CLOSING
THE METALS LOOP –
A VITAL SOURCE OF RAW MATERIALS

A PROFILE OF THE INDUSTRY THAT PIONEERED NON-FERROUS METALS RECYCLING AND REMAINS ITS DRIVING FORCE

A vast jumble of cables, wires, metal punchings, car wrecks, twisted sheet, dented cans, bulky castings, metal turnings, containers full of batteries. Is all this merely discarded and useless? Don't be fooled by appearances.

Such "scrap mountains" are in fact a vital source of non-ferrous metals such as aluminium, copper, zinc, tin, lead and the whole range of precious metals - far too valuable to be dumped. Their recycling reflects a long tradition and is essential to the protection of our environment and conservation of our natural resources. The professional recovery and recycling of metals provides the framework for transforming old into new. The non-ferrous sector of the recycling industry has been fulfilling this task for generations. It was the pioneer of what is now universally regarded as an essential activity, and remains the driving force in its advancement.

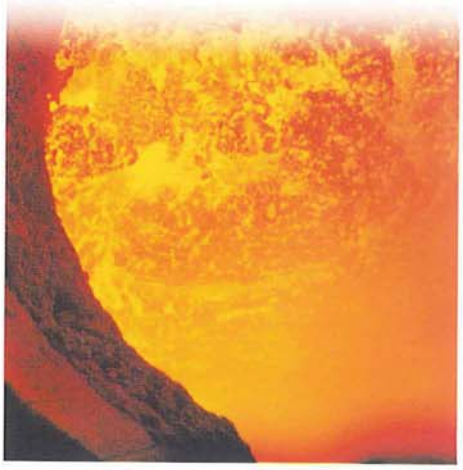
Non-ferrous metals - Valuable raw materials from "scrap"

PROTECTING THE ENVIRONMENT AND CONSERVING RESOURCES

Recyclers and consumers of what are known as secondary metals are in partnership to ensure that all forms of recoverable metal are utilised and are not allowed to be discarded as though they were waste. As well as collecting and processing physical metals, specialised companies recover metallic elements contained in residues such as ashes, dusts, sludges, slags and drosses. Recyclable metals are collected from virtually every sector of industry, from municipalities and even from private households. They may be in the form of offcuts generated by the metalworking industries, as products or packaging that have served their original purpose and can now be regarded as potential raw materials.

METAL RECYCLING - PROVEN OVER THOUSANDS OF YEARS

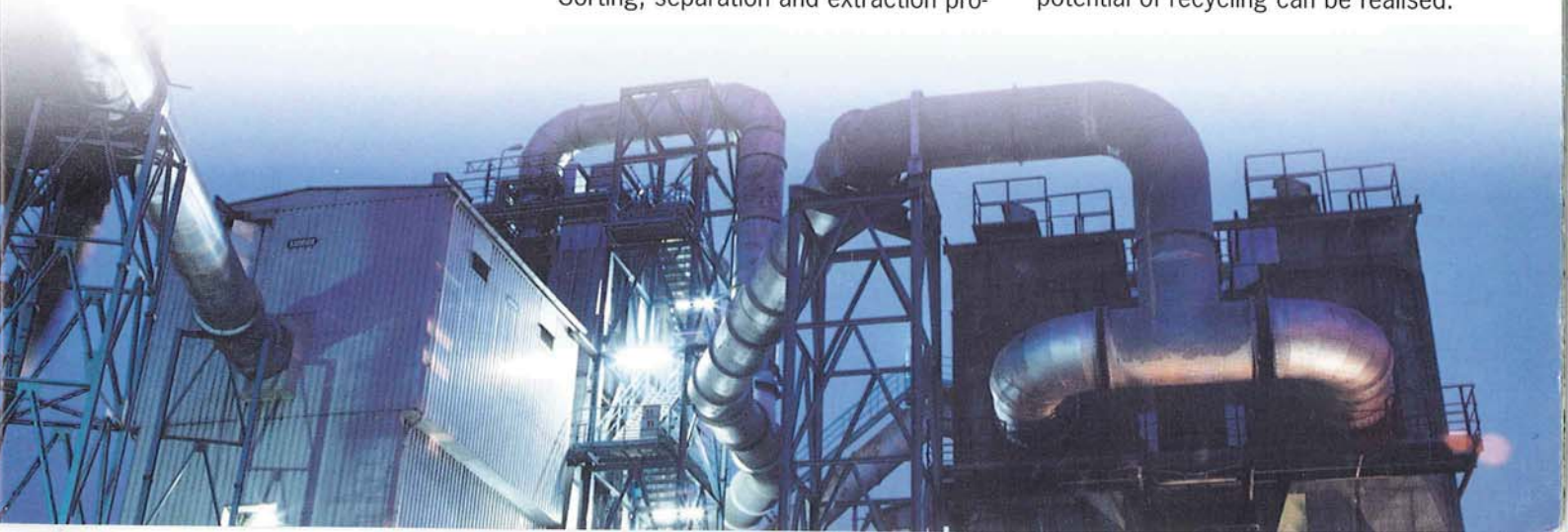
Closing the metals loop has a very deep historical tradition. The multiple characteristics and possibilities of metal utilization were recognised in the early ages of mankind. Also the advantages of unlimited repeated use became rapidly obvious. Gold and silver, for example, have been playing an important role for the human race for about 6,000 years, and copper for about 9,000 years. Metals became the objects of daily use, for instance as tools, works of art and jewellery, or as means of payment. Even in those far-off times, their special value prompted their recycling.



Metals in the flux

METAL RECYCLING - A NEVER-ENDING STORY

Because of their specific characteristics and the highly-developed technical processes involved, the exploitation of metals is a never-ending story. Metals are multiple-use materials with changing applications.
Increasing awareness of the importance of recycling also encourages the recovery of residues with a low metallic content. New combinations of materials present fresh challenges to recycling. Sorting, separation and extraction procedures become ever more complex as the industry strives to ensure that metals recycling is as all-embracing and efficient as possible. The way in which products are designed often presents difficulties in their ultimate recycling. Although this problem is being tackled gradually by manufacturers, and more products are being designed to facilitate their recycling, it has to be addressed universally before the full potential of recycling can be realised.



Metals recycling ensures the availability of raw materials for our economic future. The quantity of metals "in the loop" increases world-wide every year. Metals are not consumed, they are perpetually reusable without any deterioration in their quality. Thus provided recycling is enabled to be as effective as possible, the world's metals wealth can be ensured for eternity. Today, the recovery rate is between 80% and nearly 100%, depending on the product.

The products generating reusable metals range widely from electrical components and electronic equipment to starter batteries, electric cables, and aluminium window frames.

Unlimited recyclability of old metals – the raw materials base for our future

Priority: Conservation of natural resources

Natural deposits of metal-bearing ores are not distributed evenly throughout the world. Europe, for example, now has hardly any natural metals resources. For the world as a whole, the occurrence of aluminium, copper, nickel, tin, zinc, lead and precious metals is sufficient, but by no means unlimited.
Recycling of non-ferrous metals is essential to reduce dependence on finite sources of primary materials. The unhampered reuse of old metals secures permanently the raw materials base necessary to our industrial future. However, regional availability does not necessarily match demand, and thus metal-using industries across the globe rely on global free trade in these materials to meet total needs, wherever they may arise.

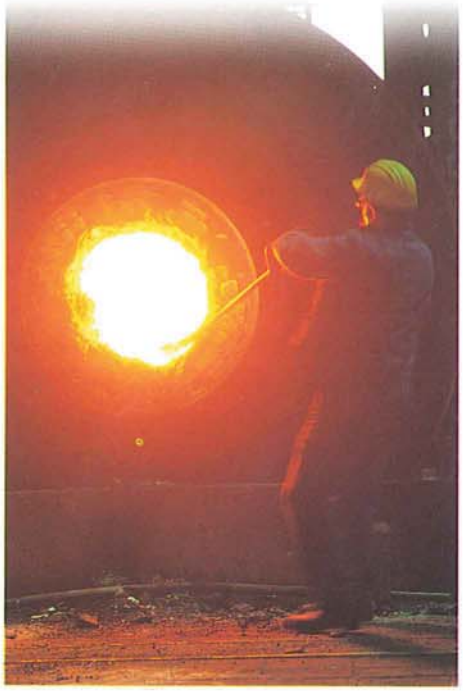
Metal recycling = Energy recycling

Recyclable metals can be considered as enduring energy banks. The energy used in converting ores into metals represents an investment that will never have to be repeated. It remains intact no matter how long the interval between original production and return to manufacture via recycling. For example, the production of one tonne of aluminium from recyclable metal requires only five percent of the energy needed to obtain the same amount of aluminium from bauxite. The energy balances for other metals are also impressive. For instance, the energy saving for lead may be up to 80 percent, about 75 percent for zinc and about 70 percent for copper. The reuse of old metals in manufacturing is far more cost-effective than the extraction and conversion of primary raw materials. It contributes to saving scarce and expensive energy, and has a lower impact on the environment.

METAL RECYCLING - USEFUL UNDER ANY CIRCUMSTANCES

Lead used in batteries enables us to start our cars effortlessly, zinc gives protection against rust, copper allows the transmission of energy and information with supreme efficiency, aluminium plays a vital role in transport, precious metal catalysts purify exhaust fumes, nickel refines and widens the uses of steel, and tin-coated steel sheet preserves food. Metals can be combined in a multiplicity of alloys, and so become key materials for high-technology applications

Worldwide, more than 42 million tonnes of non-ferrous metals are used annually, and the bulk will return sooner or later to the recycling process. Metals are indispensable to our life. They are not only vitally important materials, but also elementary components of the biological cycle. The human organism, for example, cannot survive without metallic trace elements.



Metals " in the loop" – indispensable for the human body

Metal recycling-
Mining above the ground

Recyclers and metal producers guarantee a reliable and constant quality level

Both the extraction of ores and the recycling of used metals provide raw materials for metal production. So the facilities of metals recyclers can be considered as our 'urban mines'. The raw materials of the industry arise, for example, wherever sheets of metal are being punched, bars turned and metals cast, or when used material has reached the end of its design life. Hence, recyclable metals and residues come either from industrial production or from end-of-life products in companies and households. It is important to promote the efficient exploitation of these sources for the benefit of the domestic and export markets, and thus ensure that metal is returned continuously to the cycle of use.
As necessary, collected metals will be sorted according to their type into the standard specifications that apply throughout the world. They will be freed from unwanted material such as wood or plastics. Bulky objects will be cut or compressed, cable stripped, drosses ground and iron magnetically separated. Sound knowledge is necessary of the materials, of their areas of application and of their expert treatment and storage. All this is guaranteed through the highly-qualified personnel, technological resources and solid experience of the non-ferrous recycling sector.

Quality creates trust, and is the highest priority for recyclers, producers and users of metals. Certified systems of quality and environmental management ensure that companies meet regulated quality standards reliably and consistently.

Environmentally-sound production of high value metals

Non-ferrous metals that have been collected, sorted and prepared have then to undergo the final transformation process. The range of furnace feed used in metal plants ranges widely from pure scrap of nearly 100% metallic content to material containing 10% or less. The metals are extracted using a variety of methods, in smelters and by electrolytic procedures. Residues from these processes may be suitable for further recovery techniques, or can be used as infill material by the construction industry.

New methods increasingly enable the industry to recycle almost completely even those residues that were previously fit only for landfill. For example, aluminium drosses, which are by-products of aluminium recovery from secondary materials, now yield not only metallic aluminium but also aluminium salts. The remaining residues can even be reused as well.

Non-ferrous metals recycling - Who makes it possible?

BIR

The Bureau of International Recycling, BIR, is the international federation representing the world's recycling industries, covering in particular ferrous and non-ferrous metals, paper and textiles. More than 50 countries are represented through companies and national associations.

The Non-Ferrous Metals Division of BIR encourages environmentally sound processing and recycling of non-ferrous metals scrap for the smooth supply of the metal industry worldwide. It promotes free-trade and contributes to removing artificial obstacles to trading freedom which not only distort demand but can also inhibit further development of recycling.

EUROMETREC

The European Metal Trade and Recycling Federation, EUROMETREC, is the European federation of national non-ferrous metal scrap industry and trade and represents the interests of traders, processors and recyclers of non-ferrous metals scrap within the European Union.

VDM

The Verein Deutscher Metallhändler e.V. (VDM) (Germany) is one of EUROMETREC's member associations and holds the copyright for this brochure. For more than 90 years, VDM has been representing the German non-ferrous metals dealers and recyclers and offers to its German and European members an extensive range of services.

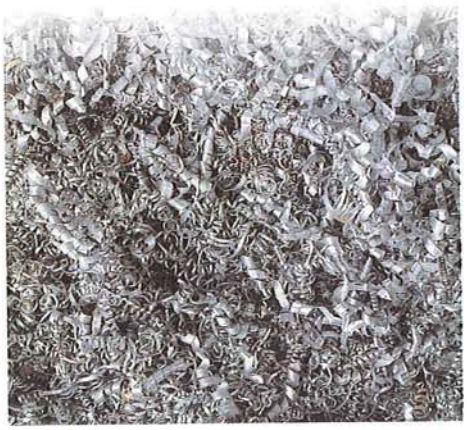
ALUMINIUM - A YOUNG METAL CONQUERS THE WORLD

Quite new on the market, but already the most frequently used non-ferrous metal

An aluminium ingot was considered a sensation at the 1855 world exhibition in Paris and was displayed right next to the crown jewels. Thirty-one years later, the development of the electrolytic process enabled the industrial-scale production of aluminium. It was then that the triumphant march of this young metal started. Its excellent material characteristics and nearly unlimited possibilities of application quickly won aluminium a leading position among the "established" metals. Today, aluminium is by far the most frequently used non-ferrous metal, with global consumption totalling some 24 million tonnes a year. The basic primary material for aluminium production is bauxite, a reddish ore which is extracted by open-cast mining.

The main deposits currently in production are in Australia, West Africa, Jamaica and Brazil.

ALUMINIUM - LIGHT AND VERSATILE



Aluminium comes to the fore in meeting the following requirements: weight reduction, stability, electric and heat conductivity, and resistance to environmental factors. The extremely light yet solid metal is rustproof and reduces the net weight of cars, trains, aircraft and ships. It contributes considerably to saving expensive energy and reducing emissions. Typically in industrialised countries, a third of aluminium production is devoted to transport applications. It is widely used in buildings, in the electrical and motor industries, and in the home where it is most familiar as frying pans or foil for packing food.

The lifespan of the different aluminium products varies, be it in the shape of old traffic signs, cooking utensils, packaging, profiles. Sooner or later the discarded products are collected for the reuse of their aluminium content.

New from old in aluminium processing

It is not enough only to collect and store these materials until they are needed. Further treatment by the recycler is required so that the metal can be used in smelting plants. Drosses have to be ground and separated by sieving. Cuttings and punchings, swarf, turnings and grindings generated by the metal-working industries, are subjected to further treatment.

Each end-of-life motor vehicle (ELV) contains in its many components an average 60kg of aluminium, the recovery of which becomes an increasingly important economic necessity. ELVs are thus being stripped of harmful substances, dismantled, and shredded in large purpose-built plants. Aluminium not already recovered by dismantling, is segregated from steel scrap in the magnetic separation stage of the shredder plant.

A car contains 4 to 6 % aluminium – and the tendency is growing

Further sorting of aluminium and other non-ferrous metals is carried out by media separation processes, in which fluids of different specific weight are employed to separate not only aluminium, but also copper, lead, zinc, nickel and tin.

Copper – one of the oldest utility metals in the history of mankind

Copper sheds its red light on our cultural history

Nearly 4,500 years ago, the highly-skilled stonemasons of Ancient Egypt built a tomb for Pharaoh Cheops in the shape of a pyramid on the banks of the Nile. In doing so, they hewed 2.5 million cubic metres of stone with tools made from one of the oldest metals in the history of mankind - copper. As this reddish non-ferrous metal can be found in nature as a pure mineral, it was already in use 9,000 years ago. Our modern high technology civilisation cannot imagine life without copper. The major copper producing countries are the USA, Chile, Japan and China, annual world consumption amounting to around 12 million tonnes.

Reliable and presentable

Copper is involved nearly everywhere in wires, cables and windings or coils, whether for machines, motors, light bulbs, the transmission of TV programmes or electronic information transfer. Because of its high electrical conductivity, it is the ideal transmitter of electric current, heat and electronic data. Food can be cooled because copper pipes resist even very low temperatures. Facades, roofs and eaves withstand the worst weather conditions. In heating and sanitary installations copper is the most-favoured material. Ball and friction bearings made of copper alloys guarantee the smooth running of machinery.

Last but not least, copper is a traditional coinage metal and, owing to its colour, is the ideal metal for artistic works.

A FEW MILLIGRAMS FOR YOUR HEALTH

In the metabolism of the human body, copper is an important trace element, two to three milligrams per day being required for the health of its organism and immune system. The body of a healthy adult contains on average 100 milligrams of copper, which contributes to the biological energy production of the cells. It plays an important role in the generation of the red blood pigment, supports the creation of skin pigmentation, and has essential functions in the metabolism of the bones and the central nervous system. Even plants rely on copper for healthy growth.

The recycling of copper – an important economic factor

RECYCLING - A VITAL PILLAR OF COPPER PRODUCTION

Always of economic significance, copper production from secondary raw materials becomes increasingly important. Year by year, increasing quantities of copper and copper alloy scrap are being consumed by smelting works and processing plants. A typical example of the source of this material is in the stripping of old cables and wire. Under their covering of insulation, they hide a copper core of highest purity. Special machines chop old insulated cables and wire into very small pieces.

Environmentally-friendly methods separate the resulting mixture of plastics and copper and return the red metal to the economic cycle. The residual mixture is increasingly recycled.
Another important source in the recycling of copper is in copper pipes, bars, sheets and strips.

Starting vehicles, protection against radiation - Lead is capable of even more

Car batteries, protection against radiation and noise etc. – Lead is one of the oldest and most important utility metals

Millions of cars are driven on our streets, and batteries with a lead core, safely contained in a plastic housing, guarantee that they start without problems. With a production of millions a year, starter batteries cover nearly 60% of total lead consumption. But it is not only in this application that lead is irreplaceable.

Its high density makes it ideal for protection against radiation, whether in use of medical X-rays or from industrial sources of radioactivity. Lead is used in roofing buildings, and wherever ingress of water is a problem. It provides effective insulation from noise. In industry, it protects pipes and cables, and is a constituent of many types of solder. Lead pigments in paint protect steel constructions against the impact of weather. Lead oxides improve the quality of glass in the optical industry and enhance the sparkle of crystal glasses. Lead is one of the oldest and most important utility metals. Already in 3,000 BC, it was being extracted in Egypt and the Near East, in Spain and in Central Europe. World-wide, about 6 million tonnes are needed each year. The most important producers of lead ore are at present the CIS, the USA and Canada.

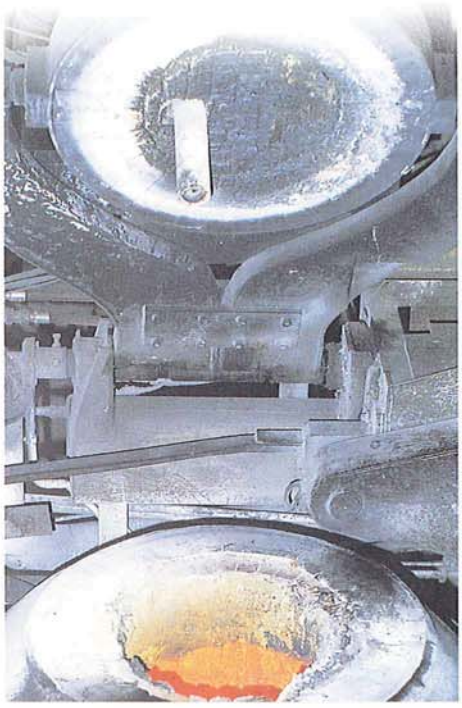
Living with lead

Lead is necessary. Today's lead products do not threaten the environment. Lead as a compound is contained in many products in an inactive, hygienically safe form. The concern that lead represents a major threat in daily life is unfounded. The introduction of unleaded fuel is removing the most important emission source of lead compounds. Moreover, the technologies used by the industry to protect the environment are designed to the most rigorous standards. Wide-ranging inspection and control through industrial medicine, as well as refined analysis techniques, guarantee that we can safely take advantage of the invaluable characteristics of lead.

Back into the loop

Recycling ensures the reutilisation of lead from sheet, pipes and cable sheathings. However, by far the greatest quantity of secondary lead is derived from used starter batteries.
At the end of the usual life-span of four to five years, the lead contained in discarded batteries is almost entirely recycled into raw material of unchanged quality.

State-of-the-art technology has drastically reduced the emissions of lead plants in many countries and contributes to major energy savings. Even the plastic battery cases and acid residues are being recycled.



Sheet, tubes, cable sheathings, old batteries – Lead recycling has an exemplary function

Precious metals - Fascination since the dawn of history

Gold has been the most sought-after metal for many thousands of years. The relatively low hardness of this glamorous metal allowed its processing by fairly simple technical means. Between 6,000 and 4,000 BC, the first centres of gold technology were developed in the Balkans, between Euphrates and Tigris Rivers, as well as in the Nile region. Silver has also played a most important role for 6,000 years in the cultural history of mankind. Evidence of the isolated use of platinum, however, can be dated back only to the first millennium BC.

The precious metals - gold, silver and the platinum group (including palladium, rhodium, ruthenium, iridium and osmium) - have significant importance in the value of world-wide trade in metals. The main producer countries are South Africa, the USA, Canada, the CIS and Australia.

The recycling of precious metals – even for small quantities worthwhile

Multiple areas of application

Precious metals are used mainly in the production of jewellery and in industrial technology. Between 15% to 20% are the objects of investment. In the industrial context, gold is also used in electronics for contact points and relays. Light-sensitive coatings on films and photographic papers contain silver. This precious metal is used on contact points in telephones, ensuring that millions of connections are established without interruption. Silver treated window glass provides translucent heat insulation. In car catalysts, the precious metals platinum, rhodium and palladium convert toxic exhaust fume components into harmless gases.

Diverse sources

Because of their high value, precious metals have always been recycled. Secondary raw materials with a precious metal content include for example old jewellery and metallic residues from the jewellery industry, coins withdrawn from circulation, residues from dental laboratories, discarded material from film and photo production, silver-bearing sludge from used fixing solutions, and electronic scrap. A car's catalytic converter contains on average 1.5 g of platinum metals. In consequence, although just 1.5 kg of platinum or 0.3 kg of rhodium can be recovered from one tonne of discarded catalytic converters, the value of the 1.8 kg of precious metals is considerable.

Complex separation - A matter of trust

Before the actual recovery of precious metals, evaluation of the material to be separated is an important first step. The supplier expects that, after deduction of the treatment fee, he receives the full value of the precious metal recovered from his material. But as the precious metal exists only as part of a mixture of many different materials, the recyclable product is initially homogenised. Representative samples are taken and analysed to establish their precious metal content. Requiring major investment in sophisticated technical facilities, the separation of precious metals leads through many individual steps to purity levels of up to 99.999%.

From a mixture of different materials arise precious metals with a purity level of up to 99.999%

Nickel improves steel

Nickel – the ideal metal for extreme conditions

When an airliner rises majestically into the sky, huge turbine blades in its jet engines provide the necessary thrust. Extreme temperatures of up to 1,000°C are generated, which normal steel could not withstand. But with the addition of over 60% nickel, the engines can stand even these temperatures.
Nickel and steel is an extremely successful combination. It leads to the current economic importance of this silvery-white alloy. Steel in combination with nickel and chrome becomes "stainless" steel, which is extremely resistant to rust, heat and acid. It can therefore be used in many applications where its properties are important. Dish-washers, kitchen sinks, cooking utensils, beer barrels, chemical equipment, process plant for the food industry, gas turbines, milk tanks and medical instruments are just some of the applications.
Production of stainless steel represents the major portion of world nickel demand, yet only small amounts of nickel increase the solidity and strength of steel. This is why low alloy steels are used for machinery and building construction as well as in many other industrial areas. Even at temperatures as low as -200°C steel does not fracture if nickel has been added.
Steels with nickel content are in consequence ideal for refrigeration machinery and for containers used to store liquid gases.

Compact Discs: pressed in nickel moulds

Nickel is a metal of diverse applications. Nickel moulds are used as matrices for the manufacture of compact discs, CD-ROMs and other electronic data carriers. Coins containing nickel have an extremely long life span, as neither oxygen nor acid substances can affect their surface. Coins are often made from copper-nickel alloys. Magnets containing nickel retain their magnetism under extremely difficult operating conditions. Resistance wires made of nickel alloys are used for measuring devices, electric radiators and irons. The reaction-accelerating effect of nickel as a catalyst is employed in fat-hardening during margarine production, and in the cracking process used for the separation of petrol. Finally, chemicals containing nickel contribute to the dyeing of glass and ceramics.

Nickel is an "old" yet at the same time "young" metal. As long ago as 2,500 years, its special characteristics were recognised in the orient, even though the metal itself was unknown. It was not until two centuries ago that it became possible to isolate elementary, i.e. pure nickel. Today, nickel ores are produced mainly in the CIS, Japan, Canada and Australia, world demand amounting to about 1 million tonnes.

The main field of application for nickel is the improvement of steel

Abundant nickel content in stainless steel scrap

As the largest use of nickel is in production of stainless steel, its scrap is an abundant source of nickel as secondary raw material. Huge quantities of stainless steel scrap of different alloys arise in the production and dismantling of plants and equipment for the chemical industry, the food and household goods industries as well as in the medical sector. Before this metal can be remelted by the stainless steel industry, the various qualities have to be collected, analysed, sorted and processed. The treatment of scrap which contains not only nickel but also other high-value metals, requires an extensive knowledge of the material as well as special technical equipment.

Zinc protects against rust

Zinc is one of the most versatile non-ferrous metals. The combination of zinc and copper produces brass

When exposed without protection, steel corrodes and its complete destruction is only a matter of time. Zinc coatings avoid premature deterioration, and of the zinc consumed throughout the world, a third is typically used as surface protection for steel.

Many precision parts of cars are made of die cast zinc. Among other applications, zinc oxide increases the service life of car tyres, improves the characteristics of glass, enamel and ceramic products, and is used in adhesive medical dressings. As construction material, zinc sheets are used for roofs, facades, eaves and gutters. Its combination with copper and zinc produces brass which has many applications including bathroom and other household fittings, vehicle radiators, hinges, screws and lamps. In the Western world, a quarter of zinc consumption is used typically in brass production.
Zinc was recognised as metal rather late, and has been produced industrially for only 200 years. As an alloy component of brass, however, it was already known to the Babylonians and Assyrians. Zinc is produced mainly in the USA, Australia, the CIS and Poland. It is the third most widely used non-ferrous metal, with world-wide demand of about 7 million tonnes a year.

Zinc is crucial to health

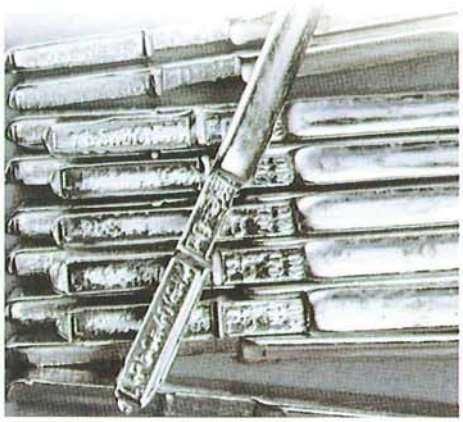
Zinc has a vital function for the human body and is needed in many organs and tissues as well as for various metabolic processes. Among the trace elements, zinc is together with iron the most frequently found mineral in the human body. Food contains considerable quantities of zinc, and the human diet should include on a daily basis 10 to 15 mg of this mineral. Zinc deficiency can lead to health problems.

Comprehensive recovery

Secondary zinc appears in many shapes and guises. Central to consumption are zinc ashes, slags and hard zinc as residues from zinc plants. The shredding of cars and household goods provides significant quantities of zinc. Old gutters and rainwater pipes find their way to the recycler, and thence to zinc mills or smelting plants. Brass clippings have to be cleaned to remove impurities, de-oiled and dried prior to their use in special treatment plants. Alloys containing zinc are simply remelted and refined as necessary. Modern procedures ensure environmentally-friendly recycling of zinc from scrap and residues. An example is the zinc-containing dust which is recovered from the exhaust fume filters of electric arc steel mills. Residual slags can be used in the construction industry. The increasing tendency for zinc coating to be used for protection against rust will increase the importance of its recovery from steel mill dust.

Zinc is the third most widely used non-ferrous metal in industrial production

TINPLATE CANS PRESERVE OUR FOOD



Many products become more resistant and solid through tin

On a 150 metre tandem conveyor belt, a strip of steel sheet, 20 to 30 km long and 1/5 mm thick, is propelled at a speed of up to 700 metres per minute through successive electrolytic baths. Under the effect of electric current, an extremely thin layer of another metal is applied to the surface of the steel sheet, to protect it from environmental attack and to enhance its formability. The metal is tin, which transforms steel sheet into so-called tinplate. After punching and assembling, the most common product with tin content is born - the can.

TIN SOLDER, GLASS AND ORGAN PIPES

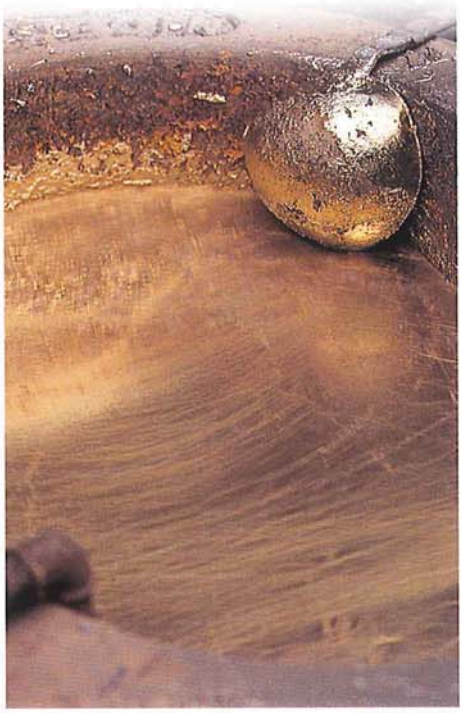
Tin chemicals protect plastics from deterioration through heat and light and preserve the translucency of the material. In car production, a small addition of tin increases the resistance of the motor block, piston rings and clutch plates. With a combination of lead and tin (soft solders), electrical connections, car radiators and other containers are soldered. To make engine mounts more wear-resistant, and to withstand extreme conditions and high revolution rates, copper is mixed with up to 8% of tin. Springs of any kind become tougher thanks to the addition of tin.

But the silver-white shiny metal can do more. Certain types of glass would break more easily if the surface had not been coated with tin oxide. Least, but not last, tin is responsible for the clear sound of bells or pipe organs. As an element of bronze, tin adds an attractive appearance to works of art.

Tin gave significance to the bronze age

Tin was a well-known metal 10,000 years ago. One of the oldest metallic compounds, consisting of copper and tin, bronze has given its name to one of the important ages of mankind (3,000 to 1,000 BC) when its use became dominant.

China is the main producer of the 200,000 tonnes of tin extracted from the earth each year. Other centres of tin production are the countries of South East Asia, e.g. Malaysia, Indonesia and Thailand, but also Brazil and Bolivia.



Tin production from secondary raw materials is worth the effort

Old metal with core values - mixed tin

Apart from precious metals, tin is one of the most expensive non-ferrous metals. Hence, recycling from secondary materials is very important.

The tinning of sheet, parts of motor engines or gear boxes, produces as by-products turnings or slags, while residues of tin solder appear in the electronics industry. Further materials for recycling are derived from old tin and friction bearings with tin content. Fume dusts from steel mills and residues from lead production also contain recyclable tin. All these materials contribute to the production of mixed tin, an alloy in great demand by the tin solder industry.

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