NON DESTRUCTIVE TESTING ON SURFACES OF INDUSTRIAL COMPONENTS FROM DISTANCE XRD

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XRD is often used to qualify (or re-qualify) surface properties for their allocated uses in several fields of applications. These fields of application concern as examples the ashes fallout from oil combustion in large boilers, the cement composition, and the composition of covers in order to establish their coating properties and durability. In these cases the phase identification plays a key role and sometimes the quantification of small amount of impurity is crucial for the qualification of the composition for the use. Sometimes this amount is really small and considered under the minimum level of resolution for the traditional XRD. However there are cases, when it is possible to resort to preferred crystallographic directions, where the above mentioned limit can be significantly lower. In general, when phase identification is involved, sampling inspections methods on a side laboratory are used with high level of reliability of the measure.
There are other fields of application where macrostructure (i.e. residual stress) effects are the matter to be investigated. These types of analysis are currently carried out in laboratory on specimens whose dimension is compatible with the specimen holder dimensions of the diffractometers.
There are also cases when the XRD is faced with very large specimens. Examples are the satellite components (e.g. tanks of propulsion fluids or gases) or scaffolds, or plates used as a thermal shield on site, or large components used as vapour collector in large scale power industry. In general these fields of industrial application require to inspection fatigued components after a number of service hours. Inspections on site are often the only available option; sometimes even the maintenance of the component in service during the inspection could be required. In this case the environment conditions shall be considered to affect the result of the analysis; it becomes mandatory to refer to a reference value obtained under conditions as close as possible.
Moreover there are cases when it is preferable to inspection the component from distance. These are the cases when the under inspection component is not easily accessible, or simply, when the component or the manufacture is unique and so precious that it should be advisable to analyse it from distance. This is the case for example of precious manufacture conserved at Museo of Argenti of Palazzo Pitti in Florence (Italy).
Results of the mentioned inspection campaign are presented and discussed along with option equipment for distance XRD analysis. This equipment uses polycapillary confining beam in order to remove the limitation imposed by the traditional Bragg Brentano and θ:θ configurations. These configurations require in fact that the goniometer centre is mechanically fixed on the specimen surface. The proposed configuration allows for the identification of a virtual goniometer centre and variable according to the distance of the surface under inspection.

Reference

G. Berti (2005), "At distance controlled diffractometer for XRD measurements in field". Proc. SPIE, Vol. 5906, p. 311-325.
G.Berti “Variable Centre Diffractometer” 6468PT patent pending.

Note: The present work has been carried out on using DifRob®, a movable diffractometer implemented by the cooperation of University of Pisa and ISPESL – Rome (Italy) (contract 42/98). Inspections on manufactures of Museo degli Argenti have been carried out by the contribution of Opificio Pietre Dure – Florence (Italy) (contract XRD-Tools 354).