

Evaluation of Welding Residual Stress Reduction by Ultrasonic Vibration Load

Akira Nakazato¹, Katsumi Kurita², Shigeru Aoki², Shigeomi Koshimizu³, Tsuyoshi Matuyama³

¹ Advanced course, Tokyo Metropolitan College of Industrial Technology
1-10-40 Higashi-oi Shinagawa-ku, Tokyo 140-0011, Japan
s20024@g.metro-cit.ac.jp

² Tokyo Metropolitan College of Industrial Technology
1-10-40 Higashi-oi Shinagawa-ku, Tokyo 140-0011, Japan

³ Advanced, Institute of Industrial Technology
1-10-40 Higashi-oi Shinagawa-ku, Tokyo 140-0011, Japan

Extended Abstract

Welding is a joining method used for many structures, and to melt the material applying heat locally. Since the tensile residual stress is generated in the process of cooling and hardening, and make less the fatigue limit of base material. Therefore, a method of welding tensile residual stresses without special devices is developing using ultrasonic vibration load. According to previous studies [1][2], they indicated that it was an effective method to reduce the welding residual stress using ultrasonic vibration load in case of built-up welding with metal block or thin metal sheets of rolled steel for general structure SS400.[3]

Since the melting point of stainless steel used for important structures such as a nuclear reactor is higher temperature than that of rolled steel for general structure, it expects that the welding residual stress of stainless steel is higher than that of rolled steel for general structure. The residual stress is one of the reasons that is caused stress corrosion cracking. Therefore, it is important to develop a method of welding reducing residual stress in stainless steel.

In this study, the effectiveness of welding residual stress reduction method using ultrasonic vibration load is investigated for austenitic stainless steel SUS304.

Comparing results of welding residual stress between with and without ultrasonic vibration load, it was reduced by the wave of welding with ultrasonic vibration load. The reduction rate between the ultrasonic vibration load at the frequency of 36 kHz and of 58 kHz was almost same. However, comparing the reduction rate between acceleration amplitude of 2000m/s² and 5000m/s², the case of 5000m/s² is greater the residual stress reduction.

From these results, the method of welding loaded the ultrasonic vibration at the frequency of 36 kHz and of 58 kHz can reduce welding residual stresses for austenitic stainless steel SUS304. Comparing effects between the acceleration amplitude of the ultrasonic vibration load and the frequency, the acceleration amplitude has a greater effect on the residual stress reduction.

References

- [1] Shigeru Aoki, Tadashi Nishimura, Tetsumaro Hiroi, Seiji Hirai and Kunihiko Mineki, "Reduction in Residual Stress of Welded joint Using Local Plasticity Caused by Ultrasonic Vibration (Welding of wheels)", *Journal of the Japan Society for Technology of Plasticity*, vol. 48, no. 554, pp. 225-228, 2007 (in Japanese with English abstract).
- [2] Shigeru Aoki, Tadashi Nishimura, Tetsumaro Hiroi, and Seiji Hirai, "Reduction of Residual Stress for Welding Joint Using Ultrasonic Vibration Load", *Transactions of the Japan society of mechanical engineers. C*, vol. 67, no. 657, pp. 1613-1618, 2001(in Japanese with English abstract).
- [3] Shigeru Aoki, Kurita Katsumi, Shigeomi Koshimizu, Akira Maekawa, Shota Mutoh," Reduction of the residual stress using ultrasonic vibration (Examination for butt welding of thin plate SUS304) ", in *The Proceedings of Conference of Kanto Branch, The Japan Society of Mechanical Engineers*, 2014, vol. 20, 10116 (in Japanese with English abstract).