Linking the microstructure to the ductile-to-brittle transition temperature of high strength quenched and tempered steel

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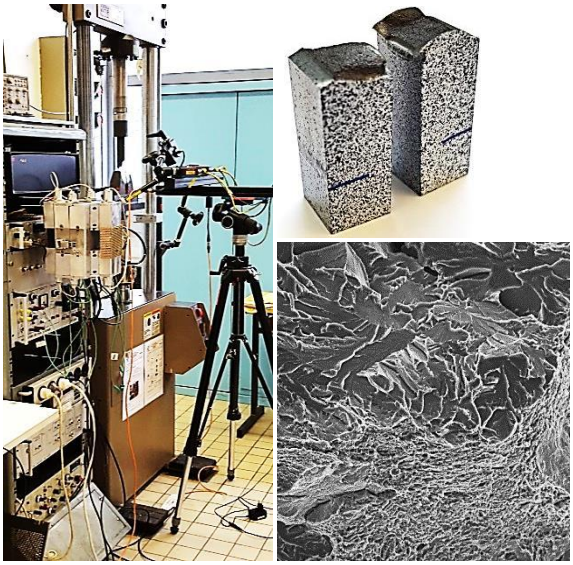

- Mechanical characterization
- Microstructural characterization
- Study of the fracture mechanism, from ductile fracture to brittle fracture
- Smooth specimens, Charpy specimens, notched specimens
- Linking microstructural parameters with the mechanical behavior
- Ductile fracture criterion
- Energy and automobile applications

Abstract:

High strength quenched and tempered steel are largely used for manufacturing of off-shore drilling parts and some components of automobile gear boxes. Because of their mixte martensite-bainite microstructure, this steel has a good trade-off balance of mechanical properties. Consequently, they are used for structural applications that require high strength, high wear resistance and relative good ductility.

The aim of this study is to find the link between microstructure, mechanical and fracture properties of the studied steel. An order aspect of the study is the development of the predictive tool of the impact toughness for this grade of steel. Thus, this study has microstructural, experimental and numerical aspects. From the as quenched and tempered cylindrical bar, we have realized two tempering at different temperatures in order to modify the microstructure, by improving the precipitation of carbides while varying the contrast between matrix and carbides. All the microstructures obtained are being analyzed (microstructures observations and mechanical tests). At this time, the results about the microstructure, carbides characterization in particular, have given good informations about the link between upper self-energy (on Charpy impact test) and the microstructure. The results of mechanical characterization are also very interesting in term of the link between tempering temperature and mechanical behavior of the different microstructures.

Finally, numerical calculations are performed, based on the experimental results of mechanical tests. These calculations will allow the identification of the constitutive equations of the steel and the development of ductile fracture criterion for these steels.