Simulated Strains-Based Approach for Explaining Distortion and Residual Stress in Quenched Steel Cylinder

Wednesday, 7 September 2022 11:35 (25 minutes)

Elucidation of the mechanism of distortion and residual stress generation in quenched steel parts has been a longstanding issue. A qualitative explanation on stress distribution changes in quenched rods appeared in the 1930s when residual stress measurements became available for the specimens. In particular, the explanation of stress changes during quenching of pure iron rods has continued to be used in textbooks in this field. At that time, the concepts of thermal and transformation stresses were applied to explain the mechanism of residual stress generation. In the case of a pure iron round bar without phase transformation, the term thermal stress was convincing because the stress originated only from temperature changes. On the other hand, the qualitative discussion of the stress change became more complicated when the term transformation stress due to phase transformations was added. Therefore, the quenching of Fe-Ni alloys, in which only martensitic transformation occurs, was used as a subject for the discussion on its simple behavior in generating residual stress. Theoretical research in this area was established by the realization of heat treatment simulations. This provides not only stress but also strains which are due to thermal, phase transformation, plastic, transformation plastic, and creep phenomena. A method for elucidating the mechanism using simulated strains was devised in the early 2000s and named the simulated strains-based approach. In this paper, the mechanism of quenching residual stress generation in mainly Fe-Ni alloy rods is explained by the classic approach using the thermal and transformation stresses and the simulated strains-based approach for understanding each concept.

Speaker Country

Japan

Register for the Tom Bell Young Author Award (TBYAA)?

No

Primary author: ARIMOTO, Kyozo (Arimotech Ltd.)
Presenter: ARIMOTO, Kyozo (Arimotech Ltd.)
Session Classification: HEAT TREATMENT
Track Classification: Residual stresses and distortion