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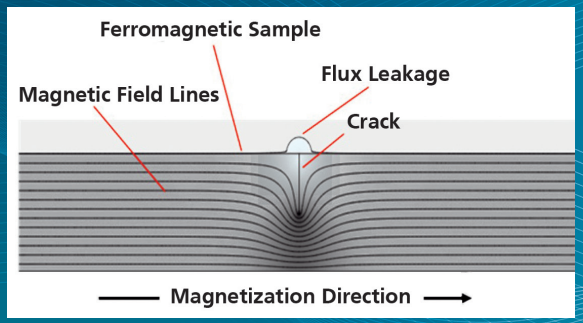
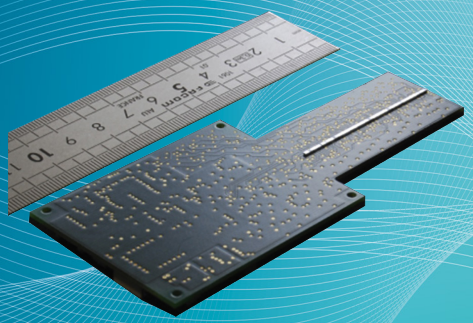
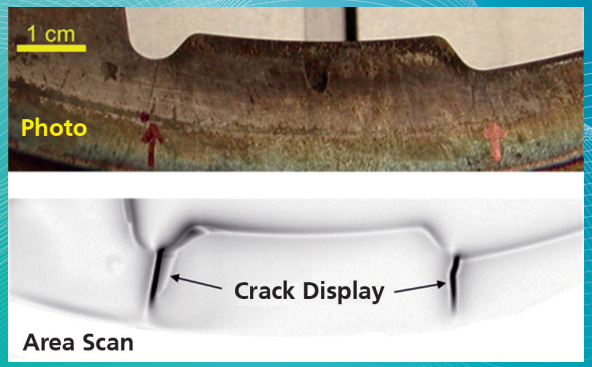
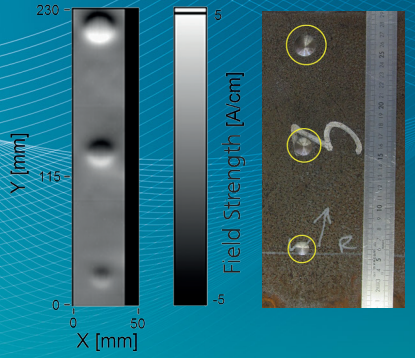
Sensor and Data Systems for Safety, Sustainability and Efficiency

Magnetic flux leakage inspection









1: Magnetic flux leakage – principle; 2: Linear array of highly sensitive magnetic field sensors

3: Crack visualization after induction hardening; 4: Corrosion inspection

Magnetic flux leakage inspection

Steel components as used in machine construction, automotive industry and plant construction or load-bearing steel assemblies as needed in building construction are exposed to high mechanical loads that may cause crack-like defects during operation or even earlier during production process. Besides cracks, corrosion induced defects can cause component failure, too. Thus, a defect inspection immediately after manufacturing is mandatory, at least once.

For this purpose, in industrial production of ferromagnetic components or semifinished products magnetic particle testing is used. This inspection method, indeed, works nondestructively, but the procedure implicates high manpower requirements. One limitation of the method relates to its automation which is impeded by geometry influences, but above all, the magnetic powder accumulates in any existing depressions. Thus, the contrast is deteriorated and, as a result the automatic detection of the defect indication is impeded.

Similarly, in construction regular monitoring of the structural integrity is desirable. Especially in the field of concrete structures nondestructive testing for corrosion and breakage detection is required. If the areas at risk are covered (eg. concrete cover in reinforced concrete poles), at present the construction has to be impaired to expose the elements to be tested.

The magnetic flux leakage inspection is designed to detect crack-like surface defects and local cross-sectional or wall thickness reductions in ferromagnetic materials. The method is based on the same physical effect, which is exploited in the magnetic particle inspection: At sharp disruptions of a component surface as well as in areas of smaller cross section, additional magnetic dipoles which produce a near-surface magnetic flux leakage are formed on application of an external magnetic field (fig. 1). Highly sensitive magnetic field sensors, generally arranged in linear arrays (fig. 2), are manually or automatically headed over the inspection surface for detecting the magnetic flux leakage in the area of possible defects.

Sensor arrays enable the fast inspection even of complex parts or flat samples (gears, etc.). The process is fully automated and is therefore also suitable for integration into production processes. For use in construction and component testing mobile testing systems using the flux leakage testing can be realized.

Application

The previous use of magnetic flux leakage inspection covers a wide range of applications:

- Crack detection in the field of the industrial production of ferromagnetic components (eg. after induction hardening or after adjustment, fig. 3)
- Detection of wire breaks in prestressed concrete poles by BetoFlux system (cover picture)
- Check for internal and external defects on pipelines for corrosion detection (fig. 4)

For fast testing of the feasibility in the case of flat samples a demonstrator (“FLUXI”) was set up.

1 Cover picture © *Uwe Bellhäuser*