Advanced Metals Discovery: Aluminum Cars And Planes Get Stronger After Sunbaking

June 22 2004

CSIRO scientists have discovered a new process which could soon lead to the production of aluminium cars and planes that get stronger the longer they are left to 'bake' in the sun.
Dr Roger Lumley of CSIRO Elaborately Transformed Metals (CETM) says the new process involves curing, or age-hardening, aluminium to a point where the curing process can be completed by exposure to sunlight rather than in a furnace.

The discovery arises from CSIRO's work in light alloys and advanced metals.

"We found in the course of this work that if the high-temperature aging process used to strengthen aluminium components, such as castings or motor vehicle body panels, is interrupted, and the material is allowed to undergo secondary aging at ambient temperature, the material became 20 per cent tougher," Dr Lumley says.

At the same time, the 'total-energy-to-rupture' point can also be extended dramatically (by up to 800 per cent) resulting in safer cars with crumple zones able to absorb much more energy as they deform or rupture on impact.

"We have developed two heat treatments using our new knowledge both of which overcome the age-old problem of either increasing the strength of aluminium, and reducing its fracture toughness, or vice versa," Dr Lumley says.

"Aluminium alloys used in the automotive, building and aerospace industries are typically age-hardened, that is they are strengthened after their initial formation by a curing process, or aged at high temperatures in a large furnace."

This method produces a range of curing times for aluminium alloys. For example the most common treatment, which gives the strongest alloys, is called T6.

To generate the tensile properties required for structural applications T6-treated aluminium alloy is typically aged for 6–8 hours at 150–170°C.

"CSIRO's T6i4 heat treatment significantly reduces the time of high temperature aging to about an hour, and uses Australia's warm climate to complete the process," Dr Lumley says.

"Significantly it means aluminium car body panels, for example, can be assembled and painted, (the baking cycle used to harden the paint adds to the process) and they will continue to strengthen in the sun.

"The process would continue, albeit at a slower rate, for the life of the vehicle," he says.

According to CETM's Industry Manager, Barrie Finnin, even better results can be achieved using CSIRO's T6i6 process, where, after several hours of secondary aging at ambient temperature, the material is again subjected to high temperature aging.

"This can provide significant improvements to mechanical properties over the T6i4 treatment," Mr Finnin says.

"A likely application for our T6i6 process would be for aircraft skins

and other aerospace applications, or any application where weight reduction and high strength are paramount."

Both T6i4 and T6i6 offer considerable savings in time and energy over conventional techniques, and in most cases requires no additional equipment.

Dr Lumley says the secret of the CSIRO discovery is all to do with the microstructure of aluminium alloys.

"What you end up with in the new process is a finer structure, engineered at the nano-scale, in a way that translates into mechanical property improvements," he says.

CSIRO says the potential spin-offs of the new processes for industry are enormous. Not only can aluminium alloy producers boost the strength of their product while making considerable energy cost savings, but the processes also allow a faster turnaround time in producing finished components and may even lead to reduced furnace sizes.

The technology, which is protected by a series of international patent applications, is now in the proving-out stage and is being evaluated by Forgecast Australia Pty Ltd – a manufacturer of non-ferrous metal components for global markets with facilities in Mitcham, Victoria and Tijuana, Mexico.

"Commercial applications are starting to build industry confidence in our innovation, which should encourage further use of aluminium alloys," Mr Finnin says.

Forgecast's General Manager, Jim Kealy, says the T6i6 technology could provide a competitive advantage, particularly where the improvement in properties fulfil a specific customer need.

Source of this news: CSIRO Australia