Development of a high-sensitivity eddy current testing system for seam inspection of hot butt-welded pipe

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The butt-welded (BW) pipes, which are manufactured continuously by rounding hot rolled coils and forging them, are used for the air pipes and other applications as inexpensive and efficient manufacturing steel pipes. The quality of the seam is most important for BW pipes. If an inclusion is caught inside the seam in the manufacturing process, there are possibility that BW pipes have the crack by inclusion during forming. Conventionally the penetrating eddy current testing (ECT) is used for quality assurance of BW pipes, but the entire length of the pipe cannot be guaranteed due to the blind zone of the pipe end. Therefore, in order to guarantee the entire length of the seam, we developed the new ECT sensor for hot and continuous process. A new sensor that has a water-cooled structure was developed to inspect BW pipes at 1200°C. In this structure, the developed sensor is covered by a thin SUS jacket which provides heat resistant and shock resistant. The sensor is cooled by passing water inside the SUS jacket, and the sensor is sunk into water bath to enhance cooling capability. Although the sensitivity of the new sensor decreased due to conductive SUS jacket and the increased lift-off with the water path, we confirmed the sensitivity is enough to detect the target flaw: inner side of the pipe, 1mm depth, 5mm length with 12mm liftoff. The new sensor was installed to a production line for the BW pipes, and the artificial defect measurement test was conducted. The artificial defect was made by drilling a small hole to material coil, then formed to the BW pipe in advance. We confirmed that the defects could be detected with a very high signal-to-noise (SN) ratio, and φ1.5mm, 2mm depth inside defects could also be detected with a SN ratio of 3. In addition, the sensor operated stably without trouble for more than a dozen hot runs.