innform

The Newsletter of Innoval Technology Ltd

innoval technology

. . . value through innovation

Issue: 1 | Summer 2004

Innoval Celebrates First Anniversary

1st May 2004 marked one year in business for the 28-strong team of materials scientists, engineers and business managers, who came together to form Innoval Technology as a result of a buy-out from the Banbury Research Centre of Alcan International.

More than one year on we have much to celebrate. Our dedication to the advancement of aluminium and other light metal technology has achieved new heights. Our experience and expertise has grown, enabling us to better serve our largest client, Alcan, as well as a growing number of aluminium and other light metal end-users.

We have invested in our skills and technology to provide our clients with a true one-stop-shop for process development, metallurgy & surface technology, materials characterisation and analysis and knowledge management.

We have made much progress in a small space of time. Our achievement of BS EN ISO 9001:2000 is testimony to our commitment to the highest standards of quality and service; and we are working positively towards further development and growth over the coming year.

This newsletter forms part of our new communications strategy to regularly inform clients, partners and other contacts about our range of services and developments in the field of aluminium and other light metal technology. We hope you find it useful and interesting, and we would very much value your feedback.

Nigel Davies

Managing Director,
Innoval Technology Ltd

ISO 9001 Award Success

Innoval has been awarded BS EN ISO 9001:2000 certification following months of rigorous planning and implementation.

Andy Darby, Innoval's Business Management System Manager, has masterminded the system's development, which started formally in January, but which has been an important goal since the launch of Innoval in 2003. Lloyd's Register Quality Assurance (LRQA), the world's best known management systems and certification company, carried out Innoval's assessment over 2 days in July.

"We have adopted 9001 as the management system for our whole business. The inherent 'Plan-Do-Check-Act' cycle methodology reflects very closely our existing operating practices. A key feature of the 9001 standard is to proactively find out exactly what clients want from the products and services we provide. However, we don't just want to meet clients expectations, we expect to exceed them." says Andy.

Inside this issue...







Gibbs Aquada looks to Innoval for surface support

Innoval was commissioned by Gibbs Technologies to assess their suppliers' surface treatment processes, thereby supporting Gibbs' development of the world's first High Speed Amphibian.

Innoval was brought in by Gibbs to audit suppliers' processes, undertake detailed surface characterisation studies, and conduct a mechanical test program in support of Gibbs Technologies' patented lightweight aluminium structure that can now be found within the Gibbs Aquada, the world's first High Speed Amphibian (HSA).

Launched in 2003, the Gibbs Aquada is capable of reaching speeds of over 100mph on land and 30mph on water, achieving powerboat functionality and even capable of towing a water skier! This unique achievement is made possible through the combination of a 2.5 litre, 175-bhp V6 engine and a proprietary jet propulsion system, which kicks into action at the touch of a button when moving from land to water.

The Gibbs Aquada features many groundbreaking technical innovations and is a triumph of British design and engineering. Cited as "one of the best innovations of 2003" by Time Magazine, the Gibbs Aquada's technology is protected by no less than 60 patents, including one for its unique lightweight aluminium and composite load-bearing and crash structure.

Innoval was brought in as an independent expert body to test and confirm that the aluminium pre-treatments used within the production process met with the appropriate industry standards. This involved visiting Gibbs' suppliers and providing detailed scientific evidence confirming metal treatment processes were within specification.

Innoval was brought in as an independent expert body to test the aluminium pre-treatments

Neil Jenkins, Managing Director of Gibbs Technologies said;

"We chose Innoval to carry out this important work because of their expertise in surface treatment and structural adhesive bonding. The Gibbs Aquada is designed and produced to the highest levels of quality and safety, and we trusted Innoval to perform to the same exacting standards."

The Gibbs Aquada already boasts a strong order list with one famous owner, Richard Branson, recently setting the world record for a channel crossing in an amphibious vehicle – just over 90 minutes!

The success of the Gibbs Aquada has also spurred the development of the 350-bhp "Gibbs Humdinga", a four-wheel drive HSA concept vehicle. One to look out for on the school run near you in the future!

Top Marks at Alstom's Rolling Mill Academy

Two Innoval lectures, one made by Process Engineering Manager, Tom Farley, and the other by Senior Consulting Engineer, Chris Davenport, achieved the highest marks from delegates at Alstom's International Rolling Mill Academy.

The Academy, which took place over five days in March at Alstom Power Conversion's UK office in Rugby, is designed to introduce rolling mill engineers to state of the art control theory and practices in hot and cold mills, with the emphasis on product quality and cost optimisation. It was organised by Alstom Power Conversion, in conjunction with the Industrial Control Centre at the University of Strathclyde.

A key focus of the Academy, which attracted 28 delegates from 7 countries, was on control design for thickness, width, profile, flatness and temperature. The Innoval lectures on "Rolling Mill Vibration" and "The Mechanics of Rolling" came first and second respectively in the overall scores given to them by the delegates for technical level, relevance and presentation quality. A third Innoval lecture on "The Business of Rolling" also scored highly.

The next Rolling Mill Academy will take place in Pittsburgh, Pennsylvania on 18-22 April 2005. For more information on this course or Innoval's other training services, please contact Tom Farley on 01295 702 814.

Getting more out of knowledge at Morgan







Businesses that capture and share knowledge at all levels are able to find new ways to improve quality, standardise operations to reduce costs and identify and replicate best practice across different parts of the company.

That was certainly the experience at Morgan Carbon of Morriston in Swansea; manufacturers of electro-graphitic carbon blocks used mainly in the automotive, rail and domestic appliance sectors. Morgan Carbon invested in Innoval's new K-Map software, which provides an easy to use, structured way of capturing all of the knowledge contained within a plant. Developed specifically for manufacturing companies, K-Maps are a practical knowledge mapping tool suitable for capturing information and data about every process and product.

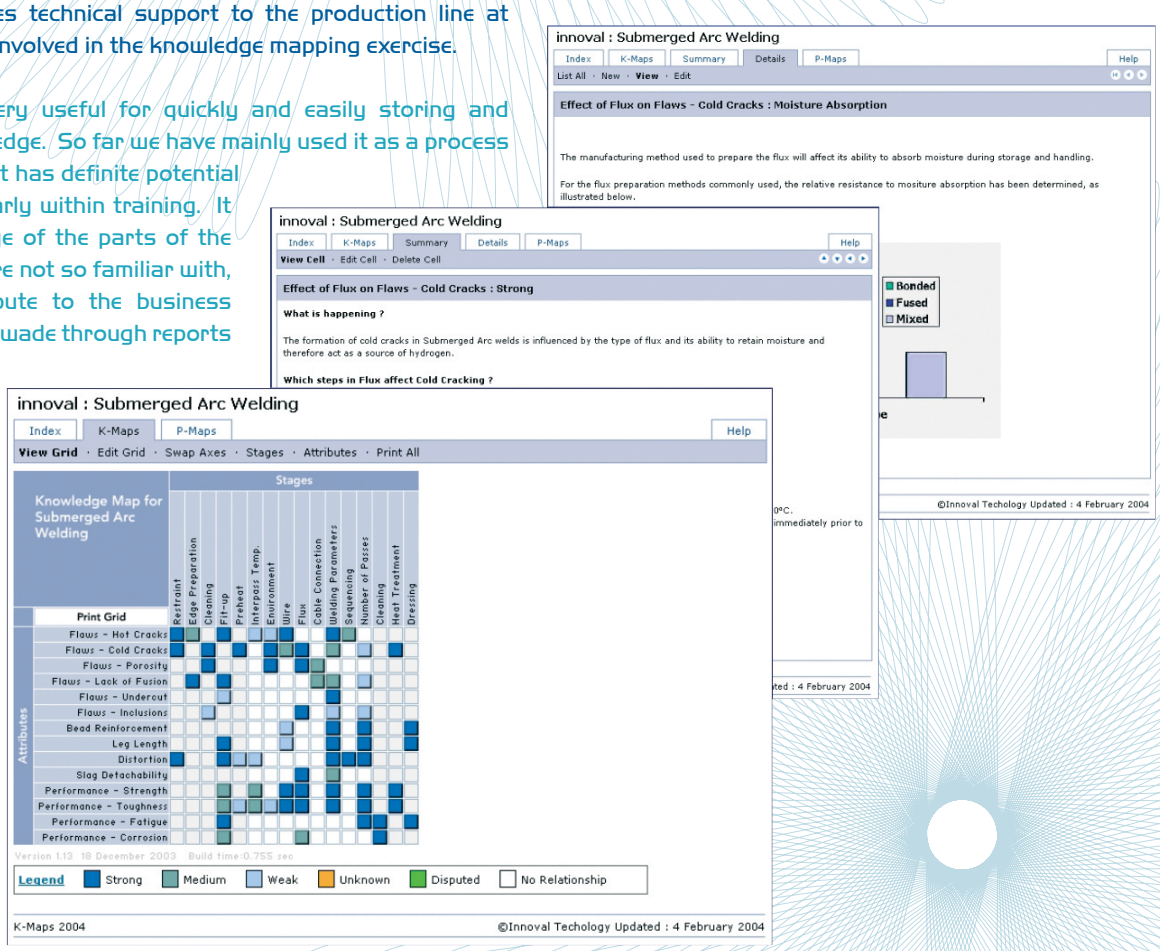
Innoval engineers worked with employees at Morgan Carbon to map all of the relevant knowledge about their products and processes onto a matrix within the K-Map software that shows visually how each process stage affects the product attributes. The "interactions" between the product attributes and each process stage were defined during a detailed workshop, where tacit knowledge (i.e. what individual team members knew) about the nature of each interaction and the quality controls in place was identified and captured. Further data to support the tacit knowledge was then acquired and stored within the software package.

"The K-Map is an excellent tool for pulling out information. We have captured knowledge from people who will not be available to us in 10 year's time. The few days spent mapping the knowledge was definitely time well spent."
Said Dr Chris Spacie, Technical Director.

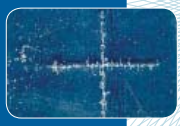
Dr Albert Easton provides technical support to the production line at Morgan Carbon. He was involved in the knowledge mapping exercise.

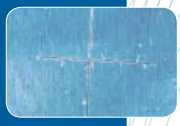
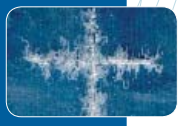
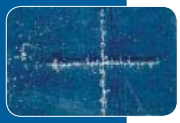
"The K-Map format is very useful for quickly and easily storing and retrieving practical knowledge. So far we have mainly used it as a process problem-solving tool, but it has definite potential to do a lot more, particularly within training. It can give people knowledge of the parts of the production system they are not so familiar with, enabling them to contribute to the business quicker than if they had to wade through reports and manuals."

If you would like more information on K-Maps or to request a demonstration, please contact Gary Mahon on 01295 702 818.



K-Map example

Critical Issues for Chrome-free Pretreatment of Aluminium Alloys

Successful chrome-free pretreatment of aluminium alloys depends on a number of critical factors ranging from alloy and process route selection through to appropriate surface cleaning and corrosion or durability testing. Geoff Scamans summarises the main issues.

1. Alloy Selection

Over the years there have been several requests for "stainless" aluminium, that is aluminium with a low propensity to corrode. If this is considered for painted sheet applications, then recent results have shown that the severity of corrosion under a paint film is directly related to the manganese content of the alloy. This means that alloys like AA3003, AA3103, AA3004, AA3104, AA3005 are all inherently susceptible to corrosion and strong consideration should be given, where possible, to using alloys with a lower manganese level, like AA3105, or to using alloys like AA5050, AA5251, AA5754, etc.

2. Alloy Processing

Deformed surface layers on aluminium alloys are produced most readily by hot rolling and, generally, the layer thickness of sheet and plate after hot rolling is of the order of a micron. The deformed layer thickness is progressively reduced by cold rolling, so alloys that have been extensively cold rolled have thinner deformed layers that can more readily be removed by conventional etch cleaning operations. This means that resistance to corrosion can be improved by increasing the transfer gauge thickness so that, after cold rolling, the amount of surface to be removed at final gauge is 0.2µm or less.

Another route to reduce susceptibility is to homogenise rolling blocks before hot rolling to precipitate out the manganese from solid solution. This is equivalent to using a lower manganese containing alloy. A further possibility is to eliminate hot rolling by using either roll cast or thin belt cast production routes. This is particularly effective when used in combination with appropriate alloy selection.

3. Cleaning

This is the most critical process step to provide alloy surfaces that can be successfully pretreated with a chrome or chrome-free pretreatment. Basically, the corrosion active surface layer must be removed using either an acidic or alkaline treatment. The amount of metal to be removed depends directly on the layer thickness, and this means that cleaning is facilitated where there has been significant cold rolling to reduce layer thickness. In low magnesium alloys, the ultra-fine grains are usually annealed out, but there is still a preferential precipitation of dispersoids compared to the bulk microstructure. The entire corrosion sensitive layer must be removed. For most AA5xxx alloys the only requirement is to remove magnesium oxide from the surface as this can reduce adhesion particularly for bonding applications. This means that cleaning of AA5xxx alloys is much more straightforward than cleaning AA3xxx alloys, particularly those with high manganese content.

Effect of Cleaning: TRC AA3105. Commercially twin roll cast materials, Laboratory cold rolled and back-annealed (350°C)

AC Electrolytic (H_3PO_4)

Solvent degreased (acetone)

Alkaline etch +desmut

Mixed Acid (HF/H_2SO_4)

4. Chrome-free Pretreatment

The principal function of pretreatment or conversion treatment after cleaning is to provide good adhesion. This can be achieved by using a treatment to enhance the natural oxide layer like anodising or hydrothermal treatment in water or steam. Anodising pretreatments have been used very effectively for many years, although they are not in widespread use as coil line treatments. Coil line treatments are based on fast anodising in either sulphuric acid or phosphoric acid. These types of preteatment have the advantages of speed, control and uniformity compared to most chemical conversion treatments. They are much under-utilised as chrome-free pretreatments.

Fluorotitanic and fluorozirconic acid based pretreatments are in fairly widespread use as chrome-free alternatives. Such pretreatments can certainly be effective, but are more difficult to monitor in production compared to traditional chrome-based systems.

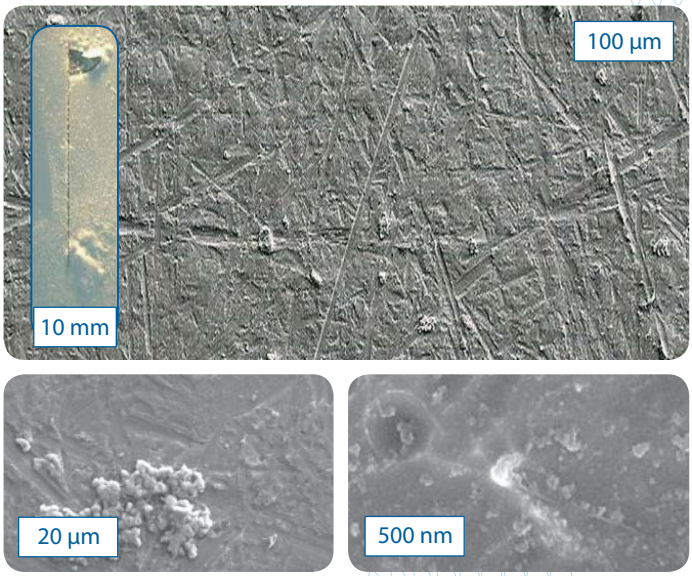
Technical Paper Extract

This extract is produced in summary form only.
To receive a full copy of the paper, please contact Geoff Scamans on 01295 702826.

Pretreatment systems based on the use of adhesion promoters such as silanes, phosphonates and polyacrylic acids have been extensively researched. These pretreatments can certainly be very effective especially when applied as monolayers rather than thick films. They are probably most useful when used in combination with a thin anodising treatment or similar treatment to increase barrier film thickness and to develop a micro-surface roughness to enhance adhesion.

5. Corrosion Testing

There is very little systematic information on field performance of painted aluminium products. Most useful information has come from the carefully monitored exposure of sets of test panels on exposure sites. The results of these studies correlate extremely well with filiform corrosion tests and with certain cyclic corrosion tests like the TNO test. There is generally poor correlation with the results of acidified salt spray tests either in terms of performance ranking or in the observed mode of corrosion. It is certainly entirely inappropriate to use corrosion tests designed for steel substrates for aluminium, as the conditions that promote corrosion are quite different. Corrosion of painted aluminium requires the presence of chloride and a high humidity. Corrosion of aluminium under conditions of total immersion or at humidity levels of more than 95% does not show the filamental corrosion mode that is seen on exposure sites or in service.



SEM images from an area of corrosion

6. Grinding and Machining

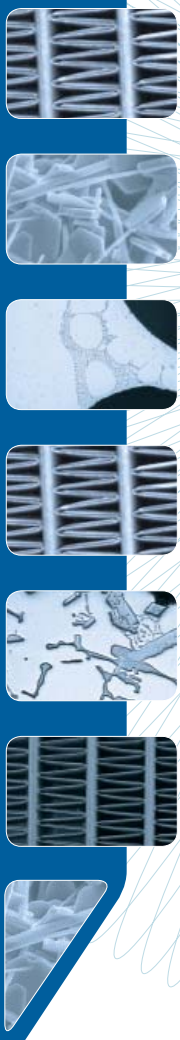
Although the surface of wrought aluminium products can be made corrosion resistant by cleaning to remove active surface layers, it is important that such surfaces are not damaged by subsequent high shear processes like grinding or machining operations. This is particularly important for aluminium automotive alloys, like AA6111 and AA6016 that are used in external closure panel applications. Mechanical grinding during processes such as rectification can readily produce an ultra-fine grain sized surface layer. This layer is not removed during cleaning and phosphating as part of the body-in-white finishing operation. The layer can become more corrosion active than the underlying bulk metal following paint baking. This is due to preferential precipitation of the ageing precipitate in the surface layers compared to the bulk microstructure.

7. Recycling and Secondary Metal

Secondary metal generally contains higher levels of impurities compared to primary metal. This can lead to higher levels of elements like iron, silicon and copper and also to contamination by elements like lead, bismuth, zinc and tin. There is also the problem of manganese from the large tonnage of high manganese alloys in use in many building product and packaging applications. Aluminium alloys made from secondary metal can be highly resistant to corrosion using chrome-free pretreatments provided that alloy compositions are optimised such that deliberate manganese additions are minimised.

In Summary

Chrome-free pretreatment of aluminium is not difficult to achieve. It can be facilitated by appropriate alloy and process route selection. The most important finishing process is surface cleaning to remove corrosion active surface layers. Following effective cleaning, a wide range of chrome-free pretreatments can be used successfully provided good adhesion is achieved. The most effective pretreatments are those base on anodisation although hydrothermal treatments should also be considered. One of the major hurdles to chrome-free pretreatment is the use of overly aggressive corrosion test methods that do not relater to service performance.



The Growth of Aluminium in Automotive Heat Exchangers

Since the introduction of long-life alloys back in the early 1980's, suppliers of alumimium brazing sheet products have embarked on a process of continuous improvement and new developments to keep pace with increasing challenges set by the OEM's. In particular the need to downsize and lightweight. While alloys like AA3003 and AA3005 are still used for many applications in automotive heat exchangers, long-life alloys have now become 'the norm' for the majority of radiator tube and evaporator plate applications.

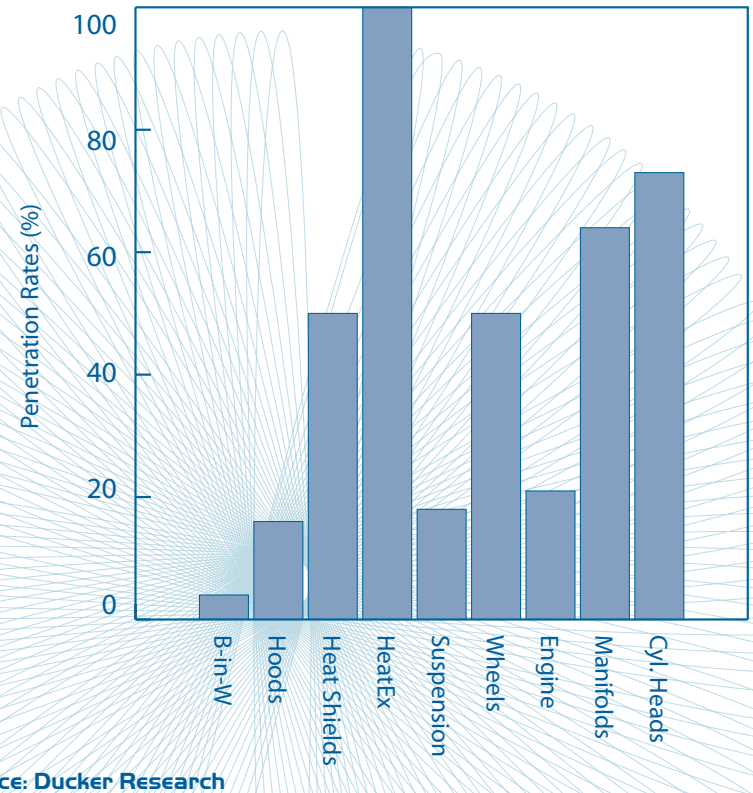
Alan Gray reviews the different types of long-life (and extended life) alloys that are now commercially available and discusses the range of properties that they offer.

1. Market Trends

Since the mid-eighties, when environmental pressures made it clear that light-weighting of passenger cars would be a key factor in reducing greenhouse gas emissions and improving fuel efficiency, the aluminium content per vehicle has nearly doubled.

By 2005, it is estimated that virtually 100% of all radiators, heater cores and evaporators will be manufactured from aluminium. In North America aluminium has already achieved 100% penetration. It has been calculated that a saving of some 20 kg of CO_2 emissions can be achieved for each kilogram of weight saved in the vehicle. Currently, of the approximately 130 kg of aluminium in the vehicle, the heat exchanger components account for about 14 kg.

Aluminium Component Penetration Rates in the US



Source: Ducker Research

2. Key Property Requirements

With industry drivers such as light-weighting, reducing the envelope size and cost reduction, there has been a clear need for higher strength alloys. However, as down-gauging of materials increases, in particular tubestock, the need for an improvement in corrosion performance is required. Therefore, improving the corrosion resistance of Al-Mn based alloys became the focus of many alloy development programs back in the late seventies and early eighties.

3. Alloy Developments

It is well known that aluminum alloys can be strengthened by a number of mechanisms, namely: particle dispersion hardening; solute hardening; age hardening precipitates; and grain size reduction.

Summarised in Table I are the post-brazed (CAB) strength ranges that can be achieved with the generic alloy options discussed earlier.

Alloy Type	Post-brazed yield MPa & (ksi)
AA3003 & AA3005	35 - 45 (5.1 – 6.5)
Long-life mkI (sacrificial band)	50 – 55 (7.2 – 8.0)
Long-life mkII (sacrificial band)	65 –70 (9.4 – 10.1)
Ultra long-life (sacrificial band + Ti)	55 – 60 (7.2 – 8.7)
Long-life (Ti layering)	55 – 65 (8.0 – 9.4)
Multiclad	70 – 75 (10.1 – 10.9)
Heat treatables (6xxx series)	75 - >85 (10.9 - >12.3)

Table I Post-brazed yield strengths of brazing sheet alloy variants

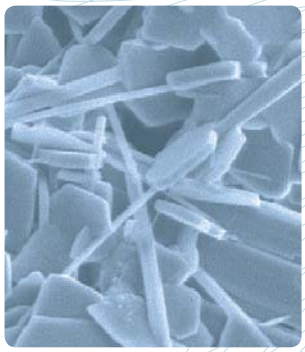
4. Manufacturing Developments

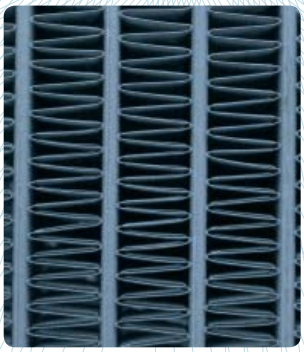
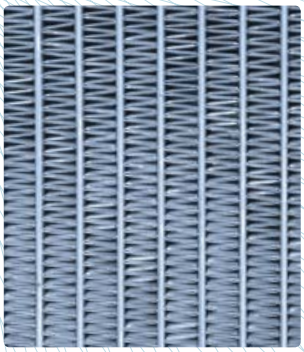
In addition to extensive alloy development programs, some suppliers have developed novel methods for cladding onto continuously cast core alloys and producing clad ingots in-situ. As far back as 1984, Alcan had patented a system

Technical Paper Extract

This extract is produced in summary form only.
To receive a full copy of the paper, please contact Alan Gray on 01295 702813.

for cladding in-line on their belt caster (FlexCaster®), and this was followed by Reynolds and Alcoa who utilised a twin roll caster (TRC) approach to produce clad products. As with all TRC products, there are some outstanding issues with products where formability is the key requirement. In addition to the cladding on-line developments, Corus and Alcoa have developed modified casting processes to produce clad in-situ ingots.

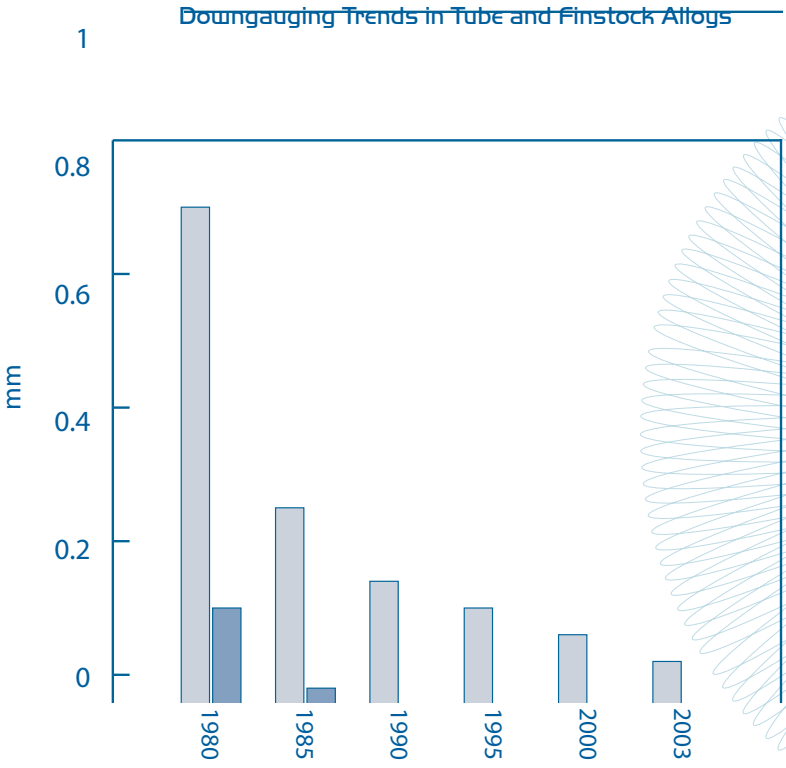


5. Future Challenges

Overall, the response of the material suppliers to the challenges presented by the new designs of heat exchanger components/systems and government legislation - 'closing the technology gap' – has been good. Without the strength increases and improvements in corrosion resistance, the down-gauging trend would not have been attainable.

However, there still remains a 'technology gap' between the needs of the industry and current materials performance availability. OEMs will continue to encourage suppliers to produce multi-functional alloys that are stronger and have better fatigue resistance. Yet irrespective of materials performance, there will always be the pressure to reduce the manufacturing and raw materials costs. It is easy to foresee some conflict when the pressure for the recycleability/re-use of heat exchanger units at the vehicle 'end-of-life' increases. One major challenge for the industry, which could have a major impact on material costs, is progress in the standardisation of brazing sheet products used in automotive heat exchangers.



Staff News

MBA Success

Congratulations and very well done to Dr. Havovy Cama, materials scientist, who has passed the Warwick MBA with distinction. Havovy's graduation ceremony on the 16th July marked the end of four years part-time study and a final dissertation entitled: "Demonstrating the Value of Knowledge Management."

Wedding Bells

Congratulations to Catherine Bansse, Innoval HR and Site Manager, who married Martin Sparks on 24th July in Banbury. Best of luck from all your colleagues at Innoval.

New Appointments

Helen Forrest, Business Development

Helen joined Innoval Technology in September 2003. Prior to joining Innoval she worked as a Process Improvement Engineer with MICE (Metals Industry Competitive Enterprise). Helen has joined Innoval Technology to help develop "K-Maps" and "P-Maps", which are practical tools to capture knowledge and transfer best practice in manufacturing companies. She also has an active role in the marketing and promotion of the company and its services.

Richard Keyte, Engineer

Previously employed at Alcan for 26 years, Richard first worked in the extrusion division where he looked after mechanical testing and assisted with die development. He then transferred to Alcan International as a Research Engineer. After the closure of the Laboratory, he worked for 12 months for a satellite communication company modelling microwave equipment, prior to joining Innoval Technology in January 2004. Richard is currently working on casting equipment for NTEC and Birmingham University.

"FEA Versus Test" Seminar with Powergen

This seminar will be held on 3 November 2004 at Powertech (part of Powergen) in Ratcliffe on Soar. Around 100 delegates, mainly FEA specialists and representatives from test houses, will attend to hear a range of presentations from organising companies Powertech, Strainsense, Damt, NAFEMS and Innoval. Chris Davenport from Innoval will present a paper on process modelling. There will also be several exhibits and display stands.

For further details, please contact Phil Bradbury on 01295 702806.

Stop Press... Stop Press.....

Innoval will be exhibiting at 'Aluminium 2004' - the world's no. 1 event for the aluminium industry - on 22nd to 24th September in Essen, Germany. We will be at stand number 7D24 in Hall 7. Find out more about this event at www.aluminium2004.com

Recent Conference Papers

Title	Author/presenter	Event	Location	Date
Critical Issues for Chrome-free Pre-treatment of Aluminium Alloys (see page 4)	G Scamans	ICEPAM 2004	Oslo, Norway	16-18 June 2004
The Growth of Aluminium in Automotive Heat Exchangers (see page 6)	A Gray	3rd International Congress: Aluminium Brazing	Dusseldorf, Germany	26-28 May 2004
Some Mechanistic Aspects of Magnesium Diffusion During Controlled Atmosphere Brazing	A Gray (Innoval) & H W Swidersky (Solvay)	3rd International Congress: Aluminium Brazing	Dusseldorf, Germany	26-28 May 2004
K-Mapping - Software & Techniques for the Capture of Technological Information & Knowledge	R Ricks (Innoval) & P G Enright (N-TEC Ltd)	Die Casting Conference	Melbourne, Australia	28-31 March 2004
Knowledge Mapping – A User-friendly Approach to Capturing Process Knowledge.	R Ricks, H Forrest & G Mahon	Building & Sustaining a Collaborative Working Environment	London, UK	4-5 March 2004

Forthcoming Conference Papers

Title	Author/presenter	Event	Location	Date
Templates for Continuous Nanofabrication Processes	Colin Butler	Electrochem	University of Leicester	12-15 September 2004
The Development of Corrosion Resistant Extrusion Alloys for use in Heat Exchanger Applications	A Gray	AFC-Holcroft Aluminium Brazing Seminar	Dearborn, Michigan, USA	26-28 October 2004
Magnesium Diffusion and Flux Interactions During Brazing	A Gray (Innoval) & H W Swidersky (Solvay)	AFC-Holcroft Aluminium Brazing Seminar	Dearborn, Michigan, USA	26-28 October 2004
Process Modelling	C Davenport	FEA Versus Test seminar	Nottingham, UK	3 November 2004

For more information on all our past and forthcoming conferences and papers, please visit our website at www.innovaltec.com

innform is published by Innoval Technology Ltd, Beaumont Close, Banbury, Oxon UK OX16 1TQ.
Tel: + 44 (0) 1295 702800, Fax: + 44 (0) 1295 702898/9, Email: enquiries@innovaltec.com, Website: http://www.innovaltec.com