Structural health monitoring with acoustic emission on metallic components of industrial plants and infrastructure

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Proof testing has been for decades an important instrument to assess the structural integrity of components under severe operational loads and it still is. However, proof testing on pressure equipment is a rather limited approach since it will result merely in a yes/no statement regarding the structural integrity of the test object. To overcome this issue, advanced testing and inspection methods have been developed throughout the years and their application, either separately or in combination with proof testing, has improved the situation significantly. The remaining limitation is that since these activities are carried out in most cases during maintenance shut-downs, the results represent rather snapshots than a stream of information. Consequently, the next step in development was a monitoring approach so that structural integrity information of the component under test can be obtained while a potential degradation process might affect its condition. But it is not only the actual condition which is of major interest for plant operation: To assist in planning and decision making, the future development of the monitored component in terms of the remaining useful life has to be assessed as well. Monitoring solutions based on acoustic emission have one major advantage compared to other methods: The information regarding the degradation process is obtained in a straightforward way by the process itself. Crack growth is a well known source of acoustic emission and in a proof test situation an external stimulus is required to create local overstress for crack detection. In normal operation this stimulus is provided naturally by the given service conditions themselves. This applies not only for crack growth but for corrosion as well. Within the industrial environment, monitoring solutions for pressure equipment and storage tanks have to be tailor made taking into account degradation mechanism, service conditions and of course the design of the test object. At present, structural health monitoring is applied in most cases on plant components where severe damage has been detected and a gap till to repair or replacement has to be bridged safely. The monitoring systems needed to fulfil the given tasks might well be quite complex in terms of measuring instrument as well as sequential control system. In contrast and in particular for highly stressed areas, the required monitoring system for infrastructure components should be compact, optimised for operation in remote areas without connection to the electrical grid. In this way existing fatigue cracks in steel bridge components are monitored in order to assess their fatigue response and to predict the remaining useful life. This contribution shows examples for structural health monitoring solutions on industrial plant components and on steel bridge girders. For the latter application RISE (remote inspection system edge) has been developed by TÜV AUSTRIA. This lean, effective and mobile solution for steel bridge inspection is described.