INCLUSION DETECTION TECHNIQUES FOR CLEAN STEEL MANUFACTURING

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The demand for clean steel increases every year. In addition to lowering non-metallic oxide inclusions and controlling their morphology, composition, and size distribution, clean steel requires lowering other residual impurity elements such as Sulphur, phosphorous, hydrogen, nitrogen, carbon, and other trace elements. The need for clean steel increases day by day as the industry is expecting components that can withstand more fatigue cycles that have a longer life in effect. Ultrasonic immersion scanning is widely accepted as a technique for the analysis of inclusions in the steel. The easiness of setting the sample,

automatic report generation, sped point-by-point of inspection, and reliability of results make the method the favorite of key players in the steel manufacturing world. The samples for inspection are normally identified in three parts in a lot, one from the top one from the middle, and one from the bottom of the casting so that the overall lot cleanliness can be identified. The sample is scanned in the state of the art **SHRUTI**® system.

SHRUTI® (Scanning High-Resolution Ultrasonic Testing and Imaging) is a DHVANI RESEARCH developed customizable, automated, multi-axis robotic scanner. Along with an advanced

ultrasonic inspection instrument, advanced data analysis (***excut***®), and image analysis package (***Imagin***®), SHRUTI provides for the easy inspection of samples and components.

SHRUTI® (Scanning High-Resolution Ultrasonic Testing and Imaging) offers a very high-resolution image of the test coupons with very high scanning speeds. The complete instrument control is through the software. Skelton of the system is being built from lightweight aluminum extrusions which are upgraded to Stainless Steel for heavy-duty applications. All the electrical connections are rugged and properly routed following
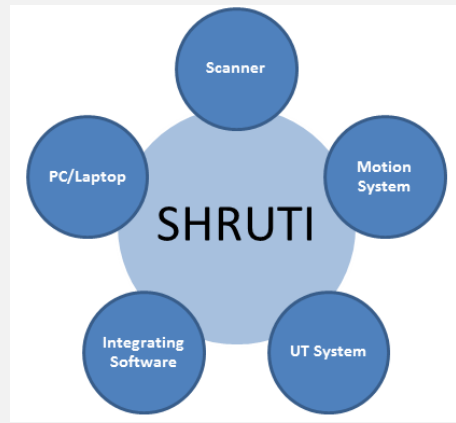
industrial standards offering very durable and reliable running.

Advantages of Immersion Scanning

The image shown below is of an immersion scanning carried out on a 5, 10-rupee coin using a 15 MHz transducer in pulse-echo mode. The image plotted is a front wall gated C Scan


Robust Hardware

Immersion scanning has distinctive advantages over other modes of scanning. The first one is the efficiency and the consistency in coupling the energy from the transducer to the test coupons. A constant water column is always maintained between the transducer and the test coupon which always ensures that the

The image shown below is of an immersion scanning carried out on a steel sample from reputed
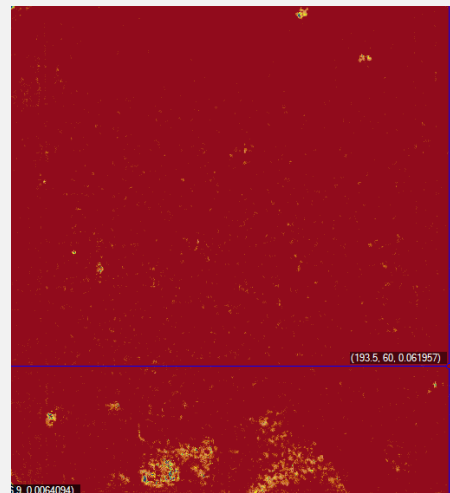
manufacturer. The red is the good area and the other colors appearing are the inclusions. Grain imaging is even possible with this technique

same amount of energy is always impinging on the sample surface giving point accuracy in the results. Another one is as the impedance mismatch between the components and water is less it enables high transmission coefficients to the sample

The sample selected will be subjected to an immersion scanning and the c scan obtained is adjusted using the gates to plot the thickness between the front wall and the back wall. This c scan will image all the defects or the inclusions in the material.
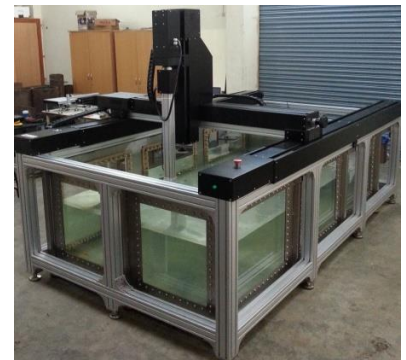

Typical SHRUTI System

In this software a histogram of defects based on complex image processing algorithms will be generated. Based on the user requirement the user can obtain the inclusion density and inclusion size distribution.

The report generated can be used to determine whether the steel manufactured can be used on certain components like the connecting rod where heavy axial loads come in action. In these cases, minor porosity or inclusions will create drastic damages which will create huge financial implications.

INCLUSION DETECTION TECHNIQUES OR CLEAN STEEL MANUFACTURING

A Dhvani Research Application Note

Chennai, INDIA
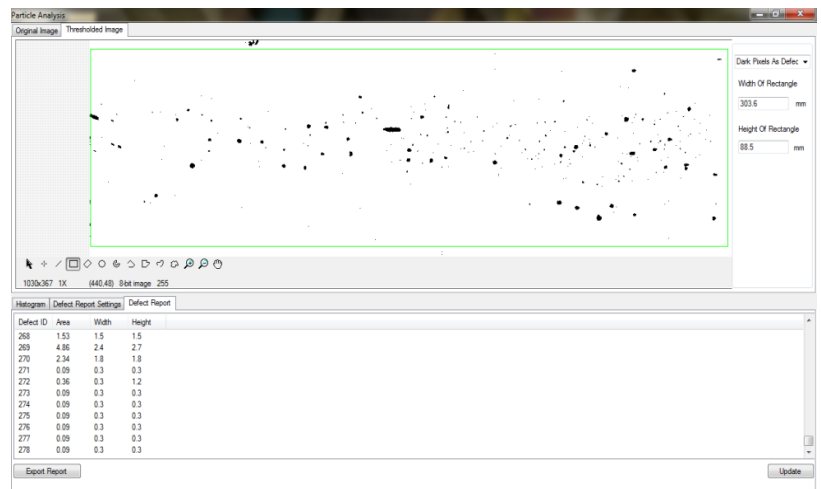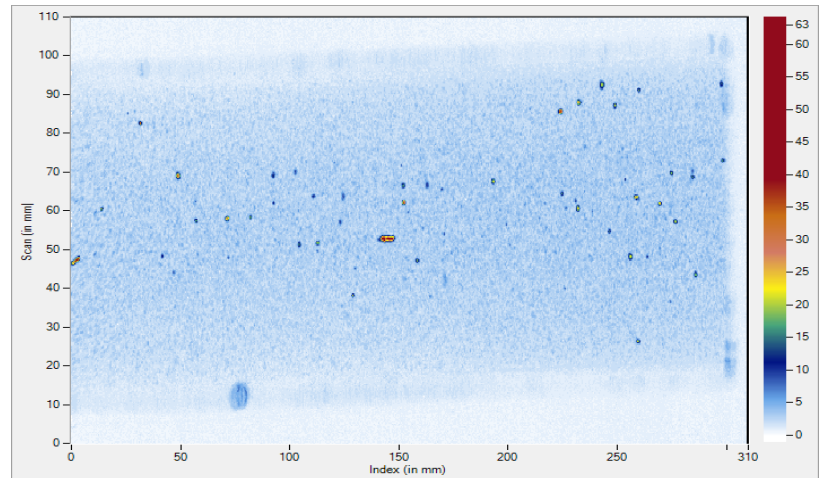
A C Scan image showing the defects in the sample gated along the thickness and the GUI of the Automatic defect detection software giving defect density and distribution

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