Raw material development and Recycling concepts for semi-solid processing

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The Collaborative Research Centre 289 (CRC) develops semi solid processing. As part of the CRC IME Institute of Process Metallurgy and Metal Recycling, RWTH Aachen is working on raw material process development as well as recycling of scrap and residues.

Raw materials development

Raw material optimised by Mn-addition is suitable for thixoforming. The microstructure meet the demands for thixoforming within typical fine globular grains. The Mn-addition between 0.2 – 0.4 % has a good effect on the average grain size and the shape factor. This is independent of the type of grain refiners used. In practice holding times between 10 – 30 minutes are applied. In this case an average grain size <100 µm and a shape factor >0.6 can be reached. Especially for shorter reheating times a Mn-addition has a good effect on the shape factor. Current and future work will focused on optimisation of further thixoforming alloys (e.g. AlSi6Cu3, AlMgMn,…) by addition of Mn as well as surface tension active elements. The comparison between grain refined and optimised materials with other conventional thixoforming materials is tackled. The documentation of the complete thixoforming process from feed stock to product and assessment by chemical analysis, computer aided image analysis and testing of the mechanical properties is one of our, and cooperating RWTH departments, main aims.

Recycling concepts for semi solid processing

Nearly one half of the raw material becomes to residue. The residues have often different chemical compositions and depend on the chemical composition of the raw material. The "history" of the materials is to be documented for all process steps. The accumulation of impurities is to be indicated. There is a correspondence between the enrichment of Si-rich components and the impurities (e.g. Iron). Special melt-treatment must be applied. Because of economical aspects residues with higher contents of impurities have to be recycled externally by secondary smelters. For the future the operation of special recycling plants is to be discussed. Nevertheless the amount of residues e.g. remainders or drops have to be minimised. The optimisation of semi-solid-processing alloys by addition of special elements could be one trail solution.

Raw material development and Recycling concepts for semi solid processing

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SFB 289 Thixo FORMING

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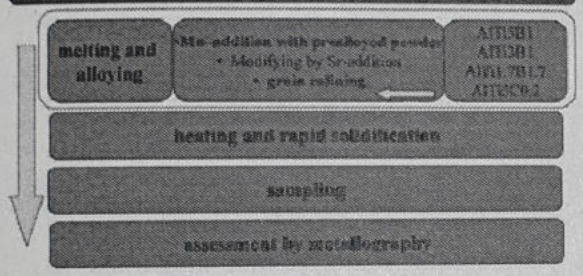
abstract

Producer of raw material for semi solid processing as well as the processing industry make demands on the behaviour of the required materials. A very essential property is the microstructure which is influenced by chemical composition. Raw material for semi solid processing should consist of fine and globular grains.

For this reason, a thixoforming alloy (A356) is investigated by metallography. Various grain refiner- and different Mn-additions influenced the microstructure before and after the semi solid process step "heating" significantly.

Mn-addition between 0.2-0.4% has a positive effect on the average grain size and shape factor, especially for short heating times (< 5 min). This is important for new semi solid processing technologies, working with short production time.

experimental procedure



basic alloy

	Si [%]	Fe [%]	Cu [%]	Mn [%]	Mg [%]	Ni [%]	Zn [%]	Sr [ppm]	Ti [ppm]
(1)	7,1	0,14	<0,01	<0,01	0,35	<0,01	0,02	200	200
(2)	6,5-7,5	0,1-0,6	0,1-0,25	0,05-0,35	0,17-0,45	-	0,05-0,35	200-250	200-250

Chemical composition of the thixoforming alloy AlSi7Mg (A356)

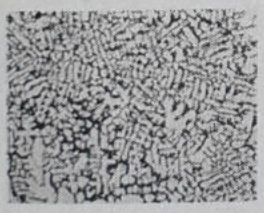
(1) composition of the applied basic test alloy,

(2) composition of the european standardised alloy

effect of Mn-addition on grain-size and shape-factor

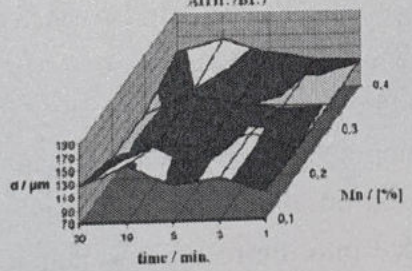
typical microstructure of raw material (as cast)

V=200:1



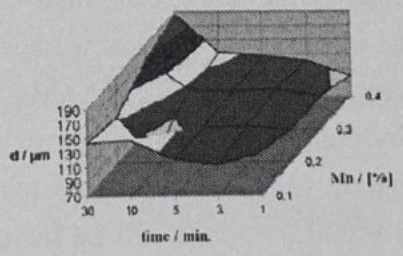
effect of Mn-addition on grain size

AlTi1.7B1.7



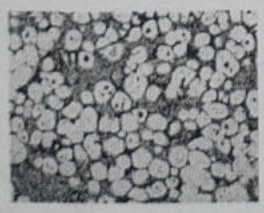
effect of Mn-addition on grain size

AlTi5C0.2



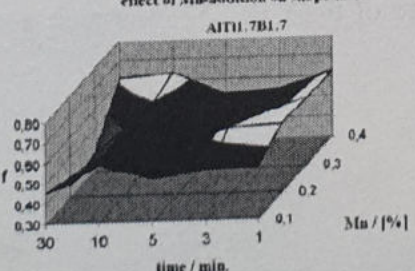
typical microstructure of a thixotropic slurry (after heating)

V=200:1



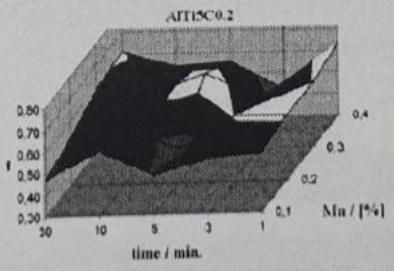
effect of Mn-addition on shape factor

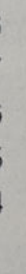
AlTi1.7B1.7



effect of Mn-addition on shape factor

AlTi5C0.2





future targets

- alloy optimisation of further thixoforming alloys (e.g. AlSi6Cu3, AlMgMn,...)
- addition of further elements: (e.g. Na, Sr, Pb,...)

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