Aluminium: Closing the Gap to Steel

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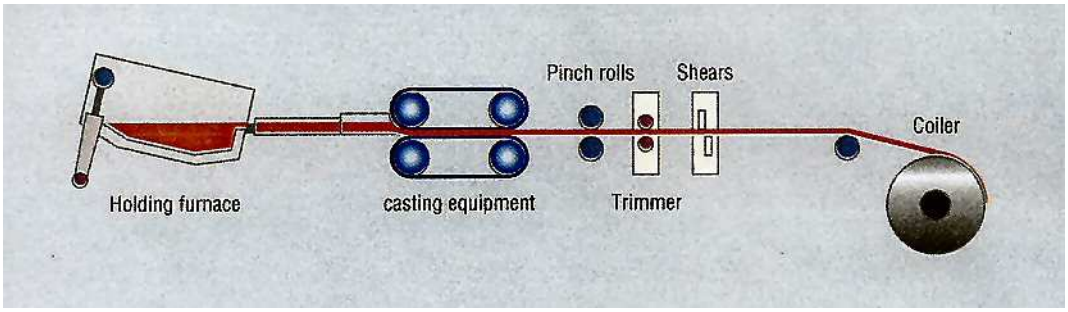
Jaguar, with their present generation XJ saloon, are the world's only contemporary producer of aluminium sheet intensive unitary cars. The aluminium build technology embodied in the Jaguar XJ could certainly be extended beyond the luxury vehicle sector if the cost of aluminium automotive sheet was significantly reduced. Aluminium automotive sheet is four to five times more expensive than its steel equivalent.

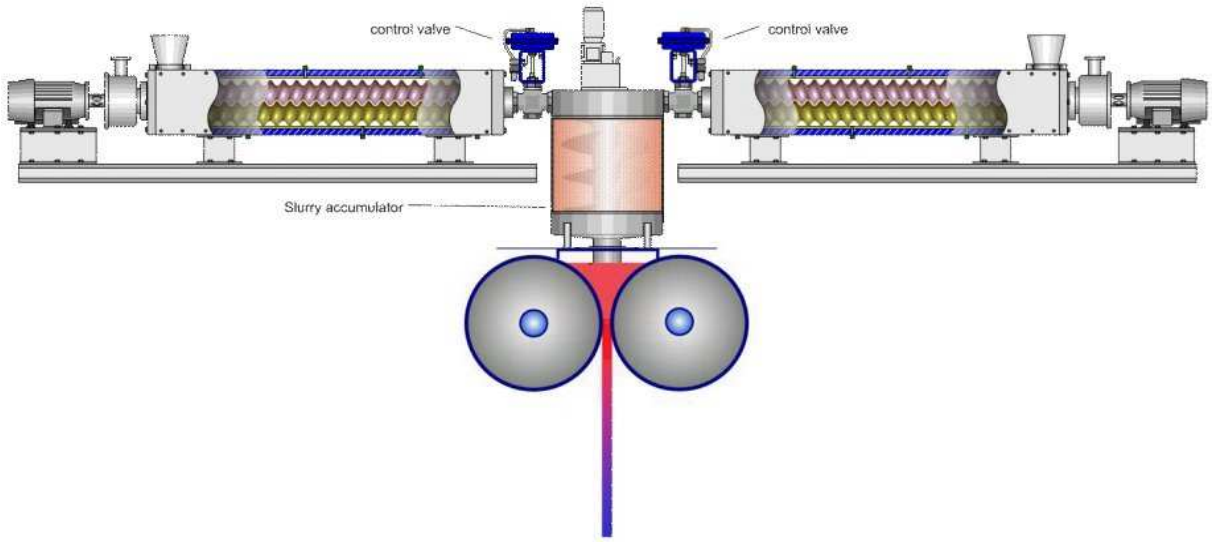
As with automotive steel sheet the route to cost reduction for aluminium is by continuous casting. This removes a significant number of expensive production steps to produce a broadly equivalent product. World-wide, most of the major aluminium sheet producers have developed twin belt, block or roll continuous casting technology but have not commercialised automotive sheet made by these routes. The exception to this is the NLM (Nippon Light Metals) continuous caster that uses a novel thin twin belt casting technology, that started production in July 2004 and will be able to supply 10,000 tonnes of sheet per month when in full scale production. Both closure panel and structural sheet have been supplied to the Japanese automotive industry for evaluation against conventional products.



The NLM thin belt continuous caster for automotive sheet production

Twin roll continuous casting has an advantage over belt or block casting in that such casters require much lower levels of investment and can provide stepwise increments in capacity. However, for continuous roll casters there are technical hurdles to be overcome both in terms of microstructural uniformity and surface quality. However, recent developments in rheocasting at Brunel University provide a novel route to overcoming these issues. The group at Brunel has shown that melts of aluminium and magnesium alloys can be conditioned before casting using a high shear slurry maker. Presently this is being used to feed metal into high-pressure die-castings to provide cast alloys with exceptional mechanical properties and an absence of segregation and porosity. The economics of this type of melt conditioning for die casting are attractive and the work at Brunel has received significant support from EPSRC and most recently from the DTI through their Technology Strategy Funding initiative. This initiative will fund a £2 million rheo-die casting (RDC) project, managed by Innoval Technology, that aims to rheo-diecast high performance, lightweight magnesium and aluminium automotive castings. The project team represents the entire manufacturing supply chain together with automotive end users and the focus will be process optimisation, simulation and industrialisation.

Innoval Technology and Brunel are now planning the next phase of work that will be to deliver a conditioned melt into a twin roll continuous caster using a new process termed Twin Roll Rheocasting (TRRC). This should enable automotive alloys like AA5754, the present Jaguar XJ structural alloy, to be successfully twin roll cast without segregation or cracking issues. There is also the possibility of producing closure alloys like AA6016 and AA6111 with the A-class surface finish required for external panels. The TRRC technology could also provide higher strength aluminium sheet to compete against some of the higher strength grades of automotive steel.



Schematic of the Twin Roll Rheocasting (TRRC) process

Presently the European total market for aluminium automotive sheet is 121,000 tonnes and structural sheet only accounts for 28% of this tonnage (34,000 tonnes); the larger tonnage (87,000 tonnes, 72%) being supplied as closure sheet to a wide range of automotive producers. The present body-in-white market (the Jaguar XJ) of 34,000 tonnes comprises 76% AA5754 and 24% AA6111. This tonnage could be provided by two twin-roll rheocasters as a typical roll caster capacity is 20,000 tonnes per year.

In summary, there is an opportunity for the cost gap between aluminium and steel sheet to be closed, by adopting TRRC technology, a continuous casting production route with a conditioned feedstock. This has been identified by Innoval as a key technology to extend the range of aluminium sheet intensive unitary vehicles to a wider market and provide vehicles that exceed proposed emission targets without compromising the driving experience.