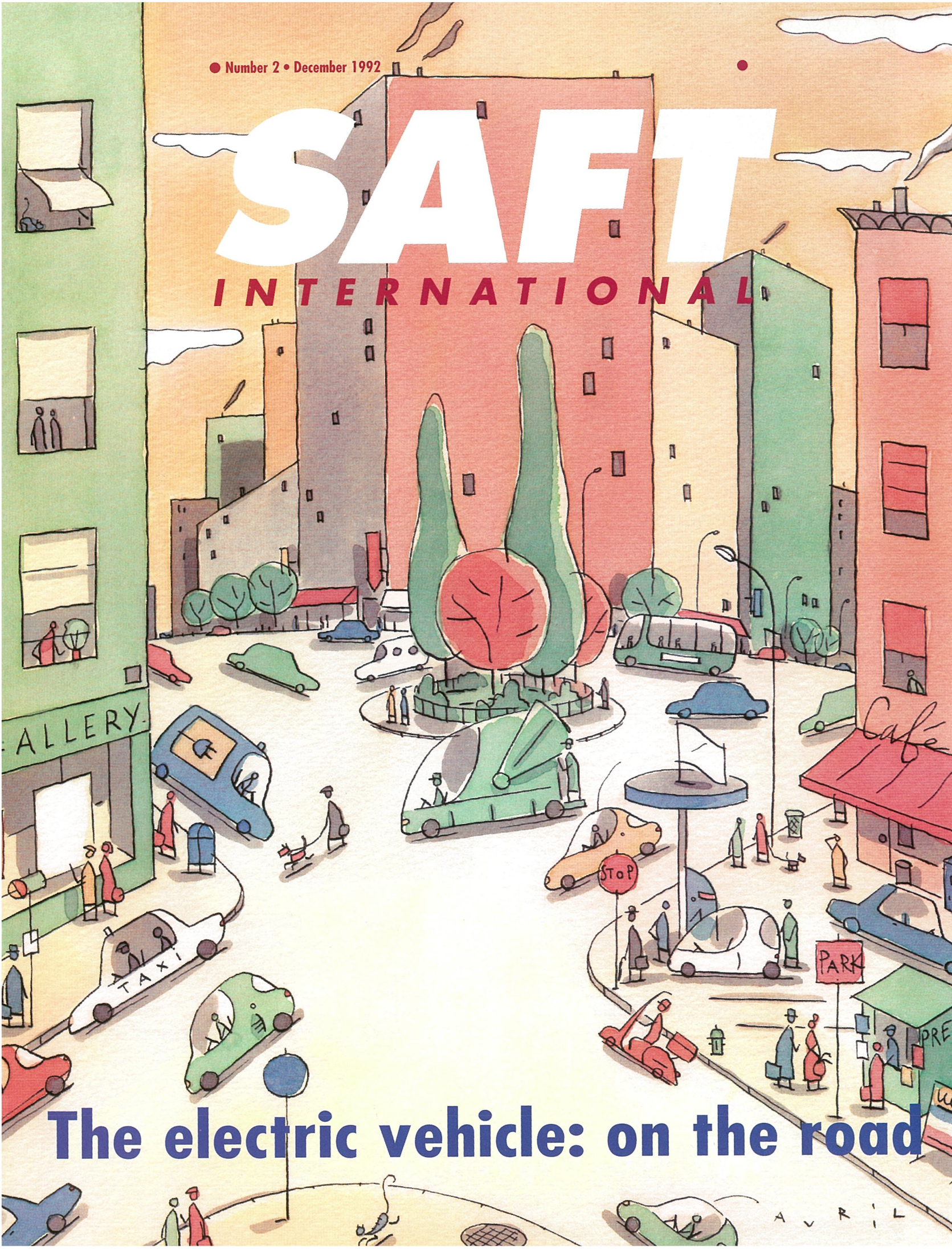
● Number 2 • December 1992

SAFT INTERNATIONAL



The electric vehicle: on the road

CONTENTS

Number 2 • December 1992

SAFT

SAFT INTERNATIONAL
A MAGAZINE FOR SAFT'S CLIENTELE AND BUSINESS PARTNERS
Editor-in-Chief: Roland Bourgeois
Managing Editor: Bénédicte Piret
Design & Editing:
Published by the Saft Corporate Communications Department
156, avenue de Metz, F-93230 Romainville
Tel.: (33-1) 4942 3434 Fax: (33-1) 4942 3400

EDITORIAL

BRINGING IN THE ERA OF THE ELECTRIC VEHICLE – as well as the New Year – with the second issue of *Saft International*... In keeping with the "new beginnings" spirit of the season, we have changed the format. In-depth articles as well as news briefs will keep you up to date on our activities and the latest developments in the technology. But we haven't changed the actual goal of the magazine – to get closer to the customer worldwide. In this spirit, this issue features a project that concerns everyone: the electric vehicle.

P. Simard

We have certainly come a long way since the projects of the 1970s. Manufacturers, governments – all are putting their hand to the task, with new initiatives that will work together to make this ambitious project a reality. A reality that we need desperately. All the signs point to it – our increasingly congested, noisy and dirty inner cities, the massive pollution problems on a global scale.

Saft has been aware of these problems for decades – and has played a critical role in their solutions. We have participated as battery supplier in all the major electric vehicle projects throughout Europe and the United States. However, as in our other areas of expertise, we aim to be more than simple suppliers – we are our clients' active partners, working together towards the same end.

Saft nickel-cadmium batteries stand up to lead-acid competition for the "first generation" of electric cars – but that's only the beginning of the story. Work on the power of the future is already underway – Saft's nickel-metal hydride and lithium technologies promise to take the electric vehicle well into the 21st century.

Our electric vehicle schedule is full for 1993. Among other projects, we will be participating in Peugeot's 106 and Citroën AX electric cars, and work is continuing on our pilot plant for full-scale industrial production. And of course, we will also be bringing you the same innovation, excellence and long-term vision that go into our EV batteries.

Our very best wishes for a happy and successful New Year!

FRANÇOIS PUTOIS
Industrial Battery Group General Manager

The electric vehicle: on the road

Citroën's experimental Citela – fast-forward to the 21st century

Citroën

The long-awaited electric vehicle will soon be rolling into our daily lives. An update on the state of the art.

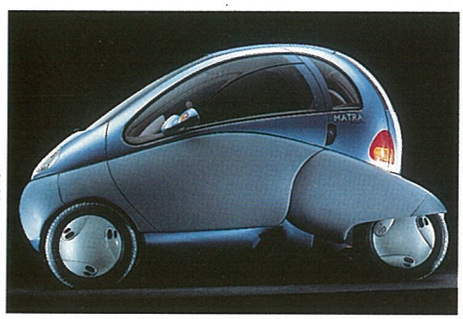
The electric vehicle is finally heading for market, one hundred years after the idea was introduced! Propelled by a new surge of environmental concerns, carmakers are teaming up with battery manufacturers worldwide to develop mass-produced non-polluting passenger cars for urban transport within the next few years.

In Europe, France has taken the lead with an ambitious industrial accord between Saft and PSA Peugeot Citroën to introduce two assembly-line electric car models in 1995. A production of 50,000 a year is envisioned by the end of the century. French government authorities, desirous of relieving urban noise and air pollution, have recently joined in the effort with a pilot program to develop an EV infrastructure in 22 cities.

And as the industry enters pre-development for the first phase of production, Saft is already moving towards battery technologies for the 21st century. Multi-million-dollar Saft research programs are being proposed for funding both in the United States and Europe.

DR

The September '92 EV symposium in Florence: 40 vehicles on display



Renault Communication

The new wave – the Matra-Renault Zoom

Though the car industry has blown hot and cold about the electric car over the years, Saft officials believe that this time it's for real. They point out that, unlike the oil crises of the 70s, which stimulated plans for the EV that were dashed as soon as oil prices came back down in the early 80s, the current stimulus – environmental protection – won't go away. In fact, it can only get stronger, as mounting air and noise pollution caused by the internal combustion engine makes city life increasingly unpleasant and unhealthy.

MANY HURDLES TO CLEAR

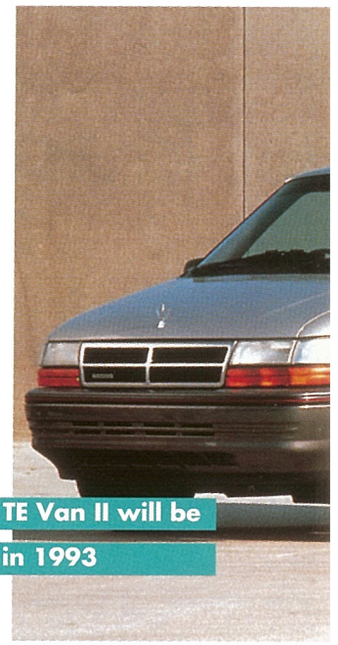
"People have been talking about the electric vehicle for more than 20 years, but in the past two years, I've seen something new," said François Putois, who oversees EV matters as Industrial Battery Group General Manager. "Government people are taking action, and car companies are actually putting together teams to develop electric vehicles for the passenger car market."

Though he is optimistic, Putois said there are many hurdles to clear – technological, industrial, financial and political – before the EV can develop to play a major role in the industry.

The challenge is that these factors are tightly interrelated, making resolution of one problem dependent on solving another, which in turn may be dependent on yet another solution.

For the market to develop, for example, experts say that a government stimulus is required: either tax incentives or tougher restrictions on polluting vehicles, or both. "There is no natural market for the electric vehicle – the public isn't sensitive enough to the pollution problem to go out and buy an electric car," said Jean-Pierre Cornu, Director of Development for the Industrial Battery Group. "You really need a push from the government."

The market's development is equally dependant on meeting consumer requirements for performance and price. Both are linked to reaching high-volume production – which, continuing the circle, is dependent on sufficient consumer demand for products that may fall short of the optimum levels needed.



Chrysler's electric TE Van II will be launched in 1993

This chicken-and-egg problem is most obvious in the challenge of moving from the first generation of EV, now under development, to the second generation. Carmakers are designing the first generation with existing battery technology – either lead-acid or nickel-cadmium – which they are applying to modified versions of existing car designs. PSA, for example, will use Saft's highly recyclable STM nickel-cadmium battery in its Peugeot 106 and Citroën AX.

Though industry officials recognize that the market is likely to respond much more positively to the second-generation electric car – whose original car designs will perhaps double performance – the industry will find it impossible to fund the research, engineering and industrial investments required to arrive at the product without proof from consumers that they will buy electric cars.

For Saft, this same dynamic will be at work in development of the first phase, as it is challenged with slashing costs in the development of a new pilot plant in Bordeaux (France) to mass-produce the STM. To meet PSA's market requirements, the battery's cost must come down from about $1,000 per kWh to around $400. At that level, it would be about twice the cost of lead-acid batteries, but still very competitive because of its much longer life (7-10 years, or about the life of the vehicle), much greater autonomy (120-140 km versus 60-70 km for lead-acid batteries) and its significantly

Chrysler

greater withstanding of mechanical and electrical abuse.

"We see a breakthrough in the manufacturing process," said Cornu. "We're quite sure of achieving this goal within five years. Next year we will reach a production cost of $800 per kWh." He said the goal could be achieved with volumes of over 10,000 units a year. Cornu sees a market of 18,000 electric cars a year in Europe by 1995, growing 15-fold to 280,000 cars by 2001 and 400,000 cars by 2003.

European governments are also getting in on the action. For example, the French government recently made an important gesture to help the market's development by signing an accord with Renault, PSA and Electricité de France, the national electrical utility, calling for a step-by-step approach for introducing EVs in French urban centers.

Under this agreement, 22 cities will be participating in pilot programs. Their local authorities will progressively introduce electric vehicles in their fleets – like garbage trucks and street cleaning vehicles. Both standard recharging plugs and rapid recharging stations will be installed throughout the cities and at public parking lots. These stations will serve in emergency situations and relieve consumers' "stress" about running out of power before reaching their destinations.

Moreover, La Rochelle, a city on France's Atlantic coast, is working on a plan to provide a fleet of 50 electric cars for public rental next spring. They will be available at public parking lots for a small rental charge plus the cost of recharging. If the experiment proves successful, the fleet could be expanded to 200-300 cars.

THE NICKEL-CADMIUM ADVANTAGE

With a decade of electric vehicle experience behind it, Saft is well positioned to power a wide range of EV applications, from cars and utility vehicles to buses and garbage trucks. Saft's nickel-cadmium designs, the STM and STH, offer critical advantages of lower weight and size over lead-acid batteries of similar capacity.

City traffic – where electric vehicles will make their debut – poses very specific problems. Space is tight, distances are short, and cars are required to start and stop constantly. The STM is ideally suited to these demands, with a range of 100 km, a service life of over 100,000 km and compact dimensions that won't restrict passenger and luggage space.

Saft's STH batteries allow bi-modal trolleybuses in Milan and San Francisco to break away from overhead lines when traffic requires – and then recharge when the bus returns to the lines. The compact STH allows each bus to carry 19 passengers more than would lead-acid batteries.

NiCd offers another environmental plus: it is almost completely recyclable. Saft's recycling facilities can recover more than 90% of the entire battery, and cadmium itself can be recycled indefinitely.

As these efforts begin, Saft is already looking to three advanced battery designs that could power the electric cars of the next decade.

For the second-generation solution, Saft is developing the nickel-metal hydride couple: it will increase energy density by 30 to 50%, and the range will rise to over 150 km. This technology has already been adapted to the demands of portable equipment. Expectations are high for its electric vehicle performance.

A BIG STEP IN ENGINEERING

Long-term solutions revolve around lithium. One lithium couple is being developed in the United States – a particularly important market, where California launched government EV regulation. By 2010, 10% of California's vehicles must be emission-free. Fourteen other states have followed its example.

In response to this new imperative, Saft America Inc. is focusing on a design employing lithium iron disulfide. It has joined with the Argonne National Laboratory seeking an R&D grant from the Advanced Battery Consortium – a group composed of the US Department of Energy, the Electric Power Research Institute, the three American automakers and battery manufacturers.

In Europe, Saft is pursuing public-private R&D funding for a battery design using lithium carbon in the negative electrode and a metal oxide – such as nickel oxide, cobalt oxide or manganese oxide – in the positive electrode.

This solution, according to Jean-Pierre Descroix, marketing manager at Saft's Advanced Battery Group, could double the performance of a nickel-cadmium battery of the same weight while satisfying the safety demands.

The challenge is engineering the battery to work on large applications such as the EV. "Lithium carbon technology exists in small systems, but scaling it up to several-hundred-pound batteries will require a big step in engineering," Descroix said. "It should be an excellent solution. The technology won't be ready for commercialization before the next century – but that's coming up fast." ■

Made to Measure

OEMs and battery manufacturers make a winning team, as Saft's custom work for Rowenta proves.

Rowenta France hopes to sweep up the portable vacuum cleaner market with the help of a new series of rechargeable NiCd battery, the VPCs 1300, custom-tailored for the application by Saft.

The vacuum cleaners reflect the close collaboration between Saft and the appliance manufacturer over the past two years. They are just one example of Saft's work with original equipment manufacturers to custom-design batteries for special applications and design constraints.

"The OEM market has specific needs," says Jean-Luc Borghero, sales manager for Saft's Portable Battery Division in France. "A standard product can't entirely fit the bill."

Saft teams its sales force with research and development staff to provide made-to-measure solutions for manufacturers. The process can take up to two years or more. An exhaustive series of meetings define the customer's needs, fix technical parameters, produce samples, provide for testing of the samples by customer, make final revisions if necessary, and ultimately, earn the order to begin production.

In Rowenta's case, the challenge was formidable – to develop a range of batteries with permanent charge and rapid discharge. "The electrode design was the really knotty problem," Borghero said. "Designing for quick charge and quick discharge is pretty simple, but it's not easy to develop a battery with permanent charge and quick discharge." The permanent-charge battery was key to Rowenta's technical needs, he says.

"Rowenta's sales argument for its vacuum cleaner line is based on autonomy," he said. The battery ultimately developed was designed in three configurations – three-cell, four-cell and five-cell units. Rowenta can thus market the same model at different price points for customers desiring different levels of autonomy.

Rowenta approved the battery design in June. The first batch was delivered in September to their French production facility in the province of Normandy.

Meanwhile, Saft will be bringing its expertise in this field to other major vacuum cleaner manufacturers. A battery design is currently under discussion with a French plant of the American company Hoover.

Environment: Saft is on the ball

What is the role of a major manufacturer in today's environmentally-oriented climate? Saft has chosen the path of knowledge followed by efficient action. Robert Eloy, Saft's environmental affairs manager, monitors regulation developments from Romainville (France). Keeping a close watch from the very start gives Saft a head start on full compliance. Rather than seeing these regulations as a constraint, Eloy's policy is to use them as a guide to establish a plan of action – in keeping with mother company Alcatel Alsthom's guidelines.

As far as production is concerned, Saft has been "green" for over a decade. Emissions, waste products, and other outputs are closely regulated worldwide. Facilities are in place for the collection and recycling of NiCd batteries.

The Rowenta AC-20 vacuum: the fruit of a close partnership

The OEM market accounts for about 70 percent of the sales in Saft's Portable Battery Division. Standardized products sold through industrial distributors represent another 20 percent, and private-label batteries made for large retailers and supermarkets account for the remaining 10 percent.

In addition to Rowenta, the Portable Battery Division custom-tailors batteries for Philips and Matra, for cordless phone applications – a booming market segment. It has also been collaborating with Alcatel to design special power packs for its new cellular phones.

Borghero said that OEM constraints are tough. Generally, he said, clients want batteries with "more power, lower weight, smaller size and lower cost." But Saft has proved to be ready and willing to take on the challenge!

But protecting the environment doesn't stop with the manufacturer – Saft seeks to make environmental partners of its customers.

Brochures available for the Industrial and Portable Battery Groups explain the NiCd recycling process and how Saft and its clients can work together for a cleaner future. Similar policies are being planned for other product lines.

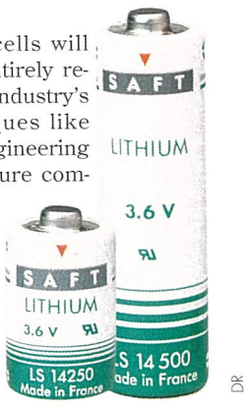
IN BRIEF

LS SETS A NEW STANDARD

The new-generation LS lithium cells will be set to ship this spring. Their entirely re-engineered production reflects the industry's cutting edge. Innovative techniques like laser welding and simultaneous engineering cut down production time and ensure complete reliability, and redesigned equipment improves quality while increasing competitiveness.

The 3.6 volt cells, with a 10-year lifespan, are ideally suited for powering home fire-alarms, as well as memory back-up in computers and other electronic devices.

The new LS also responds to the demands of a fast-growing application: electronic meters – water, gas, electric and parking – which are quickly replacing mechanical meters in Europe, North America, and Asia. Here, the LS's ability to withstand extreme weather conditions is a major advantage, as most meters are outdoors.



DR

STATE-OF-THE-CHARGE

Users of laptop computers, cellular phones, and video cameras cannot afford to run out of energy at the wrong moment! To solve this problem, Saft is collaborating with Texas Instruments on an advanced State of Charge Indicator (SCI) that will indicate the charge status of battery packs. The SCI can be programmed to accommodate different battery technologies, displaying charge status as well as time remaining until complete discharge on an LCD indicator. The SCI will be available in December 1992 – ensuring a worry-free New Year for portable battery users!

RIGGED OUT WITH SAFT NIFE BATTERIES

DR

Pemex, Mexico's number one oil company, counts on Saft-Nife pocket-plate batteries for its oil rigs. 470 SBH157 and SBL102 NiCd cells are currently cranking the gas turbines that power oil extraction on Pemex rigs in the Gulf of Mexico. They also run auxiliary services like emergency lighting and alarms. Saft Nife (México) S.A. de C.V. continues to reinforce its leadership in Mexico in this sector, furnishing reliable batteries to guarantee the constant performance critical in the oil industry.

NO INTERRUPTIONS, PLEASE!

Docklands Light Railway, the commuter rail system serving London's newly developed Docklands district, is updating its signalling system – with the help of Saft Nife on-line uninterruptible power supply (UPS) systems. Twelve 3kVA AC UPS systems will guard against power failures, backing up the point control systems and secondary signalling systems. Part of a £24 million investment, they will help ensure a smooth ride for the system's 30,000 daily commuters.

Docklands Light Railway

Lithium: safety first

Lithium, a very high-performance battery material, is often thought of as hazardous. The answers to your questions...

Among the pioneers in lithium batteries, Saft has over two decades of experience in their production. Over the years, lithium batteries have proved to offer longer operating life – 10 years or more – and an even longer shelf life. After a decade on the shelf, a lithium battery retains 80 or more percent of its energy, and some still function after 20 years.

Lithium batteries' high voltage (3V), in addition to their compact size and light weight, makes them ideal for portable consumer devices – cameras, flashlights, calculators, watches. They provide up to three times the energy of conventional batteries for a given volume and weight.

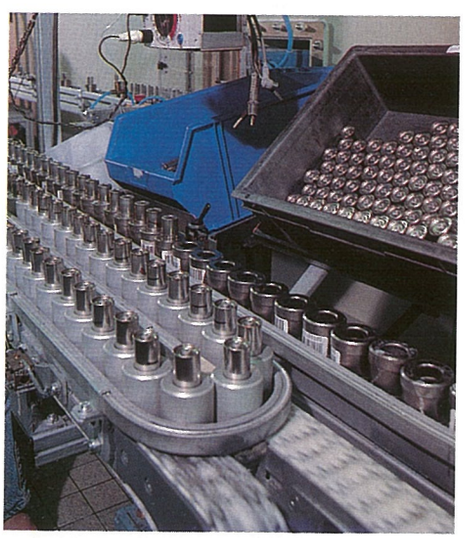
Saft produces four different types of lithium systems and 15 million lithium cells a year. A large part of its production is concentrated on higher-capacity batteries for use in applications like alarm systems or battlefield radios for the military market.

Batteries often come under attack on a number of safety fronts, and lithium is no exception. However, unlike traditional batteries, incidents involving lithium have provoked widespread publicity. They have even been blamed for plane crashes, and the slightest mishap triggers extreme reactions. This alarmism naturally stems from doubts surrounding what is still seen as a "new" technology. Furthermore, the promotion of "safe" lithium batteries raises inevitable misgivings about the rest.

Michel Grimm, head of lithium battery market studies for Saft's French Lithium Battery Division, says the actual number of problems involving lithium batteries is much smaller than those generated by conventional batteries. According to experts, the risk posed by lithium batteries is minimal. And with the extra safety features built into the products – and, of course, proper use – any potential danger is all but eliminated.

What are these potential problems? First, some lithium cells contain liquids that can vaporize and bring on potentially excessive pressure levels when overheated, either by short-circuiting or in very high-temperature environments.

To guard against this possibility, Saft has developed special safety precautions for its 3.6V lithium-thionyl chloride LS and LSH series, including pressure vents that prevent explosions by introducing a fracturing property into the cell case. In the harshest environmental conditions, such as fires, safety is maintained: the vapors released are not flammable. Some cells are equipped with internal fuses that blow in the event of a short circuit, preventing overheating. In addition, the housing is engineered to resist pressures of up to 26-30 bars. Saft's LS and LSH lithium batteries can thus handle storage under extreme temperature conditions, ranging from -55° C to +85° C. They can operate in even tougher environments, as hot as 110° C.



DR

Producing lithium cells: 15 million a year

■ SPECIAL SAFETY MEASURES

The second potential hazard is the accidental release of matter. Lithium batteries, like their conventional cousins, can be dangerous if cracked or punctured. Lithium, a substance found widely in the natural world, is not a heavy metal and has no toxic properties. But it is highly reactive and oxidizes very easily, requiring protection against dampness to preserve its properties. LS and LSH batteries are thus housed in 0.3 mm thick stainless steel and hermetically sealed

Carbone Lorraine

Lithium: two decades of expertise in the technology

using laser welding, which reduces the risk of leakage to an absolute minimum.

The absence of heavy metals in lithium cells makes the treating of used 3.6V lithium-thionyl chloride cells simple. A good soak in salt water dissolves any residual lithium and decomposes the main battery components – which can then be disposed of in any landfill.

For a final seal of official approval, Saft submits its lithium batteries to the Underwriters Laboratories (the American insurance companies' safety program), where they are rigorously tested. In addition, Saft has prepared a video to directly address the questions of its clientele and collaborators on lithium; it explains in detail the extra safety features designed into its batteries, and how best to use them.

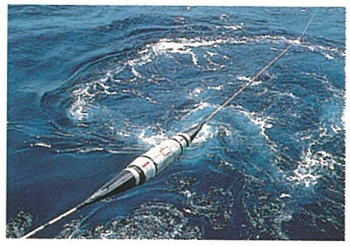
Michel Grimm has the final word on lithium. "These batteries have been used in heart pacemakers for 20 years. You couldn't afford to have a dangerous battery implanted in the human body."

IN BRIEF

ECO-ENERGY FOR ELECTRIC FENCES

Saft is redesigning its proven products for electric fences to meet strict environmental standards. Its star effort, a new air-depolarized cell called the "Green Turbo", offers a capacity of 120 Ah – 30% more energy for the same volume. Above all, it doesn't pollute: no heavy metals are used in its production. Along with the re-engineered standard line (AD 6535, AD 6540 and AD 5526), the new cell is now being distributed in France by Copélevage, the French subsidiary of Europe's top electric fence manufacturer, Horizont. Yet another step towards a cleaner environment...

WAVE OF THE FUTURE



J.M. Chourgnoz

Telecommunications is being revolutionized by underwater fiber optic cables. Saft is participating in this surge; its equipment powers 9000 kilometers of cable linking the Canary Islands and Madeira to South Africa. The power feed equipment now integrates the technology of optical fibers, as well as microprocessers, to help provide more efficient power – a 1.6A constant current at a maximum tension of 9000V. Next project underway: a cable linking Singapore and Marseille.

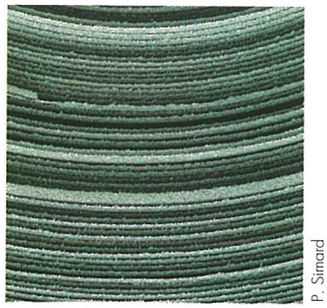
© Arianespace

3, 2, 1...

European launcher Ariane 5 is scheduled for takeoff in 1995. Like her "older sister" Ariane 4, the launcher will be exclusively powered by Saft batteries after takeoff. The Space Division is developing silver-zinc and nickel-cadmium batteries to power the "brain" which guides the craft, as well as the boosters. Designed to resist severe vibration, mechanical shock, and temperature changes, the batteries represent years of experience in providing the high reliability demanded by space programs – where the slightest error can be fatal.

HIGH-ENERGY FOAM PRODUCTION

Full-scale production of foam positive electrodes has taken off at the Nersac (France) plant. Its new production line can manufacture "impregnated foam" at a rate of tens of millions of Ah per year. Fully automatized, the line is a continuous-run process. Its simple operation minimizes waste, providing an exceptionally environmental and economical solution. Used in Saft's super high-energy VSE range, nickel foam brings 15% more capacity to portable applications. In AA and A sizes, it helps provide the compact energy source demanded by camcorders, portable telephones, computers, and faxes. High-performance foam products are on their way: 4/5 A, A and 4/3 A sizes will soon be making their debut. Even more, an AA 900 Ah battery (topping the classic 800 Ah version) is in the works!



P. Simard

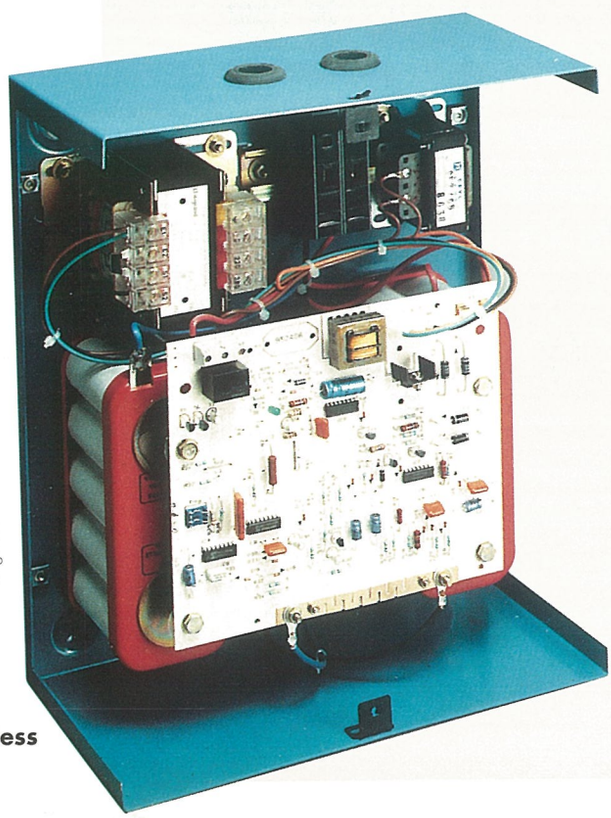
Keeping hospitals healthy

Saft batteries support numerous vital functions in the medical sector, from surgical lighting to X-ray equipment.

Saft is lending an increasingly important hand to hospitals in their efforts to save lives. Its batteries and battery systems can be found in a wide range of hospital applications, from power sources for starting up power generators in the event of an outage, to emergency lighting and portable medical equipment.

Because of the critical nature of the hospital environment, many products must meet exacting performance requirements, very often dictated by national regulatory authorities.

In France, for example, hospital norms for operating rooms require a special DC power supply that can run surgical lights for at least one hour in the event of a general power failure. "It must switch on in less than half a second after the mains cuts off," said Michel Migeot, a marketing product manager in Saft's Emergency Lighting Division.



Langereau

SCY systems switch on in less than half a second

For this application, Saft offers the SCY nickel-cadmium battery system, including a fast-charge system that, Migeot said, "allows the product to have nearly complete autonomy within 12 hours after a complete discharge." Saft offers four different 24-volt power modules, all providing one hour of autonomy, from 140 watts to 560 watts. Like modules can be tied together in parallel, providing unlimited autonomy requirements.

In France, the market for such systems ranges from 1,000 to 1,500 per year, and Saft – fast to enter the market in earlier years – now has a strong position.

INSTANT REACTION

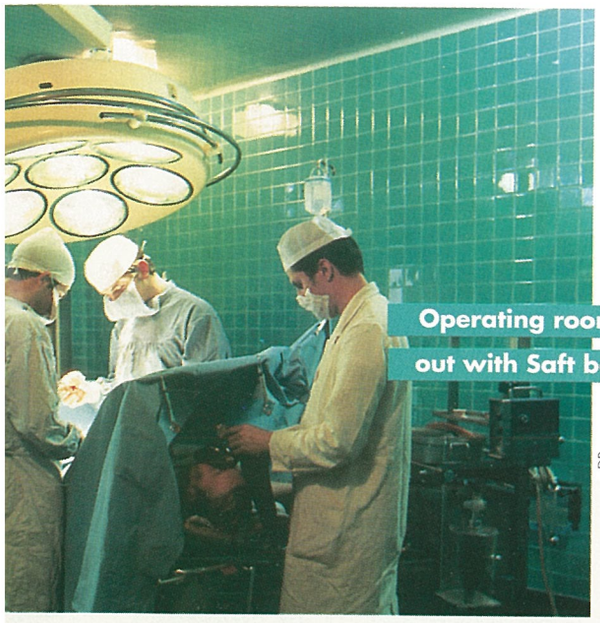
In Germany, Saft Nife markets an AC system to power an entire operating room or an intensive-care unit. The system, comprised of battery, rectifier and converter, must also come on line within one second of power failure. "With this system, the operating theater can continue for several hours on battery power without any problems," said Björ Joensh, sales manager for this line of products in Sweden. "During that time the hospital is arranging its emergency supply. The system is just for overlap."

The nickel-cadmium system, which recharges automatically when the power comes back on, has a life of over 15 years, Joensh said.

The market revolves around new hospitals and upgraded hospitals, under pressure to meet higher safety requirements. "Regulations are getting tighter and tighter," he said.

In Sweden, he added, a similar product is marketed, but it features an uninterruptible power supply (UPS) system, thereby eliminating the less-then-a-second risk.

Saft also makes batteries for a range of portable medical equipment, such as a line of defibrillators – heart monitors – which use 12-volt 1.2 Ah nickel-cadmium batteries.



Operating room lights never go out with Saft backup equipment

DR

At the other extreme, Saft has adapted one of its most powerful technologies, most often used in starting aircraft and airplane emergency systems, to power mobile X-ray units.

The company produces the VP 140 KA-MS replacement battery for General Electric-CGR-GEM mobile X-ray units, with the battery assembly consisting of three banks of 26 or 30 cells, stacked at the base of the unit. A 90-cell assembly contains a stored energy of 1.5 kWh. Saft also supplies replacement batteries for mobile X-ray units made by Picker, Philips and Raytheon.

"This application requires very high peak power, and a high power-to-weight ratio," said Fred Eric Hapiak, marketing manager for Saft's Aviation Battery Division.

The NiCd battery is designed to generate greater surges of power and to sustain that power longer than the OEM or competing battery. The high-performance cell features a thermowelding process which eliminates electrolyte leakage.

The market for these batteries is largest in the United States, where hospitals are accustomed to bringing X-ray equipment to patients. In Europe, hospitals are organized differently, providing little need for the product. "In terms of organization, European hospitals prefer to bring patients to the X-ray room rather than bringing their X-ray unit to patients," Hapiak said.

Meanwhile, Saft is looking towards new applications for its batteries in the medical field. For example, in the United States, medical researchers are designing advanced equipment for the immediate treatment of cardiac arrest. Another opportunity for Saft batteries – in this case, NiCd Aviation batteries – to come to the rescue!

WORLDWIDE

CLOSE-UP: SAFT NIFE ITALIA

Saft Nife Italia's history goes back to 1933, when Nife's subsidiary was established in Genoa. Since 1991, when Saft and Nife subsidiaries merged, the 70-person team has been serving clients like Aeritalia, Ansaldo, Fiat and Olivetti. Leaders in transport, they provide NiCd industrial batteries to power auxiliary systems for Italy's ships, trains, subways, trams and trolleys. And naturally, Saft Nife Italia is also at the forefront of Italian electric vehicle development.

The company also leads the Italian portable battery market, which is run from a commercial office in Milan. The Genoa headquarters include a plant for the design and manufacturing of Power Electronics equipment; complete products back up large industrial facilities like steel mills and petrochemical complexes – a promising sector which they are seeking to expand.

DR

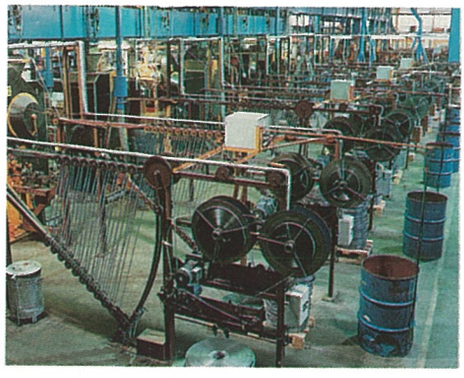
FRANCE: WORKING TOGETHER

Partnership was the order of the day at the two-day seminar held by the Portable Battery Division for its ten French distributors, in Angoulême (France). The goal was to present Saft's latest advances in electrode technology to the clients, who represent a 250-member sales force – and, even more, to reinforce Saft-distributor cooperation. Investing in training distributors, providing support and defining common objectives have long been part of Saft's policy – a winning combination for everyone.

SWEDEN: QUALITY COUNTS

Qualifying for ISO 9001 rating at the first inspection is practically unheard of – except at Saft Nife's Oskarshamn plant, whose 100-year reputation for excellence was crowned by ISO approval in 1992. "The key is the human element," says managing director Torbjörn Anulf. Oskarshamn's quality system is supported by exceptionally trained and involved personnel, who take personal responsibility for quality.

Specialized in pocket-plate technology, the 400-person plant manufactures 700,000 batteries per year – largely industrial batteries for transport and UPS systems for applications like train lighting, hospital operation theatres and airports.



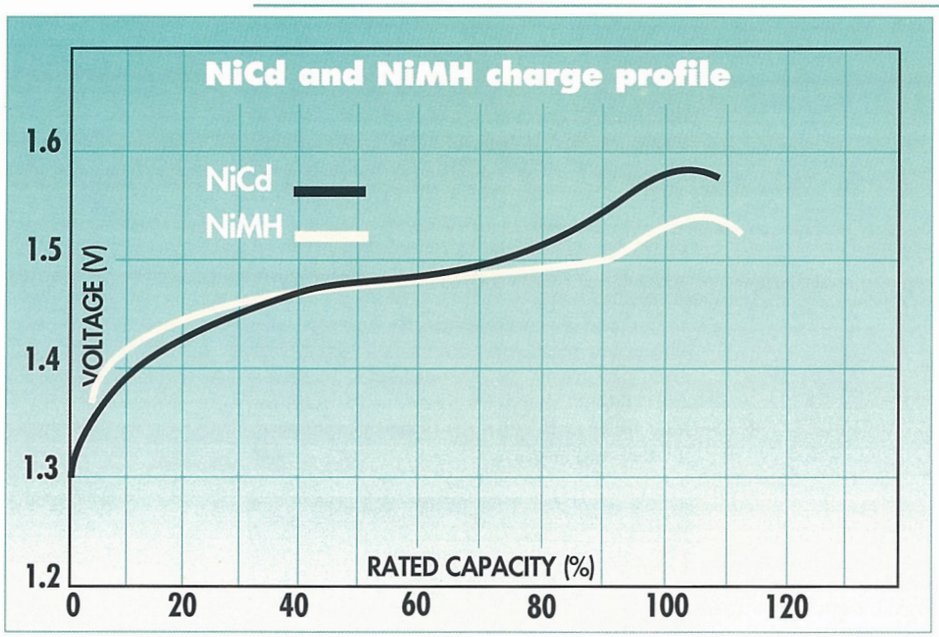
G. Swärd

Mobiles... have we

Smaller, lighter portable telecommunications equipment – the goal of every manufacturer. Here, an overview of the means to this end: the latest technological innovations.

For many years battery manufacturers have been led by market demands to produce the optimum battery for each individual application. Batteries still represent 20% to 30% of the total equipment weight, while equipment itself must lose weight and volume. Manufacturers are under pressure to find new alternatives for products like cellular, cordless, PMR, trunked and paging systems.

Since the early 1970s the sealed, rechargeable NiCd cell has dominated the mobile communications equipment market. Primary (non-rechargeable) cells are widely used for radio pagers, although this may change with the introduction of new functions requiring more power on pager systems.



The success of rechargeable batteries in this market is not difficult to understand. Mobile communications equipment requires a battery with a relatively high current drain over a short period of time, repeated on numerous occasions. Rechargeable NiCd batteries are ideally suited to meet these requirements. They have a wide operating temperature range (typically -40° C to +65° C). They are also rugged and very tolerant to abuse. Their discharge curve is extremely flat, giving maximum power up to nearly 100% discharge.

In addition, they can be fast- or slow-charged. In fast-charge mode, a sealed NiCd cell can be fully recharged from flat within an hour.

Although fast-charging with voltage cut-off is the most popular method of recharging batteries, low-rate charging can be the most cost-effective in practice. All NiCd cells can be fully recharged from flat in 14-16 hours at a C/10 rate of charge. Since NiCd batteries will withstand considerable overcharge at these low rates, it is not usually necessary to control either the battery's state of charge or the duration of charge.

Low-rate charging is useful in situations in which equipment and recovery time is not critical. The battery can be charged on or off the equipment (depending upon the application) and maintained at full charge or recharged from flat. If usage is very infrequent, a reduced charge rate (C/20) will prolong battery life.

At low temperatures, NiCd batteries give much higher performances than other rechargeable types. For example, for military applications, it is possible to charge up to 70% of the rated capacity at -10° C.

BATTERY MANAGEMENT

No special preparation is required for the storage of rechargeable NiCds. They can be stored discharged, partially charged, or fully charged; by comparison, lead-acid cells need to be stored fully charged. During storage, batteries discharge at about 1% per day at room temperature. To ensure that rechargeables are ready for use, they can be kept on slow charge at a temperature of 20° C or less.

got the power?

Each piece of mobile communications equipment has its own requirements for voltage and current. However, the user's requirements are equally important – especially the pattern of usage, which can vary for the same piece of equipment and user.

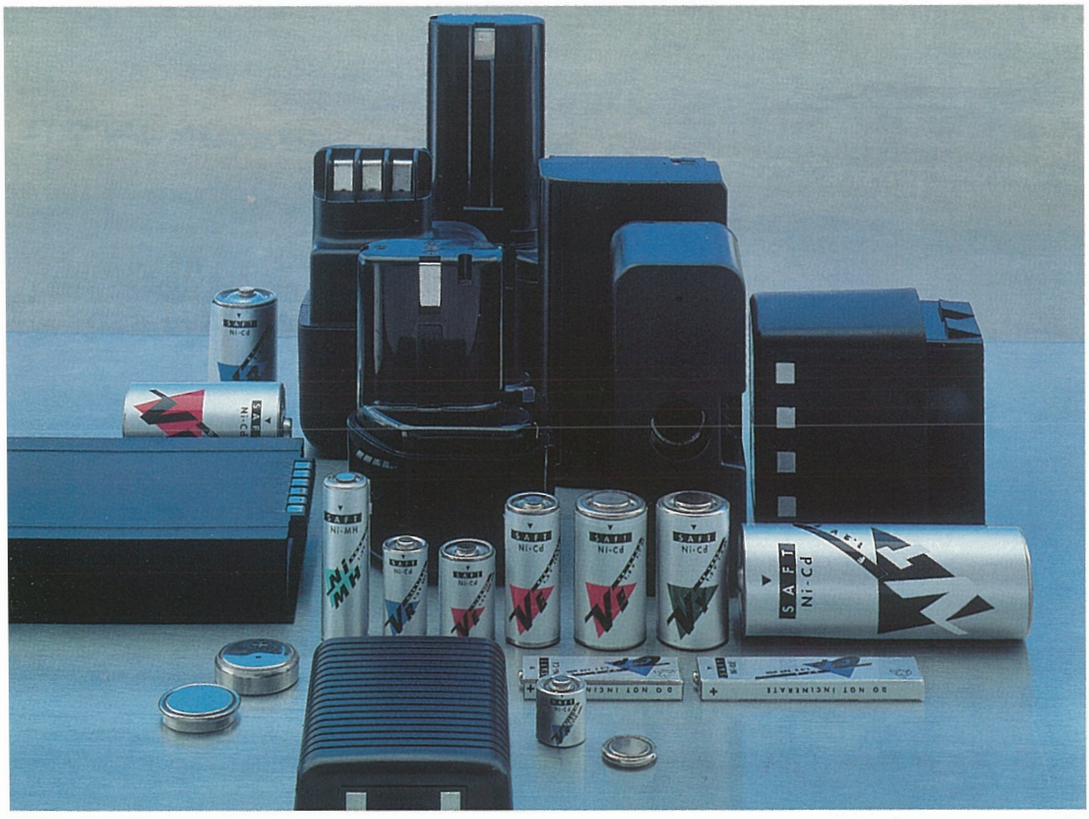
A battery typically experiences two extreme usage patterns. In standby applications it is rarely discharged – and then by only a small percentage of its rated capacity – and is maintained on full charge during the intervening periods. In pure cycling the battery is completely discharged on every occasion and then recharged.

In between these two extremes – where a large majority of portable telecommunications applications stand – is a balance of discharge and overcharge that will govern the choice of cell types and the charging method used.

THE "MEMORY EFFECT"

Most questions raised about battery maintenance center on the so-called "memory effect", a phenomenon which was originally established for "space cells" used in geostationary orbit satellites, and which can be generated under laboratory conditions.

Ever smaller, lighter and more powerful, NiCd batteries are engineered to respond to the specific needs of mobile applications



It is doubtful whether this effect is of practical significance in the majority of cycling applications, where depth of discharge is random. Even where it does occur, its impact will depend on the operating voltage limit of equipment. It is not, therefore, generally necessary to take steps to eliminate it, and overall cycle life is not enhanced by frequent total discharge.

The memory effect is not specific to an electrochemical couple but relates more to the way the battery is used (duty cycle) and to the electrode structure material.

NICD: LATEST DEVELOPMENTS

There are three main ways of increasing the energy density in a scaled NiCd cell: technological (more active material per electrode/volume unit), electrochemical (increasing the efficiency of the active materials) and mechanical (optimising the internal and external volume efficiency).

The recent introduction of sealed NiCd cells using foam technology offers major advantages in terms of higher capacity and lighter weight for a given volume. The use of a foam nickel support in the cell offers a higher degree of porosity when compared with sintered supports.

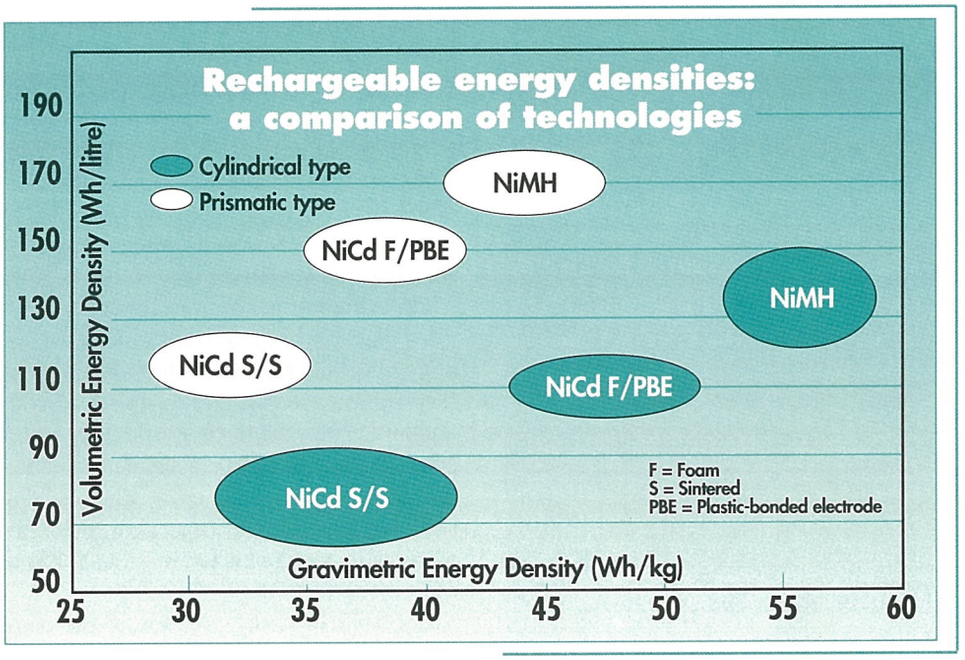
The resulting increase in the amount of active material in the support's pores means a corresponding gain in electrode and battery volumetric capacity to give a 15-40% higher capacity when compared with other NiCd technologies. For example, a double AA-sized cylindrical cell using foam technology can have a rated capacity of 800mAh whereas its sintered counterpart only has a capacity of 700 mAh.

In response to the problem of the considerable space occupied by the battery in portable products – in a market which constantly calls for smaller products – GS-Saft (the joint venture between the Japanese JSB and Saft) was the first company to introduce a prismatic rechargeable battery for these applications.

Mobiles... have we got the power?

These cells, first developed with a major Japanese manufacturer for use in a stereo headphone system, are now being extensively used in all the latest cellular phones and even in some top-of-the-range cordless phones. To cope with a continually increasing market demand, GS Saft and Saft have recently doubled their production capacities.

The prismatic cells can be stacked with minimal air space and provide higher volumetric energy density than a cylindrical cell. Comparisons reveal that a typical prismatic cell, like those in Saft's GP range, has a volumetric energy density of some 30% more than that of a typical high-capacity cylindrical cell.



This cell has incorporated many recent improvements in sealed NiCd technology – thinner electrodes, special electrode treatments and coatings, better internal connection techniques, and better use of "dead" space within the can.

The cells are manufactured with a laser welding technique; it replaces the "classical sealing" of cylindrical cells, which is impossible to use in a prismatic shape. Safety is increased by a smaller positive cell cap exposure – made possible by the use of an innovative housing cover. Typically, such cells can be recharged more than 500 times and are thus highly economical.

EMERGING TECHNOLOGIES

As well as attempting to maximize the potential of NiCd cells, battery manufacturers are also researching alternative chemistries for rechargeable batteries. New electrochemical couples such as nickel-metal hydride (NiMH) and rechargeable lithium present an additional option to NiCd technology.

Batteries based on NiMH technology offer a 25% increase in energy density over the most recent technologies. NiMH cells use a hydrogen-absorbing alloy in the negative electrode and share many of the characteristics of their NiCd cousins, including the ability to be fast- or slow-charged, a wide operating temperature range, and maintenance-free features. They can also be charged/discharged more than 500 times. Figure 1 compares NiCd and NiMH cell voltage during charge.

NiMH electrochemistry has a discharge profile similar to that of NiCd. For example, available capacity over discharge rate and temperature are 100% capacity at room temperature for an 0.2CA discharge. At a faster charge rate (3C) the cell delivers 85% of the rated capacity.

NiMH can be charged and discharged at a wide range of temperatures. The standard C/10 charge time for a typical NiMH battery is 16 hours.

NiMH batteries will complement NiCd batteries by providing alternative power sources and opening up new rechargeable

battery applications where high energy is a major requirement. Both of these cells have nickel positive electrodes and alkaline electrolytes and can be charged at constant current. Because of differences in voltage characteristics, it is strongly recommended that the charge detection system be adapted to NiMH technology. NiMH's cycle life also resembles that of NiCd batteries, provided the charging system is specially adapted and does not require any special storage or handling conditions.

In fact, NiMH technology was first developed about 10 years ago. However, the increasing need for greater autonomy has acted as a catalyst for its development. Although costs will initially limit the introduction of NiMH batteries, by 1995 approximately one-third of all portable communications equipment will be powered by NiMH batteries. Figure 2 shows the energy density of various types of secondary batteries.

RECHARGEABLE LITHIUM

At present several electrochemistries are under development. In every instance the negative electrode (lithium), the electrolyte (lithium salt in organic solvent), and the separator are similar.

Lithium offers excellent energy density and very good charge retention. However, it currently has limitations in fast-charging and depth of discharge. Technological improvements will need to be made before it can be easily used in mobile telecommunications equipment.

Forthcoming developments in rechargeable lithium technology will offer further improvements in the energy density of rechargeable batteries.

A common problem experienced in the handling of batteries is monitoring their state of charge. In an attempt to overcome this problem, leading manufacturers are developing "intelligent" batteries. Users of portable communications equipment will soon be able to buy batteries with a visual, LED indicator displaying the battery's state of charge.

Nickel-metal hydride and lithium technology developments are paving the way for the high-energy, low-volume solutions of the future.

C. Jarlan

The intelligent battery will also have many new functions – optimised and controlled fast charge (which would extend the life of the battery), adjustable and regulated voltage, and a function which would permit the user to measure its state of charge and ageing, increasing security and reliability.

RECYCLING

Environmental issues are consistently at the forefront of the minds of battery manufacturers. The EC's Waste Directive will be implemented by April 1993. With other Directives, it is expected to outline a single EC-wide approach to recycling. In general, environmentalists consider rechargeable batteries to be "greener" than non-rechargeable types: one rechargeable can replace up to several hundred "disposables" and is easily recyclable.

Saft has taken recycling seriously: it is the first battery manufacturer in Europe to have instituted a return and recycling programme for its customers and distributors. A unified system for recycling batteries is now in place in Europe and the USA and is actively being promoted to customers.

DESIGN-IN: THE WAY AHEAD?

Batteries are becoming increasingly important as they evolve from playing a conventional auxiliary role towards that of a high-energy storage component.

At one time regarded as a necessary evil, the battery is now a key player in the design of portable communications equipment. The standard cellphone is a classic example of this phenomenon in practice – its shape is determined by the batteries that power it.

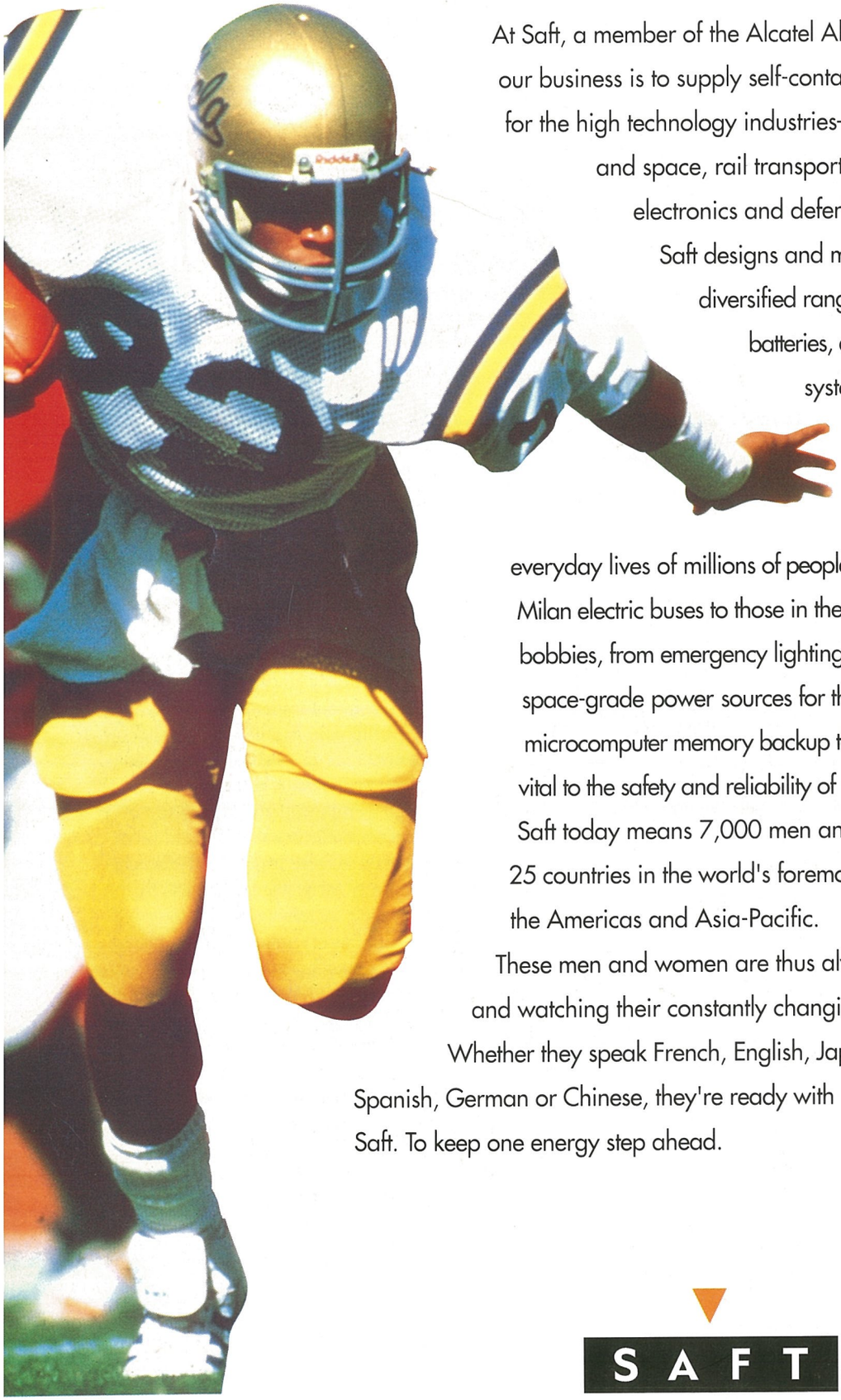
Present trends indicate that more and more telecommunications equipment producers will need to liaise with battery manufacturers at a very early stage. Gone will be the days of merely supplying an "off-the-shelf" product; the battery manufacturer will be, even more, as much a consultant as a manufacturer, working closely with the customer to design-in the battery when the product is still in the prototype stage, and offering advice on battery management.

Equipment designers are beginning to recognize the importance of understanding battery technology. A proper understanding at the equipment's prototype stage can save time often lost in redesigning or modifying the original design. Furthermore, it helps optimize battery performance as well as cycle life.

To a certain extent, this is already becoming the norm, as witnessed in the development of the prismatic cell.

This article was previously published in the September 1992 issue of Mobile Europe.

Saft, for all those who demand breakthrough energy



At Saft, a member of the Alcatel Alsthom group of companies, our business is to supply self-contained "autonomous" power for the high technology industries—computing, aeronautics and space, rail transport, telecommunications, electronics and defence.

Saft designs and manufactures the most diversified range of industrial use cells and batteries, and implements the electronic systems associated with them.

Though rarely seen, Saft's products play a vital role in the everyday lives of millions of people, from the batteries in Milan electric buses to those in the walkie-talkies of London's bobbies, from emergency lighting in movie theaters to space-grade power sources for the Ariane rocket, from low-power microcomputer memory backup to high power standby batteries vital to the safety and reliability of electric power stations.

Saft today means 7,000 men and women working in 25 countries in the world's foremost industrial areas —Europe, the Americas and Asia-Pacific.

These men and women are thus always close to their customers and watching their constantly changing market.

Whether they speak French, English, Japanese, Italian, Swedish, Spanish, German or Chinese, they're ready with an answer whenever you need it.

Saft. To keep one energy step ahead.

SAFT

156, avenue de Metz, 93230 Romainville
Tel. (1) 49.42.34.34 - Fax: (1) 49.42.34.00