EMMC Translation Case

Introduction

Translator Profile

- What type of Translator is your institution: TTI (Technology Transfer Institute), Academic group, Software Company, Manufacturing Industry, Other (Consultancy, etc.).

IK4 – TEKNIKER (http://www.tekniker.es/en) is a private research organization which main mission is to enhance the positioning and competitiveness of our clients through technology transfer. Hence, IK4 - TEKNIKER plays the role of TTI in the framework of EMMC.

- What is you field of expertise: specify type of material, type of models according to RoMM (please see Review of Materials Modelling), type of property/phenomenon, other?

IK4-TEKNIKER is a research organization which main activity is focused on manufacturing. The organization covers 4 Research areas: Advanced Manufacturing, Surface Engineering, ICTs and Product Engineering (for more information go to: https://www.slideshare.net/teknikerik4). The type of materials considered during the development of research projects are Metals and polymers, as well as functional coatings. Regarding the type of models, both continuum and discrete models are used as a tool for getting better knowledge about the experimental results obtained in the characterization stage. The type of properties of phenomenon we studied are, mainly, surface integrity, surface functionality, material response to different advanced manufacturing processes, service life assessment and benchmark testing.

Client

The client who leads the industrial case is SAPA PLACENCIA: http://sapaplacencia.com/sapa_index.php?lang=2). This company is a SME which main application sector is Defence (Antiaircraft artillery) and Energy (Mobility and power generation and power management). The Company and IK4 - TEKNIKER belonged to the same manufacturing cluster promoted by the Basque Government.

Industrial/Business Case

- Describe briefly the industrial problem.

The Company contacted to IK4 - TEKNIKER to measure and model the tensional and microstructural state of gears at the different manufacturing steps (forging, mormalizing, quenching and tempering), as well as to perform a dimensional control of them, in order to determine the origin of distortions of parts, which are one of the major causes of rejected components.

- Indicate involved budget or preferred time to solution (duration).

The preferred time to solution was 1 year. The major limitation on the schedule was the constraints linked to the access to Neutron facilities to measure the residual stresses on the bulk of the gears.

- Indicate what was the expected outcome of the translation process.

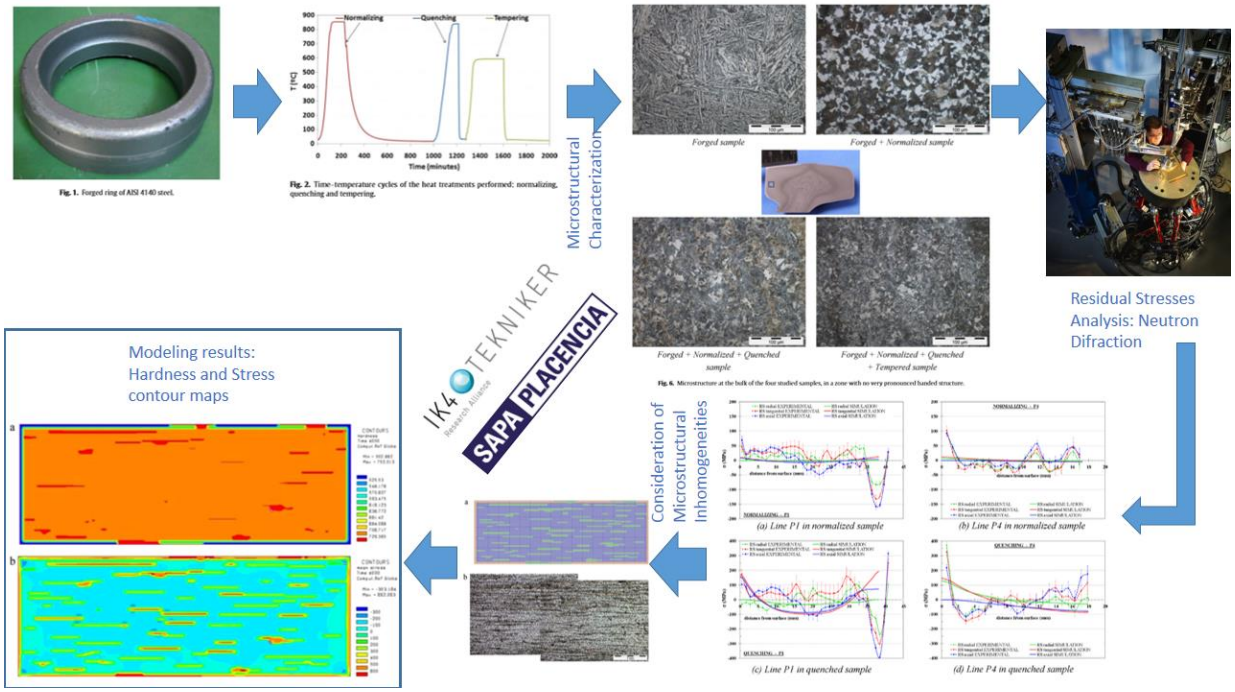
The main expected outcome is to evaluate the use of simulation tools to gain more insight about the effect of the different production stages (manufacturing and thermal treatments) on material

microstructure, final dimensional accuracy and physical properties of gears, prior to perform the sequence of treatments on the industrial component.

Translation to modelling solution

The type of model proposed was a continuum based on FEM simulations of heat treatment processes on forged gears, considering the commercial software SYSWELD which provided the required information connected to the effect of those treatments on the residual stresses and hardness of the component. These properties explain to a large extent the unpredicted distortions often observed after those manufacturing stages. The SYSWELD software assumed homogeneus material microstructure , however, inhomogeneities (banded structures, for example) can be included into the model to reproduce local changes in hardness and residual stresses on the component. The client was not familiar with the use of modelling/simulation to understand the material response to different manufacturing processed used on a daily basis. Hence, the client relied on IK4 - TEKNIKER to execute the modelling and characterization, based on the previous collaboration between both entities to solve different manufacturing problems. Additionally, IK4 - TEKNIKER has a great expertise on elucidating the diagnosis of mechanisms and the causes of faults such as fractures, residual stresses, abnormal wear or corrosion, which occur during the manufacturing stages and during the service life of elements and components (http://www.tekniker.es/en/materials-andsurfaces-performance). This way, correlation between modelling results and experimental observations can be monitored in a very straightforward way. Additionally, by considering the last generation laboratory characterization equipment, IK4 - TEKNIKER can properly determine the value of material parameters required to be included in the modeling platform.

A snapshot describing the problem, solution proposed and results is indicated as follows:



Client's benefits from the modelling

The client was satisfied with the results. These results were published in a research journal (V. García Navas et al. Materials Science and Engineering). But, it is worth mentioning that further 3D - modelling including the contribution of banded structures (microstructural heterogeneities: such as ferrite – perlite bands and decarburization), material grain sizes and orientation is mandatory to predict the experimental residual stresses and hardness values observed. This way, the industrial application requires the contribution of discrete models to be combined with continuum models. The main benefit for the client was to establish a methodology based on modelling and material characterization to be applied before the thermal treatment stages on their forged parts. Hence, a 20-30% reduction (semi quantitative) in the time consumed in trial-and-error assays was reached by the consideration of the tools explored in this translation case.