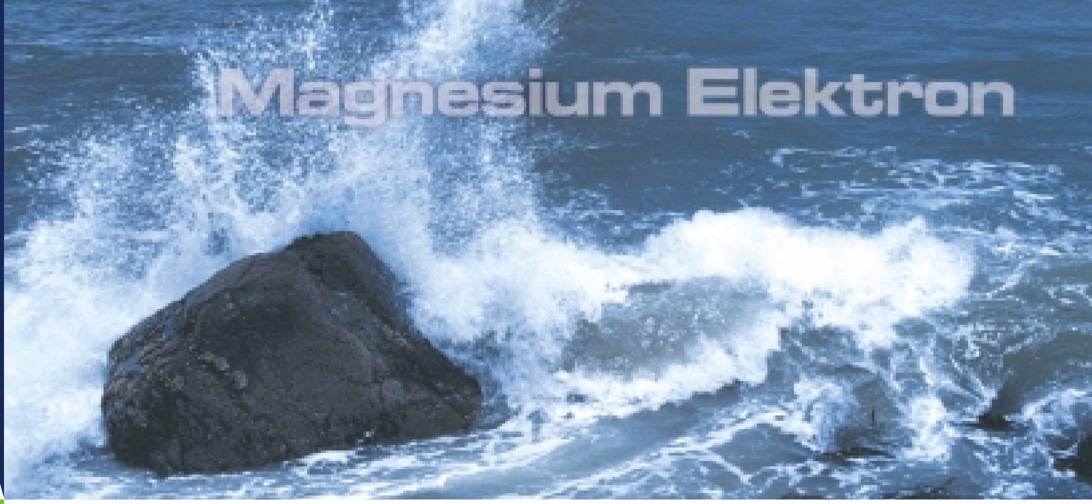
ISSUE 2 SUMMER 2002



flux

Magnesium Recycling Brief

CLASSIFIED?

In addition to economic considerations, there is a growing emphasis on using good environmental principles in relation to both the minimisation and transport of waste materials. Within Europe, most of the environmental changes are being driven by European (EEC) legislation such as the End of Life Vehicle Directive, Integrated Pollution Prevention Control (IPPC) and the Landfill Directive.

Recycling and recovery of any process arisings, regardless of industry, falls under a large variety of different legislation. This makes it extremely complicated to readily determine exactly which process arisings are covered in which legislation.

When moving process arisings from the magnesium die casting industry over international boundaries within Europe, a magnesium diecaster must follow strict legislative guidelines. As there is evidence that the movement of these materials is becoming increasingly monitored, it is important that the correct procedures are understood.

To ensure all the necessary regulations are met when transporting a certain material, for example; clean, dry magnesium scrap, magnesium swarf, fluxless or fluxy magnesium drosses, the material must be correctly described.

Does the material exhibit any hazardous characteristics? The material must be classified in relation to how hazardous it is. The purpose of classification is to describe the hazardous properties of the material to be transported, and to allocate the material to a particular grouping according to a commonly agreed system of nomenclature.

The system used is almost always based on the UN hazard classifications system, which has 9 classes, some of which include subdivisions within the classes. Once classified, the material must also be assigned a packing group, which indicates whether the material has a high, medium or low danger within its class. The appropriate packaging must then be used when transporting the material. Although the UN classifications are not law they are the model for all transport systems and are accepted worldwide.

Specific test methods are detailed to allow the producer to start classifying their materials. Characteristics such as flammability, reactivity with water and corrosivity are assessed. Magnesium swarf can fall into UN classification 4.1, and dross can fall into 4.3, but each case must be considered separately, as a whole range of die casting process and machining variables will affect the characteristics of the process arisings.

Should the material be described as a waste material? Making a decision on whether a material is described as waste can depend on numerous pieces of Regional, National, EEC, Organisation for Economic Cooperation and Development (OECD), or other international regulations. Very generally, if the process arisings do not need any additional form of treatment before it can be introduced into a further process (e.g. a recycling process) then it will not be classified as a waste. However, this statement should be treated with extreme caution as experience shows that each case should be considered separately.

It is the responsibility of the producer of the material to determine which hazardous properties the material exhibits and therefore to class the material according to the UN system, and also to determine whether the material should be additionally described as a waste material.

If the material is not described as waste, and does not exhibit hazardous properties, then the material can be moved over international borders subject to Customs and Excise Import/Export control. If the material is described as a waste, then, after appropriate classification, packing and labelling of the material, it must be moved under the guidelines stipulated by, for example, the Basel Convention or the OECD. Following identification of the material classification, the producer can use the OECD guidelines to ascertain whether the waste is Green Listed, Amber Listed or Red Listed.

If Green Listed, the waste can be moved relatively freely across international borders under a 'controlled waste' description. If the waste is Amber Listed, then the material can be moved across international borders, but only under Transfrontier Shipment (TFS) documentation and with the consent of the relevant authorities in the receiving country and the country of origin. If the waste is 'Red Listed' it is banned from movement across international borders, and may only be moved (under strict regulation) within its country of origin. Magnesium process arisings from the magnesium die casting process generally fall into either the Green or Amber listings.

Magnesium Elektron has considerable knowledge and expertise of the detail of the European legislation on this subject, and, where legislation allows, is able to transport and process these types of materials for its customers.

Information given in this article is intended as a guideline only, and no liability is accepted for its accuracy.

Executive Express

Against a backdrop of sliding European car sales, Audi, Mercedes, BMW and Jaguar are enjoying growing sales. Although July's European car sales were only down 1.6% on last year, equating to 1.27million units sold, the previous six months have all revealed a deeply contracting market. June's figures showed a massive 8% decrease from the same period last year. Almost all of the significant automotive manufacturers have experienced some reduction in sales volumes.

However, members of the executive club have been enjoying rather better fortunes, helped by the launch of a spate of new models. Audi's new A4 is much loved, with the new cabriolet version completely sold out, helping Audi achieve an almost 11% increase in sales as compared to July 2001.

When DaimlerChrysler launched the new E Class, the motoring press were both amazed by, and questioned the reported level of investment that DaimlerChrysler had put into the new E Class. The E Class' sales figures are now confirming DaimlerChrysler's decision to ensure they produced a top-flight executive express. The growth in E Class sales has helped Mercedes increase its July sales figures to 73,400 units, an increase of nearly 11% over the same time period last year.

BMW's July 2002 sales figures are up 19.6%, helped by 'New Mini Fever'. This expected first year sales boom of the New Mini has helped BMW add to its impressive growth figures of the past 18 months. Without the 'New Mini Fever', BMW's own brand figures show a more modest sales increase, perhaps due to the new significantly different BMW 7 series slightly confusing the motoring press.

Jaguar's revitalisation under the ownership of Ford is continuing to reap rewards, with Jaguar's cumulative year to date sales up a massive 51.4%, with July 2002 sales up just over 11% over July 2001. Jaguar' sales performance is confirming its place as one of the stars of Ford's Premier Auto Group of companies.

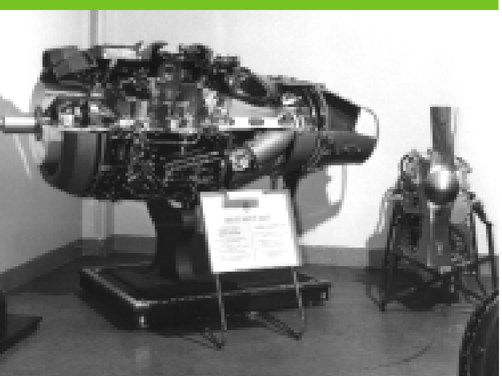
Officially Opened

Magnesium Elektron's new magnesium recycling facility was officially opened by Her Excellency Anne Pringle, the British Ambassador to the Czech Republic, on the 3rd of May.

The facility is ramping up very quickly to its target capacity to recycle 10,000 tonnes of predominantly automotive production arisings per year. Magnesium Elektron's magnesium technology, developed since 1936, is being continuously transferred to the new plant to achieve this rapid increase to full production. Magnesium Elektron cast its first AZ91D alloy ingot in the Czech Republic on 24th October 2001, as part of the first phase of commissioning, and in July 2002 the plant recycled 750 tonnes of a variety of alloys.

The flexibility of the facility enables the current range of high purity alloy types to be successfully recycled, and promises the effective integration of further alloy types to meet future industry requirements.

Looking back...



Grain Refining

With magnesium, significant improvements in physical and mechanical properties can be made by reducing grain size. The use of zirconium for grain refining was first suggested by Magnesium Elektron in 1938. However, introducing the zirconium, both effectively and economically, into magnesium alloys was found to be extremely difficult.

As a result of intensive work over two years, the problem of zirconium introduction was solved, so that the alloys possessed outstandingly improved mechanical and physical properties as well as being free from harmful contaminants. The magnesium-zirconium alloys provided considerably higher proof stress properties than had ever previously been obtained in commercially viable magnesium-base alloys, combined with high ultimate tensile stress values and good elongation.

These alloys, and further developments of these alloys, are still used today in the aerospace & speciality alloy industries.

High Performance Die Casting Alloys

The acceptance of and rapid growth of consumption of magnesium alloys for high-pressure diecastings in the automotive industry has been due principally to the development of the high purity range of alloys in the 1980's. In these alloys, the trace levels of elements such as iron, nickel and copper are carefully controlled within defined parameters. This chemistry control bestows inherent corrosion resistance on the base alloys far in excess of what would otherwise be achievable.

At present, no commercially viable process exists for removing nickel or copper from magnesium alloys. Control of these elements is therefore achieved by ensuring that feedstock materials and manufacturing equipment are free of these elements. In this way, the pick up or leaching of these elements into the magnesium during primary production is avoided. In contrast to copper or nickel however, iron has the potential to be removed from magnesium alloys. The most widely used method for achieving this is by the addition of manganese to the magnesium when in its molten form. The process by which iron is removed requires an excess of manganese to be dissolved in the molten magnesium. The temperature of the melt is then cooled resulting in the preferential precipitation of Fe:Mn and Fe:Al:Mn intermetallic crystalline compounds from the melt.

The exact relationship between "excess" manganese level, melt temperature/holding time and residual iron levels in the melt is a complex one and is best shown graphically, Fig 1. From this, it can be deduced that for a producer of magnesium alloys, a lower residual iron concentration can be achieved in the finished ingot by either lowering the melt holding temperature/increasing holding time prior to casting ingot, or by alloying the melt with higher initial quantities of manganese.

This relationship between temperature, iron concentration and manganese levels during ingot manufacture is one of the main causes of product variability, as observed by the die caster, between different suppliers high purity ingot.

From the die casters perspective, a certain level of residual manganese in the ingot is neccessary in that the high purity corrosion performance of the alloy will only be achieved if the manganese content is above a certain critical value.*

The problem for the diecaster arises if the solubility of manganese in the diecasting furnace is below that which is contained in the ingot. In such cases, further precipitation of intermetallics will occur in the diecasting furnace leading to rapid sludge build-up, increased downtime and therefore higher production costs for the diecaster.

The Elektron Refining Process

In the Elektron refining process(used in the production of primary metal and for recycling returns from the high pressure die casting process), zirconium as opposed to manganese is used as the precipitating agent in order to remove iron.

The zirconium, which is only sparingly soluble in magnesium, reacts with any iron to form iron-zirconium intermetallic particles, which are then precipitated out to produce the resultant refined high purity alloy.

The ASTM and Euronorm specifications allow a wide variation in the quantity of manganese, which can be present in the high purity alloys. Within this band, there is a much narrower optimum or desired quantity of manganese, i.e. sufficient to achieve the high purity corrosion properties but not so much so that "excess manganese" is present.

In the Elektron refining process, manganese is added to the molten magnesium in carefully controlled amounts until this optimum value is reached. Then, once this optimum value is achieved, zirconium refining can commence to also bring the iron concentration into the optimum desired range without alteration of the manganese levels.

The resulting Elektron refined alloy when used by a diecaster will display excellent melting characteristics with a minimal tendency towards sludge formation.

The benefit to the diecaster of using the Elektron refined alloy is that production uptime and finished part quality are maximised.

A further advantage of the Elektron refining process is that the resultant alloy when used in the diecasting process, is much less susceptible to aluminium depletion within the diecasting furnace. The melt chemistry and therefore fluidity remain much more consistent, and the benefit to the diecaster is that the die cavity can be more reproducibly filled and fewer parts rejected.

*In Alloys AM50A, AM60B, and AZ91D, if either the minimum manganese limit or the maximum iron limit is not met, then the Iron/Manganese ratio shall not exceed 0.015, 0.021, and 0.032 respectively.

Iron Solubility & Manganese Solubility Curves vs Melt Temperature for AZ91D

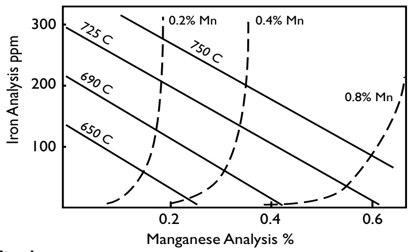


Fig 1

Magnesium Elektron

flux

Magnesium Elektron gains “Alloy Ingot Supplier Source Approval” from DaimlerChrysler

DaimlerChrysler has officially notified Magnesium Elektron that Elektron’s AM50A, AM60B and AZ91D alloys have gained ‘source approval’ status enabling them to be used in safety critical magnesium die cast components worldwide by the DaimlerChrysler Group.

The approval process, which takes 6-8 months to complete was carried out by the independent testhouse ‘Climax Research Services’ of Detroit and consists of a two stage evaluation process. Stage I consists of extensive testing and analysis on production quantities of the magnesium alloy ingots. Only after the successful completion of Stage I testing can Stage II be commenced.

In this stage, actual die cast test bars are manufactured in each of the different alloys and undergo evaluation and testing. The results from this section can then be compared with previously collated data.

Stage II evaluation showed that die castings produced from Elektron’s AM50A and AM60B alloys achieved higher impact properties than that of previously tested materials.

Magnesium Conferences in 2002/2003

September 10-12, 2002
Fonderie Sous Pression 2002
Paris, France

September 11, 2002
First International Magnesium Seminar
Geneva, Switzerland

September 26-27, 2002
10th Magnesium Automotive and End User Seminar
Aalen, Germany

November 6, 2002
IMA Health & Safety Seminar
Bottrop, Germany

January 26-30, 2003
Platform Science and Technology for Advanced Magnesium Alloys
Osaka, Japan

April 2003
IMA 2003 Automotive Seminar
Michigan, USA

May 11-14, 2003
IMA 60th Annual World Magnesium Conference
Stuttgart, Germany