FATIGUE STRENGTH OF THICK-WALLED ALSI7MG0.3 SEMI-SOLID CASTINGS INFLUENCE OF HEAT TREATMENT CONDITION

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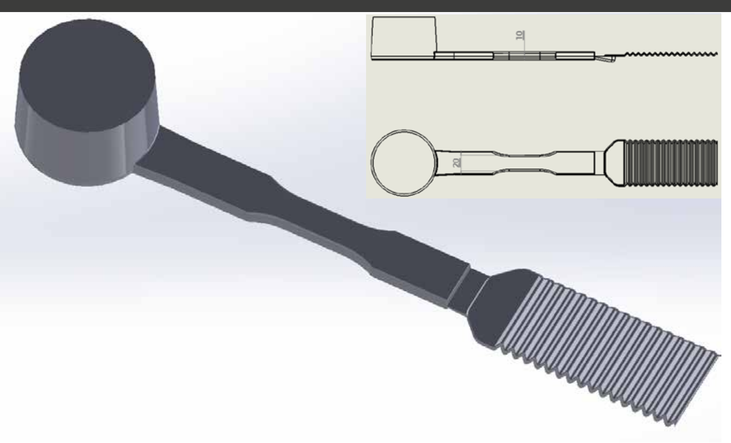
SUMMARY

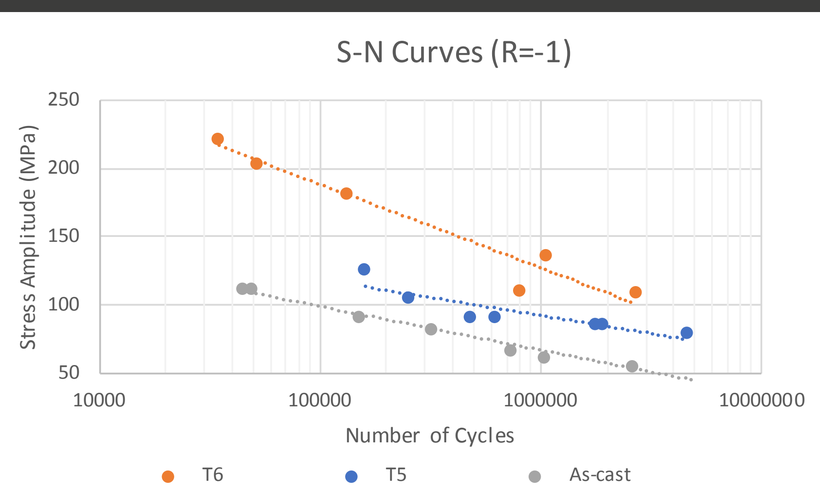
Rheometal™ process was used to produce Semi-Solid Metal (SSM) castings. The die temperature and slurry process parameters were kept constant for all castings. Tensile and fatigue tests were applied on castings with three different initial conditions, as-cast, T5 and T6 heat treated. Force controlled four-point bending fatigue tests were conducted in fully reversed loading condition (R= -1).

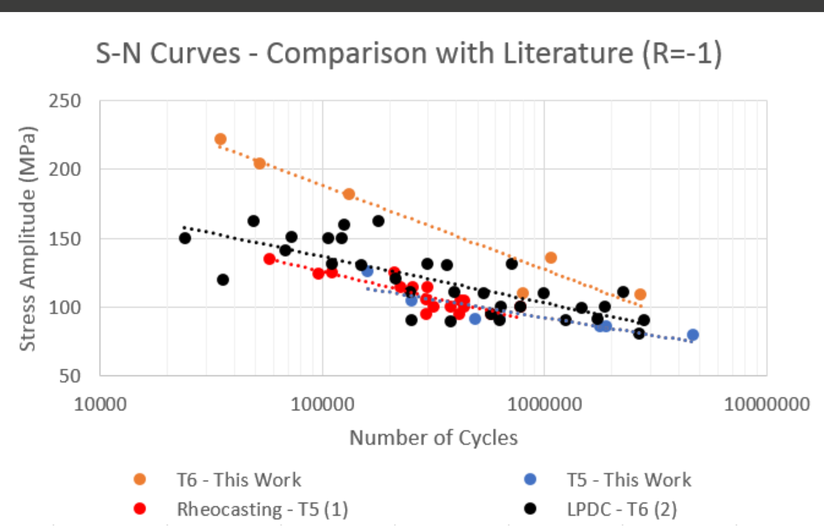
The tensile test results show that T6 heat treated castings show superior mechanical properties compared with T5 and as-cast conditions. The ductility is higher in as-cast condition and lowest for T5 heat treated castings with T6 heat treated castings showing intermediate ductility.

Fatigue strength is superior for T6 condition castings and lowest for as-cast condition with T5 heat treated castings showing an intermediate fatigue strength. Comparison with fatigue data from literature for the same aluminium alloy, show that SSM castings can perform better compared with traditional production technologies.



	$R_p0.2$ [MPa]	R_m [MPa]	A [%]
As-cast	99±2	205±9	8.9±2.2
T5	136±2	215±12	3.0±2.8
T6	223±6	275±9	6.2±2.4





(1) M. Rosso, I. Peter, R. Villa, Effects of T5 and T6 Heat Treatments Applied to Rheocast A356 Parts for Automotive Applications, 143 (2008)
(2) Y. Tijani, A. Heinrietz, W. Stets, P. Voigt, Metall. Mater. Trans. A Phys. Metall. Mater. Sci. 44 (2013)

PROJECT GOAL AND INTRODUCTION

The goal is to obtain mechanical properties and fatigue data for design and numerical simulation of SSM casting structural components.

The truck industry face increasing demand to reduce emissions and fuel consumption. Traditional materials and production technologies applied in structural components need to be replaced to produce lighter components at lower cost. SSM aluminium castings present high specific strength, low shrinkage and gas entrapment porosity and design flexibility. There is just a few published fatigue data regarding SSM castings and there is a great need for it to design and simulate light weight components.

RESULTS

The yield strength ($R_p0.2$) is superior for castings in T6 condition compared with T5 and as-cast conditions. The ductility is higher for castings in as-cast condition and lowest for T5 heat treated castings.

Fatigue strength of T6 heat treated castings is the highest with 118MPa stress amplitude for 2 million loading cycles, while in T5 and as-cast conditions are 84 and 57MPa, respectively.

The comparison with literature results show that AlSi7Mg0.3 SSM castings in T5 condition in this work present equivalent fatigue strength to other Rheocasting processes and low pressure die castings in T6 condition. In T6 condition the fatigue strength of SSM castings is superior to low pressure die castings for the same initial condition.

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INDUSTRIAL IMPACT/NEED

Mechanical properties and fatigue results of thick-walled aluminium A356 SSM casting components were obtained. This data can be used to design and simulate numerically SSM castings and lead to a development of light weight structural components, to be applied in truck industry with the final goal to reduce the specific fuel consumption and increase load capacity.

PROJEKTUTFÖRARE

FINANSIÄR