Barkhausen noise emission in the rope wires

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Rope wires are a vital of importance for reliable and long-term operation of bridges and represent their most important load-carrying components. Rope wires in the real operation can suffer from corrosion and superimposing stresses. Furthermore, the random stress oscillation together with the bridge dilatation generate addition temporary bridge loading. Corrosion extent affects the life-time of a bridge as well as influence the bearing capacity of a rope. As it was reported, rupture failure occurs although the stress is far less than yield strength of steel [1 ÷ 4]. Xu and Chen [2] executed tensile tests of rope wires. Their measurement clearly proves that yield and ultimate forces as well as yield and ultimate strain decrease with corrosion extent.

This study deals with non-destructive monitoring of rope wires via magnetic Barkhausen noise (MBN) emission. This study is focused on two aspects of rope wires such as possible assessment of corrosion extent as well as influence of stresses. Finally the combination of corrosion and superimposing tensile stresses is discussed. This study demonstrates that Barkhausen noise emission in the corroded layer is recorded despite the sensing depth of this technique is below the corrosion depth. Such behaviour is due to presence of un-corroded particles in the corroded layer. However, it is clearly shown that Barkhausen noise emission drops down with deeper corrosion extent due to the reduced volume and size of un-corroded particles as Figure 1 illustrates. The similar evolution can be found also for peak position as well as FWHM of MBN envelope however these parameters increase along with increasing corrosion depth.

The second part of this study indicates that Barkhausen noise emission decreases along with increasing tensile stresses as a results predominating stress anisotropy against crystal anisotropy [5]. The real bridge situation represents the combination of corrosion extent and superimposing tensile stresses. Figure 2 demostrates that corrosion on a wire surface makes it difficult to suggest the possible concept for the non-destructive monitoring of the real rope wires via conventional effective value of MBN signal. MBN is this case could be explained in two different ways (or their combination) such as the higher tensile stresses and/or the high corrosion depths. For this reason the alterantive way based on peak position should be considered or measuremet of the real wires pre-stress should be carried out on the surface on which the corroded layer is gently removed.

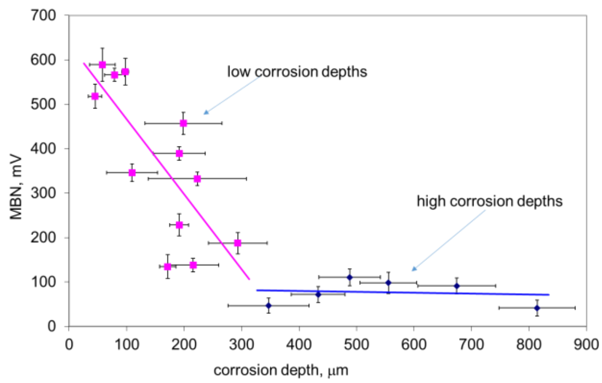

Figure 1. Corrosion depth versus MBN.

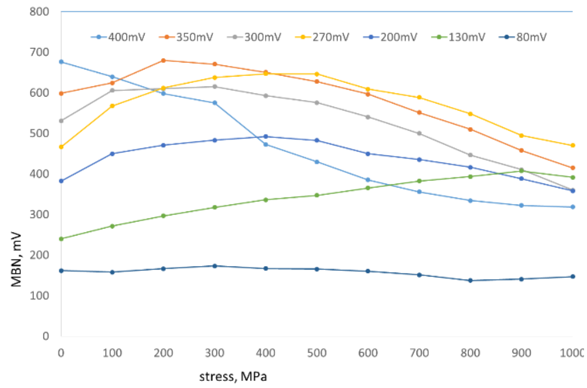

Figure 2. MBN versus tensile stresses for variable corrosion depths.

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