

## **H<sub>2</sub>SO<sub>4</sub> corrosion of API5L-X52 pipeline steel: Thermal diffusivity and microstructure**

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**Abstract.** The effect of corrosion by H<sub>2</sub>SO<sub>4</sub> on the values of room temperature thermal diffusivity ( $\alpha$ ) and the microstructure of API5L-X52 pipeline steel are studied. The samples were exposed for 3, 6, 9, 12 and 15 days in a corrosive solution in an atmosphere with relative humidity of 57.16% in average and at temperature of 23.6 °C. The  $\alpha$  values were measured by the photoacoustic technique in a heat transmission configuration. Our results show a  $\alpha$  decrease with the corrosion time ( $t$ ), with a behavior described by an exponentially decreasing curve. Microstructural study on the samples revealed the appearance of irregular surfaces with corroded grain frontiers, porosity and fractures of micrometer size as a consequence of corrosion, as well as a presence of phases mainly composed by tetra hydrated iron and manganese sulphates. The decreasing evolution of  $\alpha$  vs  $t$  show the activity-passivity behavior in the corrosion process.

### **1. INTRODUCTION**

Metals and metals alloys are among the wide range of materials used for transporting gas, petroleum and its derivatives, in particular ferrous alloys in their several crystalline phases. The mechanical properties in materials are strongly influenced by grain boundaries, grain size and grain distribution [1, 2]. In heat transport studies the before conditions are also important additionally to imperfections and impurities, because they are dispersion sites in the energy propagation, phonons or electrons, inside of materials bringing the consequence of the diminution of the thermal properties [3]. In the last years, the study of the correlation between mechanical and thermal properties has been of interest for the steel and metals industries, where there are reports of correlation between hardness and thermal diffusivity ( $\alpha$ ) for several types of steels [4, 5]. The importance of the thermal diffusivity measurements is crucial in the use of diverse industrial alloys, specially those materials that are submitted to extreme security conditions. There are a big number of works about the stress corrosion cracking and microbiologically influenced corrosion in metals and mainly in carbon steels where the knowledge of their microstructures is very important. However, the study of changes in the thermal properties by corrosion effect in these materials has received few attention [6, 7].