

PRESS KIT:
Copper & cars
"Driving with copper!"

Index

- 1- Copper for smart cars**
With everything fully electronic, copper is a material of the future for smart cars. p.3
- 2- Copper for less polluting cars**
An essential component not only for electronics but also for electric motors, copper is a key to the development of "clean" cars. p.6
- 3- Copper for high-performance machines**
Used in almost every mechanical and electro-mechanical component in vehicles, copper is used in ever higher-performance machines. p. 8
- 4- About the European Copper Institute** p.9

Further information :

European Copper Institute

Christian de Barrin

Communications Manager

Tel: + 32 2 777 70 82

Mobile: 0476 30 99 60

cdb@eurocopper.org

Press Contact

Ogilvy Public Relations

Evelyn Gessler

Tel: +32 2 545 65 42

Mobile: 0475 23 53 92

evelyn.gessler@ogilvy.be

1 – Copper in Smart Cars

Rising to the status of definitive consumer product in less than a century, the car has taken full advantage of technological advances to become fully electronic. The future is thus open to a programmed and “smart” car, designed to guarantee safety and comfort in increasingly heavy traffic. Thanks to its electrical conductivity and corrosion resistance **copper is playing a major part in this development**. In fact, a car contains between 15 kg (for smaller models) and 28 kg (for luxury models) of copper and most of which is in the cables and electrical supply. But it is in the realm of safety comfort and fuel efficiency that copper is especially well placed to be a material of the future for smart cars.

Safety objective

The car is now a mass phenomenon and the continuous increase in traffic is leading to serious consequences, particularly in the realm of safety. And yet production is forecast to rise by, on average, 8% in all segments of the private car market between 2001 and 2006¹.

Production & registration of private and commercial vehicles in 2002²

<i>In thousands</i>	Production	Registration
North America	16,724	19,890
South America	2,006	2,299
Europe	19,898	19,342
Asia	19,926	15,521
Africa	286	718

After having developed their vehicles to be crash resistant, manufacturers are now trying to avoid accidents. To the point of building cars that can react to a given situation, are capable of forcing drivers to respect speed limits, safety distances or basic safety rules. Smart cars have arrived.

¹ “Copper in the Automotive Industry in Europe”, August 2002, Deutsches KupferInstitut, ECI & NFO

² Source: « L’industrie de l’équipement automobile en chiffres » (Figures from the Automotive Component Industry), A publication from the French Ministry of the Economy, Finance and Industry, 2003 Edition, p.4

Copper & electronics: making driving more reliable

The first electronics applications appeared in the 60s: for example in its R16, Renault introduced the first electronically controlled automatic transmission. And in 1978, Citroën began equipping its mass production cars with fully electronic ignition systems. Since then, electronics have been integrated into a host of equipment. Car designers and manufacturers are constantly developing electronic applications the technology in which largely relies on the properties of copper:

- **Sensors** (pressure, temperature, speed ...)
Sensors for the automotive industry make up around a third of the global sensor market. A true sensory system for the car, the sensors allow, for example, dangers on the road to be detected, braking to be adapted, the temperature inside to be controlled, self-diagnosis tests to be run on the vehicle ... They make use of copper, notably, in the coils and cables.
- **Assisted braking:** ABS or Antilock Braking System
This was one of the first “smart” technologies, designed to make driving safer by adjusting the braking depending on the grip. Since then, a whole series of innovations have expanded the solutions available with regard to braking and road grip, including EBD (*Electronic Brake-force Distribution*) for improved distribution of the brake force or ESC (*Electronic Stability Control*) that enhances the stability of the car.
- **Driving controls:** more than a mere speed regulator, the AICC (*Autonomous Intelligent Cruise Control*) allows a speed previously set by the driver to be maintained, without having to keep the foot on the accelerator. A technology available on top of automatic transmission, the AICC monitors the speed of the vehicle in front and changes its own speed accordingly, while keeping a good safety distance.

Numerous other tools are being progressively added to complete this series of services such as, for example: monitoring driver alertness, automatic opening and starting with a smart car, active suspension systems, smart headlights with light intensity adapting in accordance with the speed, night vision ...

Vehicles as living spaces

A symbol of freedom of movement, the car has progressively become the primary means of transport in industrialised societies, hand in hand with more expansive urban areas. Thus mobility in the United States is almost entirely by car, in Europe it is 80 % and a little more than 50% in Japan.³ Moreover, the distances travelled are increasing (+75% in France over the last twenty years for almost the same time use). Car designers are slowly transforming the car into living and working spaces, thanks to a host of applications that use copper, such as telecommunications and infotainment.

³ A. Bieber, J.-P. Orfeuill, “La mobilité urbaine et sa régulation. Quelques comparaisons internationales ” (Urban mobility and its regulation. Some international comparisons), *Annales de la Recherche urbaine, Mobilités* n°59-60, June-September 2003.

With high-speed Internet access available to the driver and passengers, very soon all manner of communication, navigation and entertainment services will be embedded in the vehicles. On certain models, the onboard computer is already connected to the Internet, with the possibility of getting online travel information or weather forecasts, of receiving faxes and emails onboard or being in direct contact with breakdown assistance services.

The vehicle is becoming more and more adapted to its passengers and uses an army of small electric motors, made from copper: this is the case, for example, in applications that enable seats to automatically adapt to the size and weight of the passengers.

Innovations that need copper

All of these innovations use copper's particular electrical conductivity properties to transmit current and data. **A mid-range 2002 model already has more than 2 Km of cables**, most of it made from copper or copper alloy⁴. Moreover, the electrical distribution system and the cables use most of the copper in cars.

With the increase in the number of applications, onboard electrical systems must be constantly improved, with wires that are ever thinner and shorter and ideally not many of them. To avoid a tangle of wires and circuits, interconnections between the cards, chips and sensors must be quicker and shorter. Yet of all the non precious metals, **copper is the one with the best electrical conductivity**. It is also known that optimised copper use significantly improves the energy efficiency of electrical systems.

A new 42-volt standard

Since the traditional 14-volt systems no longer satisfy the energy requirements of smart cars, manufacturers are looking to a new 42-volt standard that improves the reliability of electrical and electronic equipment. Each motor will contain on average at least 100 g of copper. In that way **a slight increase in the radius of an electrical cable enables the number of electrical and electronic applications to be increased**. Ultimately, passing a still higher voltage through electrical wires may allow more energy to be transmitted, opening the way to a multitude of new applications based on miniature motors and digital electronics.

After becoming largely standard in Luxury cars, all of these innovations will be progressively added to high and mid range cars: segments in which the copper per vehicle will steadily rise over the next 5 years. Analysts are forecasting growth of 28% in copper use for the top of the range.⁵

⁴ Source: *Copper in the Automotive Industry*, ECI, 2002.

⁵ Source: "Copper in the Automotive Industry in Europe", August 2002, Deutsches KupferInstitut, ECI & NFO

2 – Copper for Less Polluting Cars

More than a quarter of greenhouse gas emissions come from transportation.⁶ And the part played by private cars in CO₂ emissions is enormous, notably urban transportation that on its own accounts for 40% of the total gas emitted by land transportation. Developing less polluting cars is a vital issue for the environment. Copper plays an important role because it is an **essential component both in electronics and electric motors**.

“Clean” cars: urgently needed by the Planet

Gas emissions, **most of which are of carbon dioxide (CO₂)**⁷, caused by the use of fossil fuels is one of the major environmental problems. In fact, these gases play a role in the **greenhouse** effect, which allows part of the solar radiation to be absorbed and then re-released: this causes the surface of the planet and the atmosphere to heat up. The climate changes and the planet are endangered.

With the United Nations framework convention signed in Rio de Janeiro in June 1992 and the Kyoto Protocol in 1997, the international community decided to act. For its part the European Union agreed to reduce its greenhouse gas emissions by 8% over the 2008 to 2012 period, compared to 1990 emission levels. To meet these targets, **initiatives have been taken in the field of transportation**, including measures designed to reduce the vehicles' consumption and emission per unit. In this regard, a voluntary agreement to reduce the CO₂ emission of vehicles was agreed by the European Union and the Association of European Car Manufacturers (ACEA) which aims for a reduction of 25 % of the 1995 level by 2008 (140 g/Km compared to 186 g/Km) and provides for an additional phase in 2012 to – 35% (120 g/Km).⁸ But there can be no major achievements without the development of new technologies for less polluting cars. **Copper based technology is contributing in a significant manner**.

Copper and electronics to reduce consumption and emissions

A series of manufacturers have joined in the effort to reduce or transform emissions (like with the catalytic converter that has been mandatory in the European Union since 1993). It is particularly through electronics that cars are progressively becoming less polluting, thanks to the optimisation of the engine architecture and fuelling.

Injection, for example, is a key element in controlling the consumption and the emission of polluting gases: to enable fuel savings and avoid partial combustion that causes the release of carbon monoxide (CO) and hydrocarbons, the exact amount of

⁶Source: *Annual European Commission greenhouse gas inventory 1990-2000 & inventory report 2002*, European Environment Agency.

⁷ 82% of all greenhouse gas emissions in Europe in 2000. It is also the one that has fallen the least since 1990 (-0.5%)

⁸ Source: ADEME (French Agency for the Environment and Energy Management)

fuel must be injected at the right moment. Thanks to electronic applications, injection can be finely adjusted on the basis of changes in the speed of the engine. A study carried out by the ICA and the ECI reveals that modern direct injection systems are very dependent on the quality of the electronic system, thus larger amounts of copper. Direct fuel injection thus allows the air fuel proportions to be optimised, and the fuel consumption and gas emissions to be reduced. This is what explains the success of this type of diesel engine. For petrol engines, multi-valve versions are now standard. The future lies in controlling the moment and length of time that the intake and exhaust valves are open.⁹

Copper for cars of the future

The car of the future will be of a new type with alternative propulsion systems. Different solutions are being examined, notably biofuel, natural gas and hydrogen, but equally electric motors and fuel cells. **Copper plays a crucial role** because it is the base material for electric motors.

The solution that manufacturers have developed the most up to now is **the hybrid car** that combines, in the same vehicle, an electric motor and a heat engine. The system, in effect, meets the requirements for lower energy consumption and CO emissions and for autonomy. This transition technology is of interest because it combines two different aspects that are of great importance to the driver:

- For long distances, the performance and autonomy of the traditional internal combustion engine that runs at optimal speed and causes only minimal waste;
- For urban journeys, the non-polluting technology (since CO₂ emissions are largely due to private vehicles making urban journeys) and quietness of an electric motor at low speeds, without the inconvenience of little autonomy. Indeed, the combustion engine takes over and recharges the batteries for journeys beyond urban areas.

Mass production should lead to a reduction in the cost of hybrid cars.

The exceptional conductivity of copper **makes it a crucial material for clean cars**. Hybrid cars use big electric motors or drive-trains that can contain copper coils of up to 12 kg each.

Finally, the third very promising idea is the **fuel cell**. A chemical reaction between hydrogen and oxygen generates electricity that drives a car by using an electric motor. The exhaust only releases water vapour. Work on fuel cells for cars shows great promise and with it a need for copper to convert energy into power.

⁹ Source: FEBIAC

3 – Copper for High-Performance Machines

Throughout the history of the car, copper has always been a metal of choice. The first models, such as Ford's 1916 model T with a crank handle had 4 coils and a "magneto" to power the lamps. Nowadays, **copper is used in almost all of the mechanical and electro-mechanical components in the vehicle**, from the motor system through the electrical distribution system to the chassis. It actively contributes to improving the vehicles to create ever-higher performance machines.

Copper is a widely used component in machines

The copper is simultaneously corrosion resistant, strong and ductile. These properties, essential in machines, explain its wide use, including in the form of alloys, to make rods, bars, pipes, and mechanical wires. Brass (copper zinc alloy) and bronze (tin copper alloy) bars are, for example, easy to precision machine to produce bearings, rings, guides, sensors, fluid connectors and hooks ... The copper, nickel alloy, for pipes and nozzles, ensures that the components in the braking and steering system are exceptionally strong and corrosion resistant.

Temperature control thanks to copper

Due to its corrosion resistance and heat conduction properties, copper was always a material of choice for performance radiators.

A new brass brazing procedure (CuproBraz[®] technology)¹⁰ was in fact developed to manufacture copper and brass heat exchangers for use in modern conditions. These compact and mobile heat exchangers have increased in efficiency and durability. It is successfully used in various automotive applications: from radiators for charge-air-cooling systems, through motor oil cooling systems to air-conditioning systems.

Nowadays, research has notably allowed next generation radiators to be developed using copper, which have superior heat conductivity, are corrosion resistant and can operate at higher temperatures.

Copper in electro-mechanics

Mechanics give way to the digital world with electro-mechanics. Thus the traditional camshaft, responsible for opening and closing valves, is on the point of being replaced by the EVT (Electrical Valve Train) system that significantly improves engine performance. The electronically controlled system allows both intake and exhaust to be more fine-tuned, depending on the vehicle and the circumstances of use. And digital valves enable the top and bottom dead centre points to be eliminated, thereby increasing the torque. This technology moreover improves fuel consumption and allows hydrocarbon emissions to be reduced by 10% compared to current technology.

¹⁰ Cf. www.cuprobraz.com

4 – About the European Copper Institute

The European Copper Institute is a joint venture between the world's mining companies (represented by the International Copper Association, Ltd) and the leading European fabricators. Its mission is to promote copper's benefits to modern society across Europe, through its Brussels office and a network of 11 Copper Development Associations.

ECI is active in 4 key areas in Europe:

- Electric & Electronics
- Building Construction & Automotive
- Environment
- Health

1) ECI Electricity and Electronics Programme

The ECI electricity and energy programme is aimed at promoting the rational use of energy, in the context of sustainable development, in three areas:

- **Energy efficiency:** in increasing research, awareness and market development activities, in particular by participating in community action programmes, like the "Motor Challenge", which encourage the industry to use high efficiency electric motors driven systems, in order to increase energy efficiency.
- **Quality of electric energy:** ECI is the founder of a community action programme for professional training (LEONARDO Power Quality Initiative) to improve the quality of electric energy by reducing electrical interference. Present in 12 countries, this programme involves more than 50 organisations including renowned universities, companies and professional bodies. The target is to save 10 billion euros per year by reducing electrical interference.
- **Electrical safety and convenience:** The ECI set-up a European working group on enhancing electrical safety in the home, bringing together the main players in the field: FEEDS (Forum for Enhanced Electrical Domestic Safety).

2) ECI Construction and Automotive Programme

Construction and automotive are key sectors of activity for the ECI. ECI promotional activities in these fields are centred on 3 main axes:

- **Architecture and plumbing systems:** the aim is to promote copper's many attributes, in particular in systems distributing drinking water, heating and gas and exterior design challenges.
- **The role of copper in solar energy:** raise awareness on copper's outstanding thermal conductivity as a key factor in exploiting solar energy.

- **The advantages of copper in car manufacturing:** communicate copper's essential role in improving modern cars' safety and comfort and to make possible the cars of the future.

3) ECI Environmental Programme

The ECI environmental programme is mainly aimed at understanding copper's role in soil and water. The results are used in discussions on regulations both at a European Union level and national level. All research is undertaken with the assistance of eminent scientists.

4) The ECI Health Programme

The ECI health programme is primarily aimed at understanding the possible impact of copper on health. The results are used to improve health by contributing to the discussions on regulations both at a European Union and national level.

Further Information:

Christian de Barrin,

Communications Manager

Tel: + 32 2 777 70 82

Email: cdb@eurocopper.org – Website: www.eurocopper.org

Illustration

