The aim of this PRESS RELEASE is to give an overview of the key points and status of the ALUSALT™ technology, a "Mini Salt Slag Recycling" technology that has been developed by ALTEK over the past 6 years aimed at solving a major aluminium recycling industry challenge.

ALTEK have now successfully installed a large capacity salt slag recycling plant, as a demonstration unit, in Northern Europe at an aluminium recycling operation, where it is currently in the final stages of commissioning and optimisation. The plant has successfully taken salt slag, removed the salt, re-crystalised the salt for re-use, and generated oxides (NMP) that can be used in various markets.

Full commercialisation of this new technology will start in 2018.

Introduction

Traditionally, one of the most flexible methods of recovery of the aluminium metal units from aluminium scrap and drosses has been performed using the rotary salt furnace (RSF) process, a process that produces salt slag as a bi-product. This is the easiest and most cost effective way to recycle contaminated scrap and aluminium drosses. Typically, salt slag contains aluminium metal (5-20%), a salt-flux (NaCl+KCl) mixture (40- 55%), and aluminium oxide (20- 50%) and other non-metallic products (NMP) 2-8%.

Salt Slag can no longer be landfilled in Europe and Middle East as it used to be and is currently in the USA (which may change in the future), and many countries/regions of the world do not use it because of the inability to easily dispose of it.

Consequently all salt slags in Europe are sent to central processing plants (100,000+ tpy capacity), where it is recycled and the outputs are:-

- Aluminium (sold back to the aluminium producer)
- Salt (sold back to the aluminium recycler)
- NMP (Non Metallic Product – sold for other uses in industry and also some limited 'safe' landfills)

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These central processing units, of which there are only a handful in Europe with plants in Germany, Spain, Italy and the UK, are extremely expensive to build, and operate, requiring a capacity around 100,000 tpy or more to make them economically viable. This means there are not so many of these recycling centres and requires the aluminium recyclers who generate the salt slag, to ship the salt slag over huge distances at great expense with careful consideration being required to transportation regulations driven by ever increasing environmental legislation.

Existing Technology

Existing salt slag recycling technology, which has been around for several decades, is very dated. It recovers entrained aluminium by crushing and screening the cake, dissolving the soluble salts and recovering them by evaporation of the water, and then filtering to recover Non Metallic Particulate (NMP). The process is energy intensive, particularly the evaporation of water from the brine.

The current technology has high capital and operating costs and is only economical to operate at large scale. These high costs are a significant barrier preventing small recyclers from carrying out on site reprocessing. There are thus only a few installations across Europe that each recycle 80,000 to 100,000 Tonne annually.

ALTEK with its ALUSALT™ technology has developed a lower CAPEX and OPEX alternative to this existing technology, making it possible for aluminium recyclers to recycle their own salt slag in situ at site with significant economic and environmental benefits.

Transportation and CO_2

The aluminium recycling company has no control over its location relative to the distance to the nearest existing salt slag recycling centre. If it is a large distance away compared to its competitors then the recycling company is immediately at a cost structure disadvantage than if they were nearer.

The total number of kilometres of all of the European recyclers to their nearest recycling facility is approximately 55,000 km giving many millions of kilometres of transportation per year of salt slag by road, sea or rail.

This equates to a very substantial CO_2 footprint and transportation cost.

The minute salt slag leaves the aluminium recycling operation it is deemed as being waste and comes under the Waste Framework Directive (2006/12/EC) and the Integrated Pollution Prevention & Control Directive (2008/1/EC)in Europe).

Off-site processing and disposal of residues in landfill both require specialist transportation. Emissions are thought to be circa 0.12T CO_2 per Tonne of salt slag transported. Actual emissions will depend on the type of transport used and distance transported and are best calculated on an individual site basis, emissions will be higher where the distance to the reprocessing is larger. There are also carbon emissions associated with the transport of residues to landfill and the transport of salt and Al metal

Transporting the salt slag to these locations and returning the recycled salts and the aluminium back to the aluminium recycling plants cost currently more than €50 million per annum in Europe and emit approximately 250,000 tonnes of CO_2.

A New Approach - ALUSALT™

As a result of these and other issues, that the aluminium recyclers were facing, and also bearing in mind many of the recyclers were already customers of ALTEK due to ALTEK's customer base (over 500 customers around the world), ALTEK set about, in 2011, developing a "Mini Salt Recycling plant", now called ALUSALT™.

The objective was that this technology could be located at the place where the salt slag is initially generated, (the aluminium recycling operation that uses rotary salt furnaces), to allow an environmentally and economically efficient way to recycle the salt slag and give security of management of waste streams from their operations to the aluminium recycler.

All components of the salt slag can be recovered and re-used in the ALUSALT™ process. The products derived from the recycling process are all classified as non-hazardous. Effective recycling can reduce material sent to landfill to zero, which has environmental benefits for the landfill operator in terms of leachate contamination and gases evolved.

As a consequence, since 2011 the market has followed the progress of ALUSALT™ development with great interest, driven by the critical need of the recyclers to manage their waste streams to meet environmental requirements, and the limited options they have available to them.

A high proportion of the European operations that generate salt slag are actively in discussions with ALTEK on this technology and many have already run trials through the pilot plant at ALTEK's facility in the UK.

ALUSALT™ - Reducing the transportation cost and CO_2 impact

The ALUSALT™ technology will remove the significant cost for transportation and the associated CO_2 emissions. It will also impact on space required for storage of hazardous material and the associated risks that this holds as many recyclers currently have to cool their salt slag to a temperature below 70°C before they can transport to the recycling plant. This usually takes 3 days to achieve and requires storage areas and in some cases large buildings with full ventilation systems that have been developed to manage this task pre-shipment.

Reprocessing the salt slag in house has the immediate benefit of reusing the salt and the recovered aluminium in their processes, avoiding further transport costs and CO_2 emissions, whilst retaining the desired alloy composition of the recovered aluminium. In addition there is the potential to sell the residues such as NMP to the market. These are the non-metallic product (NMP) that will be captured at the various stages of the ALUSALT™ process. Work is being undertaken as part of the project to characterise these and ensure the final NMP is safe and inert for sale as a revenue earning product.

Quite a number of the larger salt recycling plants are already successfully selling their NMP in the market under specific branded product names. These markets therefore already exist for NMP product from the ALUSALT™ process, as essentially the oxide volumes currently generated by the large central processing centres will be replaced by those generated in the localised ALUSALT™ plants.

ALUSALT™ - An Economical Answer

The economics are quite compelling with Return on Investment (ROI) in less than the 2-5 year range depending on plant sizing.

Onsite recycling will avoid the transportation costs of sending material off site for reprocessing.

On-site recycling will recover the remaining aluminium contained within the salt slag (5-15%), fully recycle the salt for re-use (with some marginal top up), in the recycling process, and produce the by-product oxides (NMP), which are suitable for use in many downstream industries (steel, cement, ceramics, refractory, fluxes etc. etc.) with many of these industries already taking these oxides from the large existing salt slag recycling operations.

It is estimated that the majority of European aluminium recyclers that generate salt slag, produce between 5,000T to 25,000T per year of salt slag at their site. ALTEK are in discussions with many of these operations during the course of the ALUSALT™ development project to ensure it meets the needs of these companies.

Plant sizing will range from 4000tpy through to 30,000+ tpy. Modular in its design and concept, the range of ALUSALT™ plant sizes will cover all the current salt slag recycling requirements of the majority of aluminium recycling plants in Europe.

The demonstration plant that has been built by ALTEK has been sized to accommodate the middle of this range.

Conclusion

The net effect of these economic drivers from ALUSALT™ is that the aluminium recycling companies who currently utilise Rotary Salt Furnaces, and generate salt slag as a consequence, can now achieve significant cost savings. This can be used to enhance a substantial profit and/or deliver cost reductions that in turn increase competitiveness within their markets.

In addition to this the aluminium recycling companies can significantly increase their security of operation as they are currently very limited in their options for where they can send their salt slag for recycling. The ability to recycle salt slag on site may even allow operations in areas currently not served by the existing processors.

The environmental and reduced CO_2 benefits of recycling the salt slag in situ at site, are clearly obvious, and also fit very well with the circular economy strategies being adopted throughout

Europe and the world. Environmental legislation is driving companies to focus on this with even more restrictive transportation requirements for material such as salt slag.

A consequence of the new ALUSALT™ technology, will be a paradigm shift in aluminium recycling. It will lower the barriers of entry to new and more localised (to scrap source) operations and allow regions of the world not currently utilising salt for efficient recycling to so do.

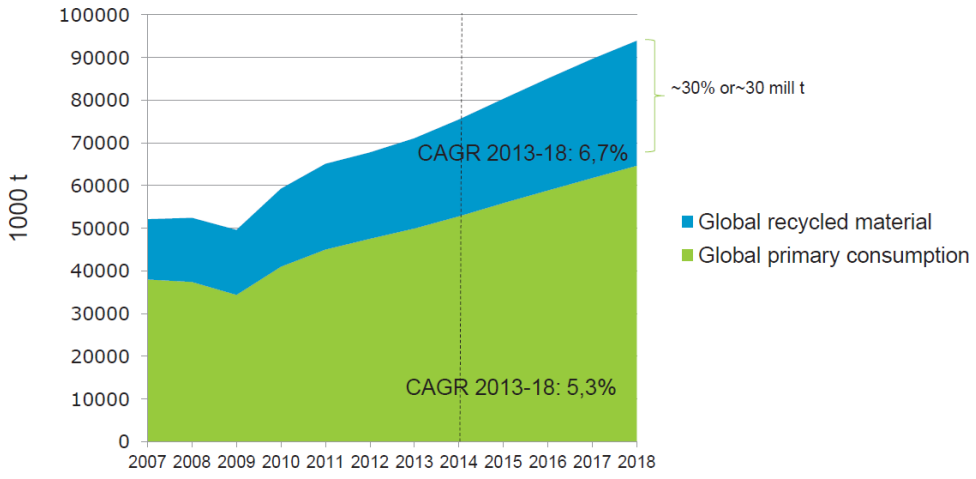
ALTEK can now claim that after 6 years of research and significant investment, the solution for on-site salt slag recycling, ALUSALT™, is now a reality.

BACKGROUND NOTES

Due to its properties, aluminium is, the second most used metal after iron. It is used in a wide number of products and sectors, either alone or as an alloy. Compared with the production of primary aluminium, recycling of aluminium products needs as little as 5% of the energy and emits only 5% of the greenhouse gas. Recycling is a major aspect of continued aluminium use, as more than a third of all the aluminium currently produced globally originates from old, traded and new scrap.

The global aluminium recycled volume in 2014 was 24 million metric tons, and regardless of the recession these volumes continue to grow 5-6% a year (shown in the graph below). The trend in Europe for growth is similar.

Recycled material is increasing in importance globally



Source: CRU

Traditionally, one of the routes to the recovery of the aluminium metal from scrap has been performed using the rotary salt furnace (RSF) process, which produces salt slag as a bi-product. This

is the easiest and most cost effective way to recycle contaminated scrap and aluminium drosses and is used extensively throughout Europe, Middle East and the Americas.

Typically, salt slag contains aluminium metal (5-20%), a salt-flux (NaCl+KCl) mixture (40- 55%), aluminium oxide (20- 50%) and other Non-Metallic Products (known as NMP) 2-8%. Depending on the quality of scrap or dross between 300kg and 1,000kg of salt slag is produced for each 1,000 kg of scrap or dross processed. This means every year, millions of tonnes of salt slag are produced globally and this number is growing with the increasing use of aluminium, particularly recycled aluminium.

Although there are more than 273 aluminium recycling companies in Europe alone, and many hundreds more around the world, not all currently use rotary salt furnaces due to the issues with disposal of this by product known as salt slag. The companies that do operate salt rotary furnaces transport their salt slag to the centralised plants (that only exist in Europe), because their local generation of salt slag is too small to support the investment in on-site reprocessing.

At present, salt slag recycling is only cost effective at large scale i.e. >80,000+ tonnes per annum. As many recyclers produce 8-10 times less than this, the reprocessing must take place at centralised plants that exist around Europe. In the Americas the salt slags are still disposed of in special landfill sites although increasing environmental legislation and scrutiny may change this.

One estimate has put the cost of disposal of salt slag in Europe alone at around €80 million. The US has recognised the problem also where approximately 1 million tonnes of salt slag are disposed of in specially designated landfills, here the costs of disposal are lower but the environmental issues are still a major concern. Ultimately the tight legislation that exists in Europe will pass over to the US. With the growing use of aluminium in Asia, India and China all of whom at the moment do not use rotary salt furnaces, this issue is going to spread around the globe as the rotary salt furnace is recognised as the most efficient way to recover aluminium from dross and contaminated aluminium scrap. The ability to recycle, cost effectively, salt slag will now also open up these markets.

Image of Salt Slag cooling in storage containers prior to transportation for re-cycling

It is very clear that salt slag is a growing environmental problem. In certain landfill conditions, when in contact with water for example, the salt slag can produce leachate containing chlorides that could contaminate ground water. Some of the gases released when it comes into contact with moisture can ignite and cause fires. Some of these gases, if released, would have a global warming impact greater than that of CO_2.

Not only is salt slag difficult to dispose of, there is a problem of transporting it. It has to be cooled in house to reach a safe temperature for transportation before being able to be taken to centralised salt slag recycling facilities. The cooling process takes place for a minimum of 2-3 days (without an ALTEK cooling press or other accelerated cooling mechanism), and emits ammonia, methane, hydrogen and phosphine gases if it comes into contact with moisture. This means special precautions are needed with dry and ventilated storage conditions and proper documentation and containerisation, is required to then allow transport of this material to the existing central recycling centres or landfill sites.

Costs to the aluminium recycling industry as a consequence are increasing with the introduction of landfill taxes and tighter regulation. The cost of transporting the waste to landfill and third party processing sites is another factor. In Europe, salt slag cannot be dumped directly to a landfill, but rather the material must be reprocessed to capture the aluminium metal content, the salt components, and the oxide (NMP) materials.

As mentioned previously, there are only 8-10 locations in Europe, mainly in Germany, Spain, Italy and UK where salt slag is recycled as there are very high initial CAPEX and operating (OPEX) costs with this type of operation. In order to become economically viable, these facilities must recycle at least 80,000-100,000 tonnes of salt slag per annum.

Over the past 15 years, many companies have attempted to remove the use of salt from the aluminium melting process within these furnaces but this only contributes to part of the ‘land fill’ and environmental challenge. A salt free process also has the disadvantage of a reduced aluminium recovery efficiency (approximately 10% less) which results in a less efficient operation and wasted aluminium units. The issues around gaseous reactions however with the resulting NMP from the slag are still the same as with the NMP from salt slag.

Main problems are:-

- Leachability
- Toxic metal ions into ground water
- Reactivity with water or moisture-
- Gaseous emissions of NH3, CH4, PH3, H2S
- Aluminium Phosphide and Sulphides

Notes to Editors

ALTEK are a supplier of world leading technologies and equipment to the Aluminium industry. With offices in UK and US it serves a customer base of over 500 aluminium companies around the world. It is currently expanding its UK operation in Chesterfield, Derbyshire which is based on a two acre site, with a significant investment in the addition of a new purpose built 20,000sq. ft factory, due to start operation at end of Q1 2018.

ALTEK has over 75 employees globally and has a reputation for innovation and the introduction of new technologies to the aluminium industry.

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