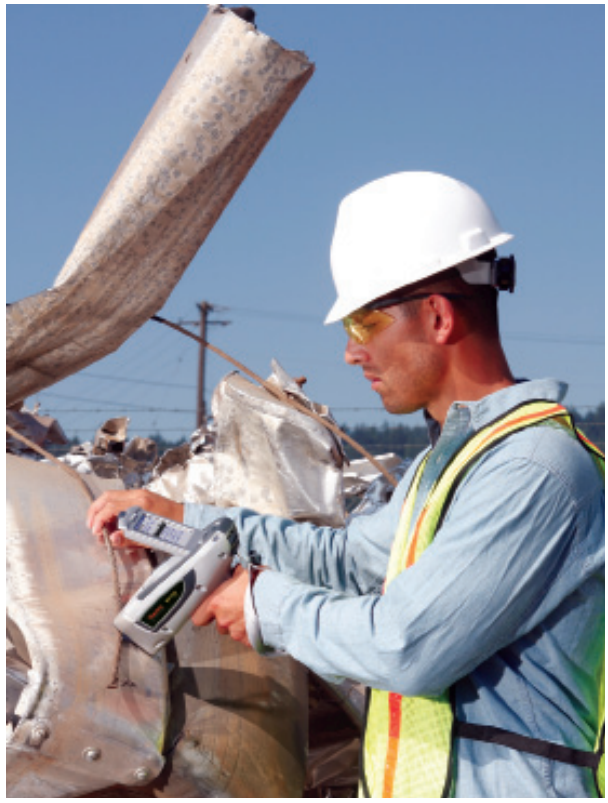
To fully understand and appreciate the immense value that handheld XRF brings to the aluminum industry, it makes sense to look at it from the perspective of its two key end users, namely scrap yard recyclers and secondary smelting operators.

Scrap Yards

Most recycled aluminum involves a mixture of various wrought and casting grades. Subodh[2] has demonstrated that even when wrought scrap has been segregated, individual lots may still have widely varying compositions due to the large number of applications and industries from which the scrap has originated. While posing a small problem for further production of casting-grade alloys, which are less sensitive to compositional fluctuations, this can be a major problem for the secondary production of wrought alloys. The fact that a given lot of scrap has originated from the same application (e.g., automotive), by no means provides any guarantee that the grade contents are similar. To illustrate this point, the bumper alloy 7029 contains a higher level of zinc (Zn), while the autobody alloy 2036 contains higher copper (Cu) levels. Similarly, the mixing of casting with wrought alloys can result in undesirable elevated amounts of silicon (Si). Equipping scrap yards with a rugged, easy-to-use, portable tool that can positively identify numerous aluminum alloy grades and rapidly analyze their chemical composition at material transfer points gives them several advantages.

Gain a competitive edge

Handheld XRF gives scrap yard owners a competitive edge by empowering them to respond to their customers' needs. The tight compositional requirements dictated by aluminum manufacturers are likely to cascade down the supply chain, that is, to the scrap yards.



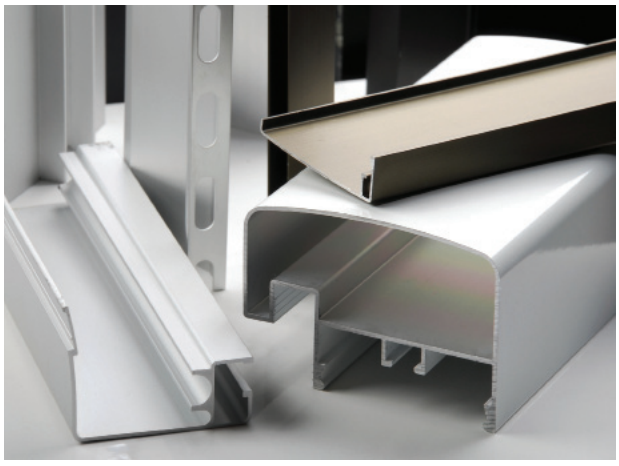
Reliable aluminum analysis in the palm of your hand with Thermo Scientific GOLDD technology

Reduce business risks

Delivering misidentified grades to secondary aluminum smelting operations carries certain risks to scrap yards. Mixed loads may not be tolerated, resulting in a negative outcome that could include downgrading the load, outright refusal of the load, or, worst case scenario, complete loss of the account. The ability to analyze the scrap prior to delivery significantly reduces these risks.

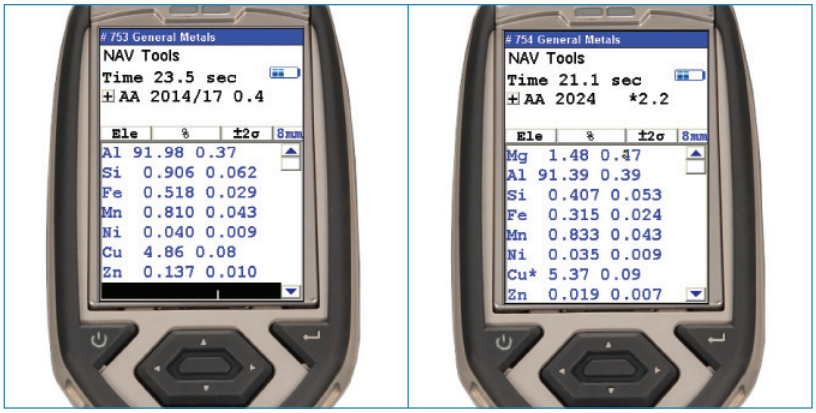
Maximize profitability

Aluminum prices may vary significantly, even within the same alloy family. Small variations in composition can result in significantly different and unique mechanical



Wrought versus cast aluminum

properties. For example, aerospace alloy grades, such as 2014, 2024, 7055, and 7449, have been designed for specific functions that are not interchangeable. Luckily, handheld XRF analyzers can easily separate these grades. As a result, scrap yards can command a premium when batches are sold locally, rather than selling the "mixed" load at lower prices to overseas markets. In another example, alloys 6061 and 6063 are some of the most popular aluminum alloys used in a wide variety of applications, including the construction and automotive industries. Considering the price differential of these alloys, one could easily see the profit potential in properly segregating these alloys when processing several thousand pounds of mixed material.



Accurately separate twin alloys with handheld XRF

Secondary Aluminum Manufacturers

For secondary aluminum operations, the ability to quickly determine and fine-tune the composition of the feed material has a tremendous advantage from a safety, regulatory, and cost-savings perspective.

Contaminant prevention

The chemical composition of the feed material can have a critical impact on the properties of the melt (viscosity, solubility, melting temperature), integrity and longevity of the furnace, end-product specifications, plant emissions, downtime, and safety of the operating personnel. Therefore, preventing contaminants from entering the melt can have a direct impact on any of these properties. As an example, the major alloying elements in 6061 and 6063 are magnesium (Mg) and Si, and their maximum Zn content must be kept below 0.1 and 0.25%, respectively. With the help of handheld XRF, it is possible to quickly remove any Zn-containing scrap, such as alloys from the 7000 series, and thus prevent downtime due to furnace contamination.

In another example, a mixed load of 6000 series material can also include alloys such as 6262 and 6033, which are used in similar applications, but contain trace amounts of lead (Pb) and/or bismuth (Bi). Without the aid of mill stampings or markings, visual inspection alone is not a reliable method for separating these materials. Therefore, larger amounts of this material mixed in a load can be detrimental to a melt if the undesired elements introduced are above the mill's specifications.

Material feed optimization

Based on availability, a secondary aluminum smelter may vary the ratios of feed grades used to produce a final alloy. In a simplified example, grades 1100, 3003, and 5052 can be mixed to produce grade 3105, in a wide range of ratios and combinations. With the help of handheld XRF the operator can select the least-cost grade combination, thus maximizing margins.

Raw material sourcing

Handheld XRF can be used to recover the value "locked up" in scrap. Prior knowledge of the type and quantity of trace elements in scrap can wisely be built into the logistics of raw material purchasing and reduce the need to source expensive additives. For example, alloys 2014 and 2024 are similar, with varying contents of Mg. The variation can be as low as 0.4% or as high as 1.6%, depending on individual lots. Thanks to handheld XRF technology, these two alloys can be separated. The difference in value between these two alloys, from an Mg-sourcing perspective, can translate into a nearly $900,000 annual savings, based on a daily turnover of 200,000 pounds and an Mg pricing of $/lb.1.5.

Trade Name	Si Min	Si Max	Fe Min	Fe Max	Cu Min	Cu Max	Mn Min	Mn Max	Mg Min	Mg Max
2014	0.5	1.2	0	0.7	3.9	5.0	0.4	1.2	0.2	0.8
2024	0	0.5	0	0.5	3.8	4.9	0.3	0.9	1.2	1.8
3003	0	0.6	0	0.7	0.05	0.20	1.0	1.5	—	—
3004	0	0.3	0	0.7	0	0.25	1.0	1.5	0.8	1.3

Twin alloy separation examples based on light element content

Thermo Scientific GOLDD Technology – Superior Grade ID

Thermo Scientific handheld XRF analyzers with Geometrically Optimized Large Area Drift Detection (GOLDD™) technology bring lab-quality performance to scrap yards and aluminum manufacturers, by delivering excellent in-family alloy grade ID and light element (Mg, Al, Si, P, S) quantitative analysis. This remarkable technology, available on Thermo Scientific Niton XL2 GOLDD Series and Niton® XL3t GOLDD+ Series analyzers, provides low detection limits, uncompromised reliability, and rapid analysis, all without He-purge or vacuum, inside a portable, robust, and easy-to-use handheld device. A built-in library can be easily expanded and adjusted to meet your specific needs.

Discover the Value

All in all, handheld XRF offers a nondestructive and robust technology to provide rapid, on-site, scrap sorting. As we continue to witness the increasing importance of scrap in the production of aluminum, there will be a growing need to install additional checkpoints along the supply chain to prevent contaminants from entering production. Achieving this early in the process, that is, before any unwanted scrap can even enter the supply chain, can help both minimize errors and protect the reputation of the suppliers. Handheld XRF is an indispensable tool for achieving these critical tasks, as well as in recovering the locked-up value in scrap.

To discuss your particular applications and performance requirements, or to schedule an on-site demonstration, please contact your local Thermo Scientific portable XRF analyzer representative or contact us directly by email at niton@thermofisher.com, or visit our website at www.thermoscientific.com/niton.

Thermo Scientific Niton XL2 GOLDD and Niton XL3t GOLDD+ analyzers deliver rapid analysis and grade ID

References

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