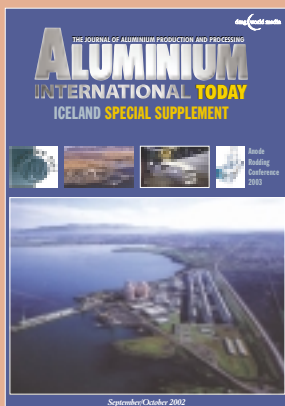


A whole world of aluminium in Iceland

VALGERDUR SVERRISDÓTTIR, MINISTER OF INDUSTRY AND COMMERCE



A whole world of aluminium in Iceland – production and processing, energy, equipment, knowledge and expertise.

A SPECIAL SUPPLEMENT PUBLISHED BY ALUMINIUM INTERNATIONAL TODAY

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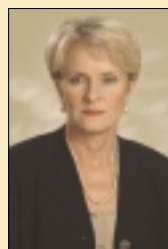


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Opportunities, infrastructure, available services – Iceland's aluminium industry is a vital part of the national economy and highly competitive on a world scale.

High-Tech business environment, multilingual society, high standards of education and one of the highest per-capita aluminium production in the world – Iceland has more to offer than geysers and glaciers.

It gives me great pleasure to greet the readers of this special issue of *Aluminium International Today* on the aluminium industry in Iceland. We have come a long way since the time when Iceland's first aluminium foundry began collecting aluminium scrap for sand casting of various components in the middle of the last century. The construction of the first smelter in the late '60s was a major boost for the Icelandic economy, which had hitherto depended heavily on fishing for export earnings. With this enrichment of industrial activities, the effects of natural and inevitable highs and lows in the fishing industry were not so significant for the national economy as before. Ever since, the Icelandic government has emphasised the further development of the primary and secondary aluminium industry. The last decade of the 20th century saw a doubling of primary aluminium production in Iceland as a second smelter began metal production. I am proud to see contributions in this edition from successfully operating and competitive enterprises – most of them triggered through the construction and operation of the two smelters.

Metal Park, the Icelandic competence centre in the field of light metals, was established in 1998 in order to promote the development of the aluminium processing industry and was supported by the Ministry of Industry and Commerce from the beginning. Metal Park has the goal of supporting the enterprises operating in this field, and moreover it constantly evaluates new possibilities for further

processing of light metals in Iceland – particularly aluminium. Further processing of aluminium in Iceland is highly favourable for economic reasons because production of the primary metal is still increasing, energy is available at a competitive price and a well-educated workforce is available. The idea to install a broad spectrum of aluminium production and processing in this country will therefore be continuously pursued.

Iceland has now the highest per-capita production of primary aluminium in the world. In that context it is worth mentioning that the aluminium smelters are utilising environmentally-friendly energy from sustainable hydroelectric and geothermal power resources. As recently as on 19th July, Alcoa, the Icelandic government, and the Icelandic National Power Company (Landsvirkjun) signed a Memorandum of understanding on the building of a greenfield 300,000t aluminium smelter in Reydarfjordur, east Iceland. This will be the third smelter in Iceland built according to state-of-the-art technology and subject to most stringent environmental regulations. This development confirms that the aluminium industry will continue to be a vital part of the Icelandic economy.

Dear reader, with these comments I would like to express here the vision of the Icelandic government regarding the future of aluminium. I hope this special edition provides you with a profound overview of the opportunities, infrastructure and services available within the aluminium world of Iceland.

Finally, I would like to thank *Aluminium International Today* and Metal Park for the initiative to produce this publication.

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Aluminium in Iceland

Invest in Iceland Agency – energy marketing

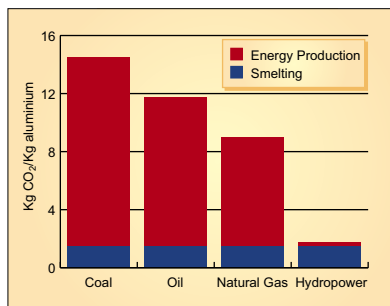
Promoting Iceland's clean energy

In recent years, aluminium production has grown substantially in importance for the Icelandic economy. Although Iceland is not generally considered to be in the big league when it comes to aluminium production, it has become in population terms the primary aluminium producer in the world, with annual per capita production of more than 900kg of metal. In a parallel development, Iceland has become the world leader in energy consumption, and power-intensive industry utilises more than two thirds of all electricity produced in the country.

What sets Iceland apart from most, if not all other countries, is that its electricity is produced using exclusively hydro- and geothermal energy that are sustainable, environmentally-friendly “green” resources. Production is free from the atmospheric emissions of fossil fuel. In the case of aluminium production, using electricity generated by hydropower instead of coal, will typically cut total emission of CO₂ by some 90% per ton of production.

The first aluminium plant in Iceland was built in the late '60s after the government made a fundamental

Estimated carbon dioxide emissions in aluminium production, by energy source



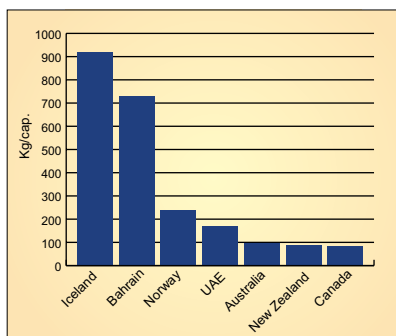
PROMOTING THE USE OF ICELAND'S CLEAN AND RENEWABLE ENERGY

In 1988 it was decided to set up an Energy Marketing Agency, an autonomous body owned jointly by Landsvirkjun and the Ministry of Industry. Its mandate is based on the government policy of promoting the use of Iceland's clean and renewable geothermal and hydropower sources, in harmony with the environment.

Being an expert in local conditions and site developments, the functions of the Invest in Iceland Agency – Energy Marketing, as it is named today, include assisting with negotiations, feasibility studies and environmental impact assessments, in addition to providing vital contacts to key decision makers.

Its marketing strategy emphasises Iceland's numerous advantages for industrial development, such as its mid-Atlantic location and modern infrastructure, educated workforce, supportive government policy and efficient environmental regulatory system. Iceland also has tariff-free access to the European market, and good industrial sites with safe deepwater harbours. Most significantly, Iceland offers large, untapped, renewable and clean energy sources and therefore reliable power at competitive cost. ▶

decision to seek the co-operation of foreign investors in building power-intensive industries. In 1966, the first agreement was made with Alusuisse to build a primary aluminium smelter, with an ultimate capacity of 60,000t/yr. To deliver power, Landsvirkjun, the National Power Company of Iceland, was established in 1965 to build a new hydro power station with a total capacity of 210MW. In the '70s the build-up continued, and the ferro-silicon plant of Icelandic Alloys Ltd was added to the Landsvirkjun customer base. Efforts in the '80s to expand power-intensive industry were unsuccessful for various reasons, chiefly related to the world market situation.



Aluminium production capacity in kg per capita 2001

Aluminium in Iceland



The 320 Gl, 34 km² large Hágöngur reservoir built in 1998

Since 1995, Invest in Iceland Agency – Energy Marketing has delivered four new large-scale industrial development contracts. At a total investment of US\$800 million, these contracts more than doubled power sales to industry and created over 1,000 new jobs.

The capacity of an existing ferro-silicon plant was increased by nearly 60% when a third furnace was built. The Nordurál greenfield smelter, owned by Columbia Ventures Corporation, was built in a record time of 15 months, and in 2001 production started on the 2nd phase increasing the annual production capacity from 60,000 metric tons to 90,000 metric tons. Finally, the ISAL Smelter, built in 1966, was expanded by more than 60%. In order to meet this new demand for electricity, investments in the power sector included the installation of three 30MW geothermal turbines at two locations and the construction of two new hydroelectric power stations, with a total capacity of 210MW.

Both companies, ISAL and Nordurál have now announced their interest in further expansion of their aluminium plants which would increase the primary aluminium production in Iceland from currently 260,000 to 760,000 metric t/yr.

The fifth contract is currently in the pipeline. It involves a project where Alcoa, the world's largest aluminium producer, will own and operate a 300,000 metric t/yr aluminium plant in Reydarfjordur in East Iceland. The plant will receive power from a 600+ MW hydroelectric power station in Eastern Iceland. The power station will be

constructed and operated by Landsvirkjun, the National Power Company of Iceland. The total investment is estimated to be US\$2 billion.

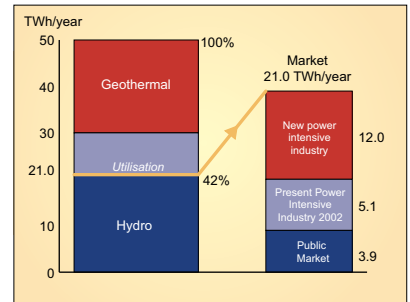
LARGE UNTAPPED ENERGY RESOURCES

Although electricity consumption per capita in Iceland is second to none in the world, with some 28,200kWh consumed per person, only a fraction of the country's energy potential has as yet been tapped. Iceland is therefore the only country in Western Europe that still has large sources of competitively priced hydroelectric power and geothermal energy remaining to be harnessed. Total viable electric power potential is now estimated at 50,000GWh/yr. In early 2002 some 8,000GWh/yr of this power had been harnessed or only about 16% of the total electric energy potential. In addition, geothermal steam with pressure up to 20 bars and temperature up to 250°C is still to be harvested, a huge potential for steam consuming industries to come. As an example, it would be worthwhile for an alumina refinery to consider this option.

Natural conditions in Iceland favour the use of hydropower for the generation of electricity, and potential power available from hydropower is estimated at around 30,000GWh/yr. In 2002, the total installed hydropower is 1,155 MW in 28 power plants capable of producing 6,830GWh/yr. The largest single hydropower plant has an installed power capacity of 270MW.

Icelanders are world leaders in the use of geothermal energy for domestic and industrial purposes. Some 87% of the

Electrical power potential and possible utilisation in 2015



population enjoy central heating by geothermal energy at a price that is generally less than half of the comparable cost of oil or electric heating, thus contributing to making Iceland one of the cleanest environments in Europe. Geothermal steam has been used directly for a number of industrial processing applications in Iceland for decades now, and has also been developed for electricity generation on a small but growing scale. Today, the total installed geothermal electric power is around 200MW.

Clean and renewable energy for the future.

THE FUTURE

It is clear that Iceland wants to continue to invest in the energy sector. Even though there is rapid growth in new industries like genetic engineering, software services and other hi-tech areas, it is obvious that further utilisation of Iceland's energy resources will be highly beneficial both for Icelanders and potential users of that energy. In the future the aluminium industry is likely to continue playing a significant role in the utilisation of these resources, although diversification will be sought into other power intensive industries and there is ample space for all. In the aluminium sector, existing smelters have expansion possibilities that can be implemented at relatively short notice. Also as mentioned, preparations for a new smelter in east Iceland, set to begin production in 2006/2007, are well under way and a memorandum of understanding has been signed by the Icelandic government, Landsvirkjun and Alcoa.

Invest in Iceland Agency – Energy Marketing will, therefore, play an even greater role in promoting Iceland's clean energy resources to the world in the years to come.

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Búrfell hydroelectric power plant entered operation in 1969 and was refurbished and upgraded to 270 MW in 1998



Metal Park – takes the Icelandic initiative

Increasing awareness of Light Metals, their properties and applications

CO₂-free generation of electricity has been the main attraction for international aluminium companies siting their production of primary aluminium in Iceland. This has led to two aluminium smelters being built in Iceland and a third one possibly on its way. As a result, small and medium sized enterprises (SMEs) in Iceland, specialising in service, equipment and spares for the smelters, have now considerable knowledge and experience in the field, enabling them to compete on the world aluminium market. However, almost all the aluminium produced in Iceland is still exported for further processing, meaning that the value adding is not being realized in Iceland. But, aluminium processing is power consuming as well, and therefore it is economically favourable to locate it close to the smelters. Transport from Iceland to Europe and to the USA is on a daily basis so that production in Iceland can be shipped to and received at all major European and USA sites within a week.

To promote a value-adding industry – that was the idea behind Metal Park – the national centre of competence for the Icelandic light metal industry initiated by companies and political institutions around five years ago. The aim is to provide companies in this field with knowledge, resources, and contacts as well as to initiate common R&D activities.

IN THE BEGINNING.....

Starting with the construction of the first aluminium smelter in Iceland in the 1960s, ideas to establish industry based on further processing of the primary metal began to evolve. Those ideas were further developed with the initiation and construction of the second aluminium production plant at Norduráral. Now, with plans for a third smelter in eastern Iceland, such an industry is still gaining importance as it is contributing strongly in the value chain compared with merely exporting primary aluminium.

To initiate, stimulate, and provide background information to those interested in establishing companies in the framework of such a processing industry, the Minister of Industry and Commerce established a committee with the aim of promoting this

kind of industry in Iceland. This committee was led by MP Hjalmar Arnason and the results of the committee's work were published in September 1997.

METAL PARK

The most significant of the committee's suggestions was to establish an Icelandic competence centre in the field of light metals. Such a knowledge centre was aimed at assisting incubators in raising new companies, initiating new possibilities such as production of new or enhanced



components, and support R&D projects – thus increasing the expertise in the field of light metals.

This initiative began in 1998 under the

Knowledge and expertise developed in light metals.



Aluminium in Iceland

In perfect harmony

Aluminium in Iceland – art, culture and environment

The work of one of Iceland's most innovative sculptors, Steinunn Thórarinsdóttir highlights the links with aluminium and Iceland's unusual environment, art and culture.

Trained and qualified in England and Italy and having worked in this field for over 20 years, Steinunn outlines her work and special relationship with aluminium:

“The figure has always been a focal point in my visual world, both as physical and spiritual being. Over the years I have used several materials, such as glass, cast iron, stainless steel, plaster and concrete. The use of materials is a very decisive factor in my work as the material normally reflects the underlying idea.

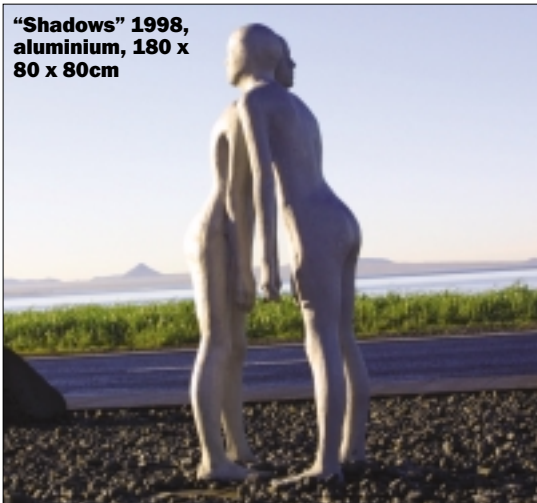
“Many years ago I was looking for a material with a specific ‘feel’ and I found what I was seeking in aluminium. To begin with I was a bit prejudiced, as it is a material not much used for casting art works but it has served wonderfully both for inside and outside work. I have now started to experiment with anodising which opens up possibilities for colouring metal in a permanent way. Aluminium is very easy to handle – it is light and yet quite strong. For me, it portrays technology, flying, the sea, reflection, cold, mechanics and lightness – as well as being a beautiful material visually.

“The aluminium pieces I have produced have been placed inside buildings and also outdoors. One outside piece, ‘Shadows’ is sited very close to the sea and even there in the windy, salty environment and unfriendly Iceland weather, it has stood up very well and shows no corrosion or other problems after many years.

“Aluminium is an ideal material for art works and it has proved to be one of the most durable and unchanging materials that I have used”.

Steinunn Thórarinsdóttir, Framnesveg 68, 101 Reykjavik, Iceland. Tel: +354 861 1633; email: thorar@mi.is

**“Shadows” 1998,
aluminium, 180 x
80 x 80cm**



Aluminium in Iceland

CONTINUED FROM PAGE 4 ▶

name Metal Park. It is associated with the Materials Department of the Technological Institute of Iceland (IceTec), a state-owned, non-profit research institute serving the Icelandic industry. Acting in close cooperation with industry, the institute focuses on R&D, technology transfer, education, consulting and testing, with the goal to increase innovation, productivity and competitiveness of the Icelandic industry. The Materials Department has over many years gathered experience in working with established and start-up companies operating in the light metal sector.

The board of Metal Park was appointed by companies from the primary aluminium industry, the Federation of Icelandic Industries, companies from the metal foundry industry, the University of Iceland, and the Technological Institute of Iceland. The chairman of the board is Ingolfur Thorbjörnsson, head of the former Materials Department, now Department of Materials and Environmental Technology. At the start of its operation, over 30 companies and individuals signed up as members of Metal Park. Funding for Metal Park was provided by the Ministry of Industry and Commerce.

Since its creation in 1998, Metal Park has been focusing mainly on three major aspects.

First, it was aimed at generally increasing awareness concerning the significance of light metals by promoting information to companies both working in the field on the one hand, and to the public of Iceland on the other.

This has been pursued by, for instance, establishing the first Icelandic Anode and Rodding conference in 2001, where 136 participants from 22 countries took part. This conference was addressed to that part of the primary aluminium industry that usually gets little attention in the aluminium community, although the proper operation of anode rodding plants is crucial for the overall efficiency of aluminium smelters. This conference showed clearly that this sector of the industry is very innovative and many new products and efficiency improving measures are on their way to the market. Particularly the development of inert anodes was presumed to have the potential to change the whole industry.

Due to the huge success and overall positive feedback, a second conference on anode rodding plants has been scheduled to take place in Reykjavik on the 23-26 September 2003. Further information may be found on the conference homepage: www.iti.is/etd/rodding.htm

Another example for increasing the general awareness on light metals is the monitoring and participation in the highly promising field of magnesium technology. For this purpose, Metal Park is taking part in the Nordic Magnesium Cluster (NORMAC). It is an initiative within the community of the five Nordic countries with the goal of increasing the knowledge about magnesium and related technologies



Light metals R&D and education are key drivers in industry support.

as well as to build up a network of magnesium knowledge centres and users (see also <http://www.normac.org>). This network is financed by the Nordic Industrial fund.

The second field of interest among Metal Park's activities is to participate in and stimulate the R&D work within the field of light metals in Iceland. Metal Park is now participating in several projects involved with the light metals of relevance for Iceland, namely aluminium, magnesium and titanium. Projects are national as well as international in cooperation with companies and knowledge centres from Europe and Australia. These activities are very important for Metal Park in order to increase the knowledge required for establishing new companies and assist existing ones in their effort to compete with other materials such as steel and polymers.

The third focus of Metal Park's activities is to assist in secondary school education and University departments. The students

learn about the complex interaction of production and processing methods and of greenhouse gases. One highlight in the context of these educational activities is the so-called Light Metal Day where a group of students visit the research site of IceTec and are there introduced to the research and testing of light metals. This is followed by experiencing primary aluminium production at the Alcan in Iceland smelter and a visit to the aluminium foundry Hella where the students see demonstrations of casting of aluminium parts. This event has been a very positive experience for both students and their teachers.

FINALLY...

Metal Park has proven to be a very effective concept. The connection between research centres and the University of Iceland has provided the necessary theoretical background and the links with the primary and secondary producers of aluminium imparts essential information regarding the needs of the industry to achieve further growth.

Metal Park will continue its work regarding all these aspects. The focus will be on the need for innovations in existing fields of the industry as well as the exploitation of new fields. As one example, Metal Park is now involved in the compilation of a business plan for a possible magnesium foundry in Iceland. It is the strong growth of this sector and the expected production of magnesium in Iceland that is the driving force behind this initiative. In this way, Metal Park will continue to investigate and explore new opportunities and increase knowledge of light metals in Iceland – particularly aluminium. ●

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Aluminium in Iceland

Alcan Iceland Ltd – an important pioneer

Alcan Iceland Ltd is by far the biggest industrial company in Iceland. The company plays a big role in Iceland's economy and in 2001 supplied 14% of all the goods exported from Iceland. The smelter's annual capacity is 170,000 tons and it employs 500 people year-round. The company is ISO 9001 and 14001 certified; it combines latest technology and environmental responsibility with the assets of highly-skilled and well-trained workmanship.

THE BEGINNING

Negotiations between the Swiss company Alusuisse and the Icelandic government to build an aluminium plant in Iceland had been going on for several years when finally contracts were signed in 1966. The Icelandic Aluminium Company (ISAL) was founded and construction in Straumsvík, south of the capital Reykjavik, began. The smelter went on stream three years later, with a smelting capacity of 33,000t/yr. Since then the smelter has been expanded four times and its capacity is now 170,000t/yr.

Alusuisse (later Alusuisse-Lonza and then algroup) was the sole owner of ISAL until 17 October, 2000, when it merged with the Canadian company Alcan, under the name Alcan Inc. headquartered in Montreal, Canada. Alcan is a multinational, market-driven company and a global leader in aluminium and specialty packaging with 2001 revenues of US\$12.6 billion. With world-class operations in primary aluminium, fabricated aluminium as well as flexible and specialty packaging, Alcan is well positioned to meet and exceed its customers' needs for innovative solutions and service. Alcan employs 48,000 people and has operating facilities in 38 countries. To underline the close relationship with the mother company, ISAL has been renamed as Alcan Iceland Ltd.

PRODUCTION

Every day Alcan Iceland produces about 460 tons of aluminium. The alumina used is processed in Australia and is transported by sea to Iceland where a vacuum unloader removes it from the freighters. It is then transferred into the red- and white-checked silos that tower over the premises in Straumsvík (as illustrated). By using the dense phase conveying system, to transport the alumina from the silos to the potrooms, all dust contamination is avoided since the system is entirely closed.

The three potrooms house 480 pots in total. The anodes used are processed at Aluchemie in Holland.



They have to be replaced every 28 days and remains of used anodes are sent abroad for recycling into new anodes.

Every two days, aluminium is tapped from the pots. The molten aluminium is thus transported to the casthouse. In the casthouse, the molten aluminium is poured from the crucibles into mixing furnaces, where various metals are added to the aluminium to bring its chemical composition up to customer specifications. When the right composition is acquired, the aluminium is treated with gas to reduce hydrogen, sodium and solid impurities. Then it is poured into casting machines, via filters and a gas treatment system that cleans the last

impurities before casting.

In the casthouse sheet ingots are cast in four casting machines. The ingots vary in size and composition and altogether about 200 different products are manufactured in the casthouse. Waste materials are recycled as much as possible and the company melts down cuttings for re-use. The dust produced during the sawing process, together with the filters used for cleaning metal, are sold for recycling. Aluminium slag, a by-product consisting of pure aluminium and aluminium oxide, is also sold for recycling.

COMPUTERISED INDUSTRY

Computers control the entire production process, both in the

Aluminium in Iceland



potrooms and the casthouse. Hundreds of industrial computers control pots, furnaces, casting machines, a water supply system, a gas cleaning system, ventilation, a power supply system and other systems. Hundreds of computer terminals are used at Alcan Iceland, and all are connected to a network. The industrial ones are connected to an industrial computer network, one of the largest in Iceland.

SALES

Alcan Iceland's entire production is sold to Europe, where various products are made from it, including plates for aluminium cladding, sheets for Audi and Rover car bodies, printing plates for the lithographic industry, aluminium foil for packaging, and sheets with high shine for use in reflectors.

PERSONNEL

Alcan Iceland employs 500 people year-round – including skilled mechanics, engineers, electricians, technicians, automotive mechanics, carpenters, business administrators, blacksmiths, painters, masons and cooks.

Longevity in employment is the rule rather than the exception, and almost 100 employees boast 30 years of service. Some finish their employment in the so-called Workshop, a special workplace for those with reduced working capacity as a result of age or loss of health.

Alcan Iceland provides its employees with free bus transportation back and forth to work no matter where they live in the Reykjavik Area. Employees also receive work clothes and free canteen meals during work hours.

Occupational training is among the company's top priorities, and the company received the first Icelandic Occupational Education Awards.

In the year 2000, Alcan Iceland spent a total of 28,000 hours on employee training. The company runs a training centre for unskilled workers to improve the skills of those employees who only have a basic school education. Their training is divided into general studies and craft-related subjects – 325 lessons in all during three semesters. Nearly 50 employees attend the centre at any given time.

Executives, leaders and future leaders are provided with management education courses while various other educational programs are available for all employees. The purpose is to improve staff technical skills as well as their knowledge in safety, computers, communication and similar subjects. Newcomers attend special courses and are provided with a "foster-parent" within the company, who looks after the newcomer in the first few weeks.

**High quality
production and
excellent
financial results.**

ENVIRONMENTAL ASPECTS

Discussion of environmental issues has increased considerably in Iceland over the past years. Individuals and companies are increasingly aware of their environment, how land is accessed and natural resources are utilised. Environmental issues are among the most important issues considered by Alcan Iceland, and in 1997 the company became the first Icelandic company to implement the environmental management system as set out in the international standard ISO-14001. The system covers all aspects of operation and is tightly integrated into the quality-control system. In the past, extensive improvements have been carried out on cleaning equipment but the company is still looking for new

ways to improve environmental factors, to set new goals and achieve them. In 2001 the company achieved the Environmental Recognition, which is handed out annually by the Ministry of Environmental Affairs.

It is Alcan Iceland's goal to protect and promote the environment, and the health and safety of all employees and of the community where it operates. This will contribute to greater sustainability thereby benefiting all employees, the community, customers, suppliers and shareholders.

The disposal of waste has been reduced considerably through a systematic categorisation of waste materials in a recycling station within the area. Since the station opened, all unclassified waste has been significantly reduced. Packaging materials have also been reduced through collaboration with suppliers.

The majority of all waste is recycled or re-used, and new ways of recycling are continually being sought in order to reduce disposal. Alcan Iceland is a founding member of Skil21, a project that focuses on the recycling of organic waste to combat soil erosion. Over the years, Alcan Iceland has supported various projects that focus on environmental protection and research.

LOOKING FORWARD

There is obviously more to Alcan Iceland than just the financial key data. From the beginning, the company has felt responsible for the well being of its employees, the Icelandic community, and environmental issues. It has put a lot of effort and time into these extra activities.

Whatever changes the future may bring, the company will not neglect its other fields of activity. There is a strong drive to further develop the educational efforts, not only for unskilled workers but also to increase leadership competence among the top- and lower management. Alcan Iceland is aware that life-long learning is an important pre-condition to assure capable and highly-motivated employees. Environmental issues will further play a crucial role, as it has in recent years.

But, of course, it should not be forgotten that Alcan Iceland is able to deliver high-quality production and excellent financial results. It has definitely been a valuable investment for shareholders and the country of Iceland as a whole. ●



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Nordural aluminium smelter

The Nordural smelter is located at Grundartangi on the west coast of Iceland, some 50km from the capital of Reykjavik. Nordural started operations in June 1998 with an original production capacity of 60,000t/yr. Construction of the second phase of the smelter was completed in June 2001, and subsequently the production capacity increased to 90,000t/yr. Both the initial construction and the expansion were completed ahead of schedule.



The expansion has already proved to be profitable and an important factor in ensuring competitiveness and long-term viability. Further expansion of production capacity is considered necessary as was anticipated in the investment agreement made prior to the construction of the first phase. Recently, the Icelandic State Planning Agency has approved Environmental Impact Assessment for an expansion up to 300,000t in the future, if power and other resources can be made economically available.

Nordural is a wholly owned subsidiary of Columbia Ventures Corporation, a US-based company headquartered in Vancouver, Washington, and owned by Kenneth D. Peterson, JR. Rich A. Roman is the COO of CVC. Richard A. Starkweather, the Managing Director of Nordural. "Our aim is to create a first class, globally competitive smelter that we can all be proud of. In order to reach our goal, we place an emphasis on the importance of caring with respect for the safety and well-being of our employees. This care implies showing responsibility in protecting our environment and creating jobs that attract employees. We also give priority to contributing to the Icelandic economy and community at large. Finally, we stress the importance of delivering appropriate return to the shareholder on the capital they have invested. It is our resolution to apply

the principles of Continuous Improvement in all our endeavours to reach this objective", says Starkweather on the company's mission.

NORDURAL – THE PLACE OF WORK

Nordural is one of the largest workplaces in the western part of Iceland. The production runs continuously 24 hours a day, every day of the year, so a large portion of the work force is shift scheduled. A large community has formed there of hardworking, co-ordinated people, the employees' association is growing rapidly and the social activities are flourishing. Due to expansion, the number of positions at Nordural increased from 164 to just over 200 during 2001.

Nordural offers specialised jobs which demand a great deal of training. The Icelandic labour force is well educated, flexible and highly skilled, and is therefore well suited for this kind of industry, where a high level of efficiency is required. Great emphasis is placed on continuous education at Nordural. Conditions are usually put in place for industrial and technical education and a great deal of training takes place at the workplace aiming at developing the full potential of our employees, to their own satisfaction and the benefit of the company. Safety of employees has absolute priority at Nordural and strict safety rules are followed in every respect.

Significant efforts have been made regarding cost reduction. This can be associated with improved utilisation of fixed assets, production increase, better use of raw materials, employee enthusiasm and more experience. The gain sharing system of Nordural inevitably has encouraged employees in controlling costs. In addition to cost savings, gain share is paid for other factors such as good quality, production volume, and safety performance.

The organisation of the company centres on the entrepreneurial attitude, i.e. doing the impossible. The organisation is lean but adequate, informal and flexible. Nordural stresses the just-in-time approach whenever practical and keeps their inventories at a minimum. The use of IT-technology for communication is extended which means less use of paper. For more effective decision making, lines of communication are kept short and direct. Contracts regarding raw materials, power and metal sales are long-term and throughout the organisation the attitude of quality and cost saving prevails.

The clean and economic hydroelectric power, which has supported the major part of aluminum production in the world, is about to be exhausted in many of the major industrial countries. Nordural represents a new step forward in Iceland's drive to industrialise and utilise its non-polluting hydroelectric and geothermal resources.

Nordural is committed to fulfil or exceed demands put forth in laws, regulations and operating permits regarding the environment. This commitment is clearly demonstrated in research conducted by independent parties. The research has shown that the effect of the industrial area has in all aspects proved to be within the valid frame of reference and therefore no undesirable effects have been detected.

Nordural, Grundartangar, 301
Akranes. Tel: +354 430 1000;
www.nordural.is

Entrepreneurial attitude: profitability, competitiveness and long-term viability.

Aluminium in Iceland

Total quality control system for the primary aluminium industry

by Jon H. Magnusson, ALTECH JHM Ltd, Reykjavik, Iceland

Carbon anodes are the main consumable materials cost in an aluminium smelter using pre-baked anodes. Any extension of anode cell life, no matter how minor, has a significant effect on operating costs. Spent anode butts can provide detailed information about cell performance, but such information is most often interpreted subjectively and is rarely recorded or analysed. Production losses resulting from faulty anode assemblies transported to the potrooms can be substantial.

Anode rod assemblies require constant maintenance and regular replacement, but most smelters do not yet have detailed maintenance history regarding rod repair to provide a basis for accurate cost analysis.

A modern anode and rod tracking system should fully address all aspects of anode production, processing and handling and to provide invaluable information leading to major cost savings throughout the carbon and rodding plant as well as the potrooms. The "ALTRACK" Anode and Rod Tracking and Quality Control System from ALTECH, Iceland, meets all such requirements and is a vital tool in securing total quality control in primary aluminium smelters, enabling the potrooms to be served with consistently high quality anodes. The Altrack System provides a unique possibility for aluminium smelters to evaluate raw materials from different suppliers, from both a quality and a price perspective.

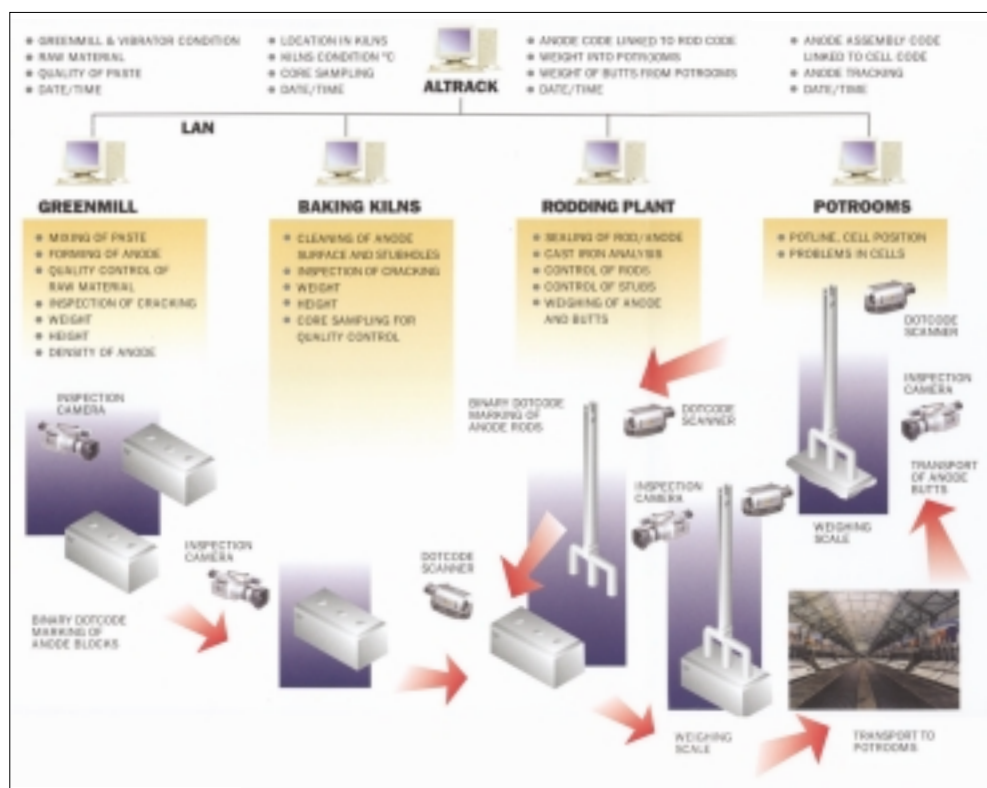
ALTRACK – A MODULAR SYSTEM CUSTOMISED TO THE NEEDS OF EVERY SMELTER

The Altrack system is modular, providing almost total customisation and permitting a smelter to address perceived problem areas both quickly and economically, subsequently building on process improvements. In other words, a smelter may begin with the installation of as little as one Altrack stub and rod bi-metal inspection station and associated modules, adding more modules to the system with time as resources permit.

An outline of the overall options available in the Altrack system may be seen in the flow diagram in Figure 1.

ALTRACK – TOTAL QUALITY CONTROL

The modular Altrack system provides a total production planning and quality control system for an aluminium smelter; the carbon plant – rodding plant and potrooms. It enables tracking of anode performance from raw materials to spent



All aspects of anode production, processing and handling addressed.

butts; providing full traceability of rod assemblies, analysis of defects and logging of maintenance history and costs, and providing valuable information concerning reduction cell performance and nett carbon consumption. In the casthouse the Altrack system provides computerised metal and billet tracking.

ALTRACK – REFERENCES:

Since first introducing the Altrack concept to the primary aluminium industry, Altech has received a very positive response and numerous enquiries. The first Altrack installations are at:

Aluminerie Alouette, Sept Îles, Canada.

An anode stub analyser for hexapod yokes with 2 x 3 stubs, 180mm in diameter was installed at Alouette as a part of an Altech

automatic stub straightening system.

ALCAN Iceland – ISAL, Straumsvik, Iceland.

A computer vision inspection system has been installed at ISAL for the analysis of anode butt thickness downstream of the butt cleaning station.

Hydro Aluminium Sunndal, Norway. Altrack system including the following Altrack modules: rod coding and tracking, computer vision stub inspection, rod inspection, bi-metal clad inspection and butt cleanliness inspection.

CORUS, Voerde, Germany.

Altrack system, including rod coding and tracking, computer vision stub inspection and rod inspection.

Altech JHM Ltd, Lynghals 10, IS-110 Reykjavik, Iceland. Tel: +354 525 2300; Fax: +354 525 2319; www.altech.is

Active aluminium development in Iceland

Huge space demands, specifically focused facilities, and high electricity consumption are characteristic requirements of primary aluminium production sites. This leads to considerable demands in the planning, construction and maintenance of aluminium plants which again calls for great experience and know-how in all fields of engineering, including environmental.

The HRV group, formally established in 1996, is a co-operative combination of three engineering companies that aim to provide such comprehensive services for large-scale-projects taking place in Iceland.

HRV is composed of three consulting engineering firms:

- H: Hönnun Ltd
- R: Rafhönnun Ltd
- V: VST Ltd

All with head offices in the same area of Reykjavik, Iceland. HRV has a staff of about 250 people of which around 200 are professional engineers. A high proportion of the engineers has higher degrees, MSc or PhD, obtained at various universities in Europe and Northern America. The group offers a full range of professional engineering services required for this type of power and industrial development, including Environmental Impact Assessment. Whenever needed, additional experts are provided on subcontract basis.

The HRV Engineering Group was formed to create a strong block of Icelandic engineering firms, fit to compete with or team up with large international companies. Projects of this kind in Iceland call for strong local presence for practical and economical reasons. This is also favoured by international financing institutions. HRV also offer their services abroad.

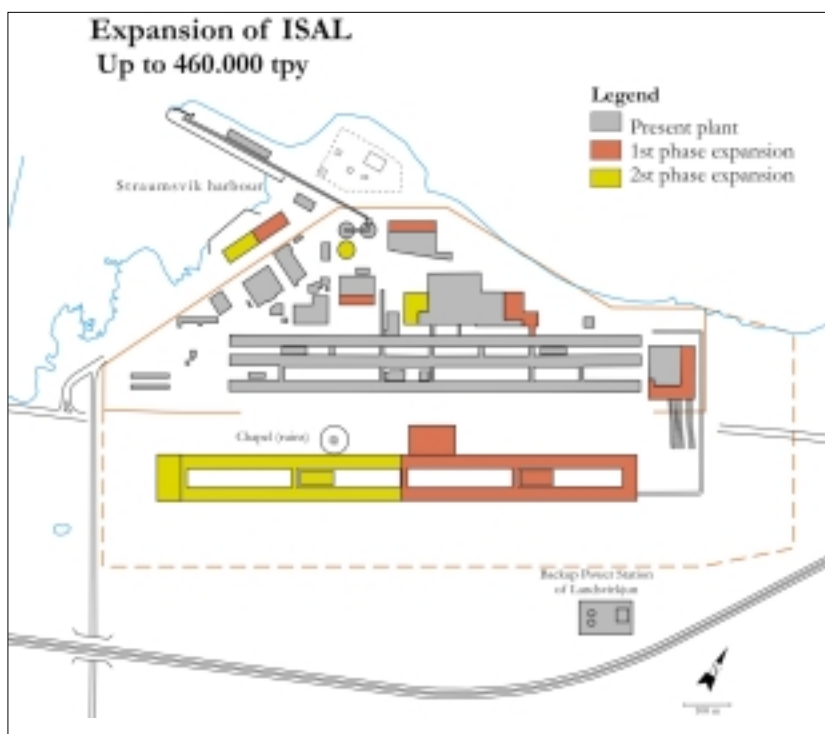
The individual firms had teamed up even before they started their formal co-operation.

The first large-scale project in connection with aluminium production was accomplished in the late '60s, when Alusuisse built an aluminium plant close to Reykjavik, whilst at the same time the National Power Company, Landsvirkjun, was established to build a large hydroelectric power plant, Búrfell, in south-central Iceland.

Further development was resumed in the '90s:

- Alumax, Hoogovens and Granges were about to construct the ATLANTAL aluminium plant when the project was

Co-operative combination for engineering large-scale projects.



shelved at the very last moment, with contractor bids already received for the hydroelectric input.

- In the mid '90s, Icelandic Aluminium Company Ltd (ISAL), now Alcan Iceland Ltd, decided to extend their production by 62,000t/yr. This project was successfully built, ahead of schedule and under budget. Alcan Iceland Ltd is now considering another expansion of 260,000t/yr.
- This project was followed by the new Nordural (Nordic Aluminium) reduction plant, realised by Columbia Ventures, Washington, with – at first – 60,000t/yr and recently expanded to 90,000t/yr of aluminium production. Construction of both phases was very successful. Further expansion by at least 150,000t/yr is targeted.
- A new large aluminium plant is planned on the east coast together with the construction of a new 630MW hydroelectrical plant in the highlands.

This project was prepared under the name Reydarál by Norsk Hydro and Icelandic investors. Alcoa is now studying this project and negotiations are continuing.

The three HRV firms were the main local consulting force in all the projects listed above.

All these projects were prepared with active participation by Icelandic engineering firms and research institutions, and those actually realized relied basically on local engineering resources, contractors and work force. This active local participation was one of the keys to economical success and timely execution.

The recent projects in Iceland where HRV played key roles were all completed with exceptional work quality and a very high degree of speed and efficiency.

The HRV firms have participated in most of the other large projects built in Iceland, e.g. in the hydro-power development, of which many recent

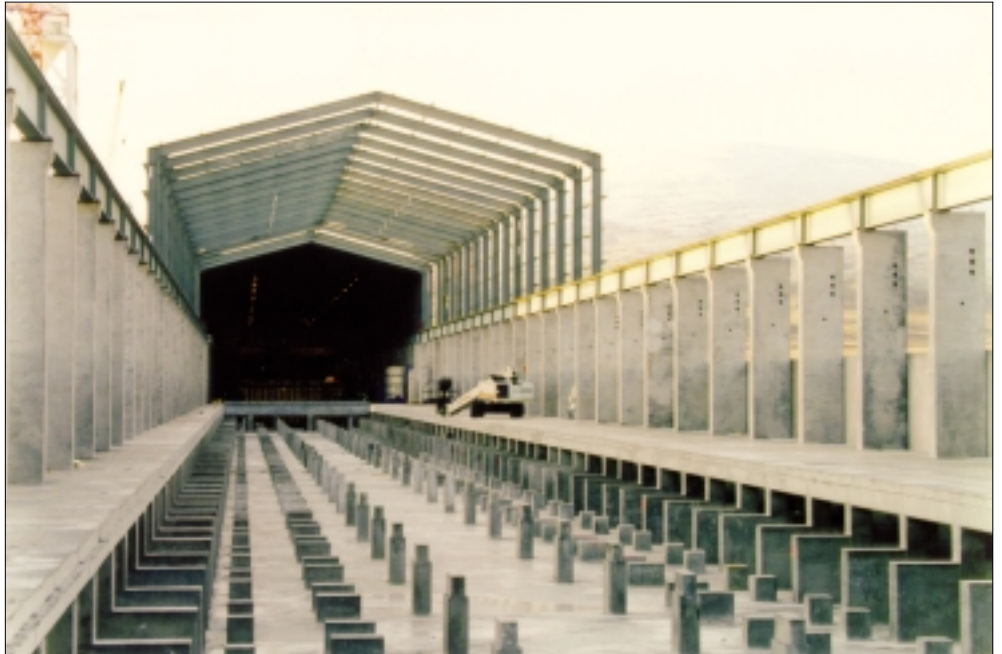
Aluminium in Iceland

projects are in the US\$100 to US\$300 million cost range. The firms are members of the Association of Consulting Engineers in Iceland, a part of FIDIC, and are fully independent. They receive no financial support from any commercial, manufacturing, contracting or public sources.

ENVIRONMENTAL IMPACT ASSESSMENT

Law on environmental impact assessment (EIA) was first introduced in Iceland in 1993, with European Union regulations as the basic model. The first EIA report on aluminium was prepared by one of the HRV firms for Icelandic Aluminium Company Ltd, now Alcan Iceland Ltd. Since then the HRV firms have conducted five additional major EIA studies and reports for Alcan Iceland Ltd, Nordic Aluminium and Reydarál, including the latest plans for expansions of the existing smelters. Coming up is the adaptation of the EIA for the planned eastern smelter to fit the requirements of Alcoa. HRV has good contacts with the appropriate and qualified research institutions and special consultants in Iceland that are required for the EIA studies, such as impact on marine life, flora and fauna, etc.

Distribution of emissions from a smelter is one of the most important aspects of an impact assessment. The air dispersion of such emissions can be simulated with sophisticated mathematical models which are able to determine so-called dilution zones, areas with a certain amount of expected pollution due to the emission, around the aluminium plant (see figure below). This, in turn, imposes restrictions on the planning of the plant, as for instance, concerning the vicinity to ecologically sensitive or populated areas. For mathematical modelling, HRV subcontracts a highly qualified local firm, Vatnaskil, a company with many years' particular experience in this specialist field. Vatnaskil also models the distribution of releases to the marine environment, which is particularly important when a wet scrubber is



planned in addition to a dry scrubber for fume treatment.

HIGH VOLTAGE POWER SUPPLY

In Iceland, the power contracts deliver the power to a reduction plant sub station at high voltage. The design of the sub station and switchgear, in addition to the rectifiers, is one of the tasks in the realisation of such a plant. One of the HRV firms has for decades been a consultant to Landsvirkjun, the National Power Company, in the field of high voltage substations and switchgear and thereby gained extensive experience in this specialised field. The most recent major project of this kind designed by the HRV Engineering Group, the 90MW Vatnaskil hydroelectric plant, has just been completed.

The valuable experience on high voltage electrical systems has helped HRV a great deal in the recent aluminium construction projects in Iceland.

ICELANDIC BUILDING METHODS

All countries have their own different traditions and methods in construction,

according to the prevailing climate conditions and the availability and cost efficiency of different construction materials.

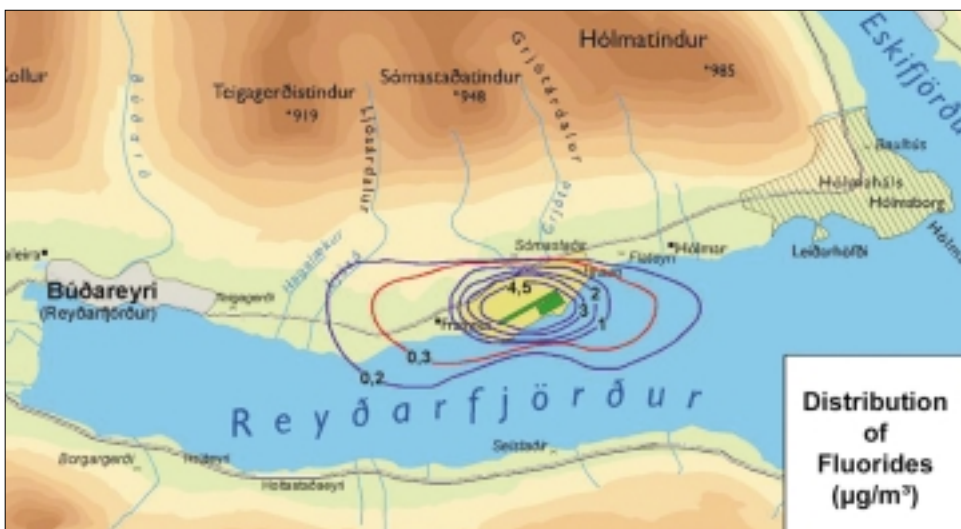
As an example, the use of concrete in Iceland is more common than in most countries, as this is an entirely local product and as the climatic conditions favour the use of concrete. At the Nordic Aluminium construction site, HRV introduced an advanced technique of using precast concrete elements, including wall elements in the earth-free zone and concrete columns up to the level of crane beams. These elements were produced with good conditions in precast yards and transported to the site on trailers. As a result, the time of construction was considerably reduced as the dependence on weather conditions in the wintertime was minimised using this system.

CONCLUSIVE REMARKS

Iceland is heading towards being a major aluminium producing country on an international scale. The HRV Engineering Group has gained extensive experience over the years in this development and is the leading consultant in this field in Iceland. The staff of the HRV firms is highly educated with specialties and experience in the various tasks required for aluminium development – from technical preparations and environmental assessment to realisation and construction. The group has worked smoothly together for decades so that any customer may expect the best possible engineering service just as from a single source.

HRV Engineering Group: email: hrv@honnun.is. Hönnun hf. – Tel: +354 510 4000, Mr Arnalds; Rafhönnun hf. – Tel: +354 530 8000, Mr Valsson; VST – Tel: +354 569 5000, Mr Erlingsson; www.honnun.is

Optimum engineering service from a single source.



From a small splash...

It all started with a small splash. Vidar Magnússon was pouring metal at his workplace in a ferro-silicon factory when suddenly this small metal splash detached from the hot melt and hit a spot on the top of his right foot. The hot metal burned immediately through the clothing and left a painful 2nd degree burn on the skin. Despite the small size of the burn, Vidar was off work for the next three days.

Vidar and his colleagues experienced incidents like this more than once. Splashing metal is a common problem at work places where liquid metal is handled.

A few years later, in 1992, Vidar Magnússon acquired a sock production site. Still with the splashing accidents in mind, he came up with the idea of developing special protective socks for people working in liquid metal environments. The product turned out to be a great success. Therefore, it seemed only reasonable to extend the product line to a full set of protective clothing. After about three years of research and development, it was decided to spin-off the protective clothing from the sock production: Foxhall ehf. was born.

The company which is in its fourth year of operation is located in the town of Akranes and employs four people. The product range comprises a full set of protective wear, such as:

- Socks
- Trousers
- Coats
- Overalls
- Underwear

The clothes are offered in different cuts and sizes for female and male workers.

TECHNICAL FOCUS

The following will give some insight to the technical aspects and uniqueness of Foxhall's clothing.

The primary requirements of materials for protective clothing against molten metal splashes is that they should be flame retardant and repel molten aluminium in order to avoid skin contact of the melt.

The average temperature of the skin is about 30°C. If the temperature of the skin rises to 45°C or higher we start to feel pain. If the skin temperature rises to 55°C, 1st degree burn will occur after 20 seconds, followed by 2nd and 3rd degree. The degree of burning depends on the intensity of the heat transfer to the skin and its duration, but it seems to be accepted that second degree burn will start when the skin has received 8.5J/cm².

A 1g splash of molten aluminium at 700°C releases 1,100J of energy (heat) when cooled to 30°C. If a splash of this size would be caught close to the skin inside a

well-insulated garment, for example a boot, it could cause a second degree burn in an area that measures 11.5 x 11.5cm². This is of course a hypothetical example since all the energy of the cooling splash will not be transmitted to the skin. But even if only 1% of the energy is transmitted to an area that is 1cm² it will cause a very severe and uncomfortable burn in that area, resulting probably in absence from work for some time.

FABRICS USED FOR PROTECTION AGAINST MOLTEN ALUMINIUM SPLASHES

There are already some protective wear materials on the market. For protection against molten aluminium splashes, American Foundrymen's association recommends materials like treated and untreated wool, cotton and Vinex.

However, Vinex has the disadvantage that it shrinks on contact with molten aluminium.

Materials like Nomex (molten aluminium sticks to it), Kermel, Flamex II, Trinex, phosphorous treated cotton, nylon, and polyester are described as unsuitable.

Extensive material tests were carried out in the UK about 20 years. An important conclusion from this work is that evaluations based only on flame retardance of the fabric can be completely misleading. As an example it is claimed that fabrics from aramids, or glass fibres cannot be considered for protection against molten metal protection. Of the materials tested, by Bensiék and Edmondson, wool was found to offer the best protection for molten metal protection. Untreated cotton offers slightly lower protection.

Several companies now offer fabrics for molten metal protection based on Viscose FR from Lanzing.

FOXHALL 100

Through various research activities in the last years, Foxhall has succeeded in developing a fabric called Foxhall 100 that meets the above requirements. It is composed mainly of Viscose FR and wool coated with a special finishing. It is a very

Key health and safety protective clothing for molten metal handling.

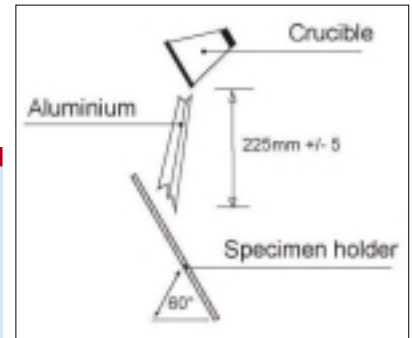


Fig 1. Schematic picture of the pouring apparatus

light-weight, flexible and smooth material that can be easily tailored. The material has been extensively tested and compared to other protective material to prove its extraordinary quality. It has proved to be strongly aluminium-repellent and non-shrinking, as demonstrated here.

The determination of the quality of a protective garment is performed by standardised tests that simulate the interaction of the molten metal on the fabric and the skin.

A test method for the assessment of resistance of materials against molten metal splashes is described in European standard EN:373 (1993) (Stadalráð Íslands 1993). In this test method a test piece is placed over a piece of a PVC film. The PVC film can be regarded as a skin simulant. The test piece is inclined 60° (see Figure 1) and a certain quantity of molten aluminium is poured on it at a certain speed.

Damage to the fabric and skin simulant is then examined and the fabric is said to pass the test if the skin simulant is not damaged. Fabrics can then be classified according to the quantity of aluminium it can withstand. The classification and requirement of materials for protective clothing is given in Table 1.

To meet a certain performance level it is sufficient that the fabric can pass a test with the minimum quantity of aluminium shown in Table 1.

Table 1. Performance level of fabrics against molten aluminium splashes, according to standard EN:351 (1995)

Performance level	Mass of molten aluminium that does not damage PVC film (g)	
	Min.	Max.
D1	100	200
D2	201	350
D3	351	

Altrack DMM

Altrack-DMM is an Asset Management and Maintenance System, which has been adapted specifically for primary aluminium smelters and is based on the highly successful DMM System originally developed for electrical power generation and transmission. Altrack-DMM has the following main features:

In 1997 DMM, then a five-year old company, reached a co-operation agreement with ALTECH to adapt the DMM software to the specific requirements of Primary Aluminium Smelters. The first Altrack-DMM installation was at Nordic Aluminium in Iceland. After two years of successful operation, Altrack-DMM was upgraded and further customised to Nordic Aluminium requirements, further enhancing an already excellent system that now has over three years proven operation in an aluminium smelter. Altrack-DMM is known for a simple and easy-to-use yet fully-featured user.

DMM HISTORY IN NORDIC ALUMINIUM

Nordic Aluminium (Nordural) is owned by Columbia Ventures Corporation, WA, USA. The smelter was started in 1998 with a capacity of 60,000t/yr and is being steadily expanded towards a goal of 240,000t/yr. Nordural's original asset registry used a "flat" numeric coding system, which had a number of limitations in concise analysis and reporting. Altrack-DMM was originally configured to use this coding system, but in April 2000 Nordural to the decision to switch to the AKS asset registry. The AKS Coding System for aluminium smelters was originally developed by VAO in Iceland and GABO AT + PM in Germany. At Nordural today there are over 10,000 registered codes in use in the Altrack-DMM system and the asset history is over 14,000 work orders.

LINK TO ASSETS THROUGH CAD DRAWINGS

One of the main hurdles for CMMS (Computerised Maintenance Management Systems) is that the number of assets quickly becomes so large that it is difficult to search through the registry tree. The Altrack-DMM system has a viewer with a gateway to the drawing database. The asset registry code is inserted into the drawings and a link is automatically established between the asset registry tree and the drawing. Many companies using the DMM system take advantage of this feature. It is generally accepted that maintenance staff adopt a "single-line drawing" mode of thinking during breakdown and maintenance. Access to the registry database via CAD drawings logically extends this thought process for quick and efficient problem solving.

DMM, Idavellir 9b, 230 Keflavik. Tel: +354 420 6200; Fax: +354 421 6200; www.dmm.is

Optimum materials – maximum protection.

According to standard EN:531 it is stated that protective clothing that is claimed to offer protection against molten aluminium splashes should at least meet performance level D1 in Table 1.

Foxhall considers performance level D1 to be insufficient and requires that the clothing material should meet performance level D2, in addition to other requirements of standard EN:531.

But Foxhall feels that for good-quality garments not only the protective aspect should play a role but that it is equally important that the user of the clothing feels comfortable wearing it. Therefore, Foxhall's aim is to make the fabric light, soft, non-shrinking and anti-allergic.

TEST RESULTS

The results for materials commonly used today in the aluminium industry are shown in figs. 2, 3 and 4. The first example is Pyrowatex treated cotton; as can be seen from fig. 2 the performance of this material is unsatisfactory. The aluminium partly stuck (not shown) to the fabric resulting in extensive damage to the fabric and the PVC skin.

Another result of a test of a fabric used for protective clothing is shown in Figure 3. This fabric is made of viscose, wool and cotton and it repels molten aluminium, but a hole is formed in the material resulting in damage to the PVC film.

An example of a fabric that repels molten aluminium with no damage to the film, is shown in Figure 4. The viscose used in this sample is a special blend of cellulose and silica. However this material does not fulfil the requirements shown above since it shrinks considerably upon contact with the molten aluminium.

FOXHALL MATERIAL

The test results for Foxhall 101 show clearly superior properties of the material.

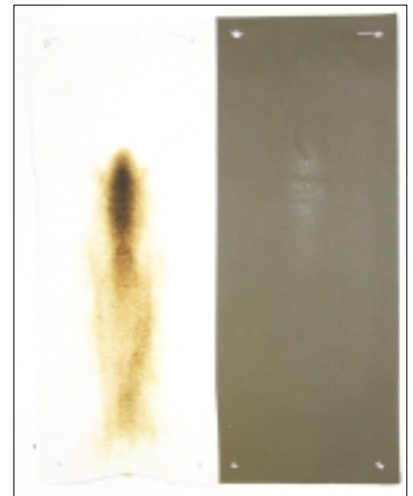


Fig 4. PVC film and specimen of a fabric made of Viscose FR, polyvinylalcohol and modacrylic (280 g/m²). Tested with 208g of aluminium

As was said before, the fabric developed by Foxhall comprises mainly Viscose FR and wool and treated with a special finish. An example of a test result of this fabric is shown in Figure 5. This material repels molten aluminium and there is no damage to the PVC film.

The fabric even meets performance level D3 (see Table 1) if a piece of knitted underwear (composed of Kermel, wool and Viscose FR) is inserted between the fabric and the PVC film. This is an easy and very comfortable way of reaching maximum protection as can be seen in Figure 6.

Those results indicate that combining Foxhall 100 underwear and outer garments, a performance level far above the norm requirements is reached. Foxhall has therefore reached its aim to protect employees to a maximum level.

Fig 2. PVC film and specimen of Pyrowatex treated cotton (290 g/m²). Tested with 213g of aluminium



Fig 3. PVC film and specimen of a fabric made of Viscose FR, wool, and cotton (315 g/m²). Tested with 208 g of aluminium



Aluminium in Iceland



Fig 5. PVC film and specimen of a fabric made of Viscose FR and wool (300 g/m²). Tested with 207g of aluminium

DESIGN OF PROTECTIVE CLOTHING FOR MOLTEN METAL SPLASH PROTECTION

In the design of garments for molten aluminium protection it is of utmost importance to minimise the risk of aluminium getting trapped on, in or under the clothing. This prohibits the use of open pockets or regular seams. All seams and pockets are covered in such a way that possible aluminium splashes will flow downwards without halt. Trousers should cover boots to minimise the risk of

aluminium getting trapped in the boots.

A further important point is that common chemically treated materials are often a cause for skin irritations. Foxhall 100, in contrast, can claim to use 100% allergy-free components. Even for the cleaning regular detergents may be used, no chemical dry-cleaning is necessary.

LOOKING TO THE FUTURE

Foxhall has devoted a great deal of effort into research of hot metal protective materials and has come up with a reliable and comfortable solution. The feedback of the users is throughout positive. However, the company will not sit back but rather keeps up focussing new aims in improving their garments.

Development has been initiated on a fabric that resists liquid metal even when unintentional folds form. This goes far beyond the EN:373 (1993) requirements where such occurrences are not taken into account but it plays an important role in real-life situations where aluminum may get trapped in such folds. Additionally, Foxhall has the ambition to meet performance level D3 with the new fabric being developed.

In the future, the company will continue to focus on customer needs

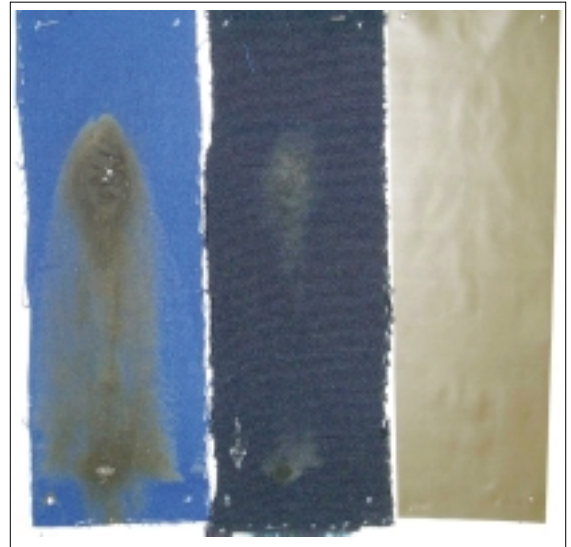


Fig 6. PVC film, knitted underwear made of Kermel, wool and 25 Viscose FR and specimen of a fabric made mainly of Viscose FR and wool (300g/m²). Tested with 354g of aluminium

and provide as comfortable clothing as possible.

Who would have thought that a small splash would make such a big difference?!

Foxhall Safety Clothing,
Kalmansvellir 3, 300 Akranes, Iceland.
Tel : +354 431 3200; Fax: +354 431 3343; www.foxhall.is

Aluminium in Iceland

From aircraft wrecks to anode clamps

Reykjavik in the early 1950s: a small aluminium foundry called Hella has been in operation for just a few years. The large storehouse is full of huge and bizarre-looking pieces of metal. At a closer look the unusual stock turns out to be heavily damaged aircraft parts! It was nothing unusual for the employees at that time to go on long and strenuous travels to the mountains with the purpose of collecting aircraft wreck parts from the World Wars. This was the only possibility for the young foundry to acquire raw material for their production site as the Icelandic state heavily restricted the import of raw materials, equipment and machines necessary for the company to operate.

Reykjavik, 2002: Hella, with now over 50 years of casting operation, is now located in a spacious building of a flourishing industrial area south of the Icelandic capital. Although still recycling used aluminium parts, Hella is now also using high-quality primary aluminium to cast a broad variety of products with modern, state-of-the-art equipment. The foundry now supplies industrial customers with components made from aluminium and copper as well as aluminium and copper alloys blended with several additives like silicon or magnesium. The product palette has grown from household equipment in the early days to high-quality specified industrial components, such as anode clamps for aluminium production, or connector clamps for electrical substations. Although Hella does not sell directly abroad, its components can be found in facilities all over the world.

HELLA – MANY YEARS' EXPERTISE

Hella was founded in 1949 and has been operated by the founder's families ever since. During the company's life-time the economic environment has changed dramatically from heavily protected government-control to a market-oriented investor-friendly economy, therefore facilitating the access to raw materials, machines, and necessary equipment. Hella now employs 10 people with qualifications in casting and mould-making. It is a small foundry, quick on the move, and thus able to fulfill individual customer's requirements to the utmost satisfaction. It enjoys strong support through cooperations and customer relations with companies such as Alcan Iceland (ISAL), the National Power Company (Landsvirkjun), the State Electric Power Works (RARIK), and the Technological Institute of Iceland.

Today's raw material comes from two sources. On the one hand, Hella buys high-quality primary aluminium from the aluminium smelter ISAL in Straumsvik and Nordurál in Akranes (both Iceland) and on the other hand, there is a strong commitment to recycle used aluminium. The employment of recycled aluminium is justified in cases where an exact knowledge of the material composition is not required,



High quality aluminium castings for a wide variety of products.

such as for guiding posts. In the past few years, Hella has cast around 20t of recycled aluminium compared to 10t of primary aluminium per year. The primary aluminium is blended with a variety of additives like silicon, magnesium, copper, titanium and mangan to reach the desired properties. Hella's main focus in alloys is on magnesium-aluminium, Silafont, and Alufont.

COOKING, CONNECTOR CLAMPS AND CRISP COLD

In the early years Hella's production focused mainly on household equipment and small parts for machine maintenance. Since then, the product range has been dramatically broadened and focussed on industrial demands while not omitting the private and public sector. The company offers a large variety of signs and badges for private houses, as well as guiding and warning posts used all over the country.

The industrial product range includes abutments, anode clamps and bearing castings which are used by Alcan Iceland (ISAL) and SÖRAL in Norway; this has been one of the largest projects Hella has been working in. The National Power Company and the State Electric Power Works use connector clamps and other components, fabricated by the foundry for the electrical substations and the electric power distribution networks. These products have to be very strong and enduring in order to cope with high pressure and to withstand the frequent changes in the harsh Icelandic weather conditions.

Components for the Icelandic fishing

industry are other examples of high-specific products of which high strength and durability are demanded. Hella offers different kinds of flanges, cleats, and machine pieces for fish processing.

Hella also serves another, very Iceland-specific industry: it casts automobile parts, such as gearboxes, for the modification of off-road trucks through which vehicles are enabled to drive through harshest, uninhabited terrain such as glacier areas, water, and swamps.

www.hella.is/html/framleidsla.html

HEADING INTO A HIGH-QUALITY FUTURE

Hella's mission is to add value to the Icelandic aluminium industry and thus strengthening this significant economic sector.

The foundry is a company with a sense for tradition and continuity and at the same time looking ahead to the future and enforcing innovations. Regular research projects are conducted to improve the foundry's processes and end-products. The owners and employees can strongly identify with the company and its mission, are aware of changes in the business environment and follow them closely. The company's philosophy has never been one of mass production but rather on producing small-quantity high-quality products, working closely with their customers and satisfying their individual demands. Hella feels strongly about environmental issues and tries to minimize aluminium waste by reusing as much material as possible. It also takes responsibility to ensure clean and safe workplaces that go far beyond the regulatory requirements.

Hella wishes to continue in providing a good service and satisfying its customers. The company keeps its eyes open and is always willing to offer new products and improve its processes. At the same time the company believes in their guiding principles that have strengthened the company for the last 50 years. But, despite that, everyone is glad not to have to collect pieces of aircraft when going on a holiday trip to the mountains...

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Aluminium in Iceland

A modern cast iron foundry with experience and ambition

To produce good quality articles that meet modern standards, for delivery at the correct time and at a competitive price – that is the mission that Malmsteypa Thorgrims Jonssonar ehf. is committed to. The company was founded in 1944 and is located in a modern, purpose-designed building in the town of Gardabaer close to Reykjavik. The company produces 700t/yr of castings in grey cast iron and S.G. cast iron with products weighing from less than 1kg up to 1,000kg. About 30% is exported to the primary aluminium industry in Europe.

Malmsteypa Thorgrims has, in a number of cases, redesigned castings, resulting in a longer lifetime used in the aluminium industry. In urgent cases the company can react quickly and flexibly and has for instance produced patterns and delivered castings within a few days. Shipping, for instance to Rotterdam, only takes four days and forward shipping for the customer can be arranged so that castings can be delivered according to schedule.

PRODUCTS

Among items which the company has delivered to the primary aluminium industry are: inner and outer collars for collector bars; suction pipes for collector ladles; lips for open suction/collector ladles; skimmer tools for fixed and telescopic bars installed on payloaders or on fork lifts; leakage vessels; cast iron moulds; furnace lips and connect runners, and furnace door frames etc. Malmsteypa Thorgrims has more than 30 years of experience in castings for the ISAL smelter which is now a part of Alcan.

PRODUCTION AND QUALITY STANDARDS

Malmsteypa Thorgrims uses modern production methods and state-of-the-art technology in the field. Moulds are made in furane sand which is very strong and ensures moulds with stable forms and good quality surface. Pattern making for the customers is arranged if a new pattern is needed. Before melting – which takes place in an induction furnace – the materials are measured and treated according to the most detailed quality standards. The composition is analysed in a spectrometer. Ultra sound tests and hardness tests are carried out to check material specification and the quality of the production. For high strength items Malmsteypa can test up to 100t in compressive strength and 80t in tensile strength. Castings are delivered fully machined according to specifications. All material purchases come from suppliers who meet the ISO 9001 quality standard.



Suction pipes on collector ladle cast by Malmsteypa Thorgrims for Nordic Aluminum



Collars for collector bars cast by Malmsteypa for Alcan

INNOVATION AND RESEARCH

Malmsteypa Thorgrims Jonssonar ehf. places a strong emphasis on improving processes and material quality. The foundry has decided to devote around 4% of the yearly turnover into research and development. The company has participated in a number of research projects in order to maintain a high level of expertise and follow the frontier of development in the field of casting. This can be illustrated by a few examples.

In the framework of the Nordic metal cast project Hubert-work in the years 1986 to 1992 the company collaborated with The Technological Institute of Iceland (IceTec) in researching the quality of S.G. iron castings at different cooling rates. The project was supported financially by the Icelandic Research Council, The Nordic Industrial Foundation and Ictec, and was carried out in cooperation with the major

laboratories in the field of metal casting in the Nordic countries. In this way, valuable experience had been gained when the marketing of S.G. iron started in 1991.

The company has worked on further research projects with the Technological Institute of Iceland. Among them was one centred on developing a method to improve specific qualities of castings, as for instance the hardness of surfaces. Major improvements have been achieved here.

Moreover, Malmsteypa Thorgrims Jonssonar ehf. has participated in a number of projects – funded by agencies from Finland, Norway, Iceland, Sweden and Denmark – with the objective to increase the expertise and productivity of the metal casting industry in the five Nordic countries.

FUTURE

Malmsteypa Thorgrims Jonssonar ehf. can proudly look back on more than 55 years of production, experience, and improvement. It has served customers in the national and international primary aluminium industry to the highest satisfaction and has thus acquired a good name in this field.

The foundry aims to keep up the good work and furthermore to expand their business activities stronger to the international market. The management and employees will be happy to contact new clients from all over the world and to help in realising their customer's ideas.

Despite the ambition to extend their activities, Malmsteypa will always keep to its stated mission and deliver high-quality products as fast as possible and at as reasonable as possible prices. The international market will thus definitely deal with a quick, flexible, and self-confident competitor.

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Fast and flexible production of high quality castings.

Ultrasonic test of casting



Highly capable supplier

Successful spin-off company Stimir is an instructive example how Iceland's primary aluminium production triggered the operation of a highly capable and growing supplier of various technologies. The company was established in 1995 by six former employees of the Alcan Iceland smelter. The founding team came from various departments of the smelter and could therefore refer to a broad technical background plus many years of working experience in an aluminium-producing environment. This provided the company with insight into the needs and demands of customers operating in this field.

Ingi Rútsson Managing Director of Stimir said: "The idea behind the foundation of Stimir was to create a company for the development and production of machines and devices that the industry demands. After the establishment of the company we have been involved in many demanding tasks in the field of design, construction and software for primary smelters. It is our belief that our background experience has been a benefit for us and our customers."

STIMIR'S ROLE IN THE PRIMARY ALUMINIUM INDUSTRY OF ICELAND

As of today, the two Icelandic smelters produce approximately 260,000t/yr of aluminium, of which Alcan accounts for 170,000t/yr and Nordic Aluminium, the recently built smelter, around 90,000t/yr. Particularly, the low-priced hydro-generated electricity is an important factor for the energy consuming aluminium production plants to choose Iceland as their operation site. Both of the existing smelters have shown interest in expanding their plants. Negotiations are now underway to build a third smelter in the east side of the country. All this gives significant evidence to assume a substantial increase of Icelandic primary aluminium production over the next years.

Stimir's mission is to supply their customers with complete solutions and turnkey projects, i.e. to perform the mechanical and electrical design, to execute the mechanical and electrical construction and to supply PLC software and Scada systems. "It is our belief that it is of great benefit to our customers if they can be offered all of the above services from one source," Ingi Rútsson explains. Furthermore, Stimir has from the very beginning been involved in the production of various machines for the aluminium industry.

PRODUCT RANGE

Stimir hf. is committed to deliver strong and durable quality products for the harsh and demanding environment of aluminium production sites.

For aluminium casthouses, Stimir developed the TMMS200, a non-contact inductive aluminium level sensor which comes with a 200mm sensing range. The

TMMS200 is used on DC casting machines and launders. The accuracy and the long sensing range has been proven to increase safety and control accuracy, especially when slab casting is started. Over 100 such sensors are now in use all over Europe and excellent results have been obtained. Some of the main principles put forth when designing the TMMS200 were durability, precision and efficiency. The arm of the sensor descends and ascends by a step motor controlled by a computer depending on the distance of the metal from the sensor's head. The computer constantly measures the real metal level, calculating the status of the arm and the measured signal from the sensor head with utmost precision.

Stimir's TMMS200 comes as an independent unit capable of interfacing with almost any type of metal casting systems available and as such is a highly adaptable hardware. In addition to that Stimir also manufactures aluminium flow controllers, MFC, for controlling the flow from launders into casting moulds. The MFC is a pin position controller, driven by a stepper motor, through which great accuracy is achieved. Those flow controllers have proven very reliable in the most difficult conditions.

For Anode Rodding Shops Stimir has designed and built several machines. One of them is the Collar Mounting Machine for placing paste collars around anode stubs for protection. This machine is totally automatic and can operate both aluminium and heat resistive cardboard.

Stimir has also designed, built and installed a machine for the placement of anode rods into anode blocks before the iron cast-in procedure.

One of Stimir's recently very successful products is the Anode Stub Sawing Machine installed at Alcan's rodding shop in Iceland. The stub cutting is a part of the rod repair process. This sawing machine uses a band saw blade and replaces the procedure of using propane gas/oxygen to cut off the damaged stubs. After the damaged stubs have been cut off, a new stub is welded on. As with usual procedures, the cutting surface from the gas burn as well as the stub lengths are normally very uneven. The Stub Sawing Machine, however, causes the cutting surfaces to be

very smooth, horizontal and equal in length, this again being of a great advantage when it comes to welding on new stubs. It has been proven that the average electrical resistance across the welding area is significantly reduced which results in a considerable energy saving in the potroom. Other advantages are, substantial gas energy saving, elimination of greenhouse gases, reduction of required cast-in iron, better current distribution through the anode and finally, manpower is saved through the machine.

Innovative current meters for potrooms are also part of Stimir's expertise. The anode rod current meter is based upon measuring the voltage drop over a certain fixed distance. The meter for measuring cathode current is based upon measuring the density of the magnetic field around the conductors with Hall effect sensors.

Both the anode and the cathode current meters are used in four smelters and have proven themselves very well. The advantage of both meters is that they are very light and handy (weighing only about 1.6kg).

Moreover, the company provides all kinds of calibrated and non-calibrated, thermocouples, thermocouple assemblies and accessories.

OUTLOOK OF EXPANSION

Stimir hf. has successfully managed the step from a small spin-off enterprise to a self-confident, internationally active company. It is the aim of the company to expand its production and sales activities in both the Icelandic and international markets. "We have developed our machines and technology to our best belief and experience. We have definitely profited from the goodwill and support given by the management of Alcan in Iceland which has been priceless for what we have achieved," resumes Stimir's chief of designing, Karl Rútsson.

Stimir is ready for the expected growth of Iceland's aluminium industry and is willing to take part in this development which will have a major economical impact on this small nation. ●

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