

## Development of Advanced Steel for Piping to Contribute to Extending the Life of Salt Manufacturing Plants

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### Summary

This is basic research aimed at ensuring the reliability of piping in various plants including salt manufacturing equipment and establishing advanced technology for the materials used for it. This year, we focused on the evaluation of fatigue reliability. Specifically, AIH-FPP treatment was applied to the laminated molding material of the hourglass type fatigue test piece using MC particles in which steel particles were coated with aluminum particles, and the fatigue characteristics were evaluated. We also investigated the behavior of the compressive residual stress generated on the surface of the test piece changing during the fatigue process. Based on the results, we investigated the effect of AIH-FPP treatment on the fatigue characteristics of laminated molding materials. The obtained results are shown below.

(1) By improving the AIH-FPP processing device, it is possible to apply AIH-FPP treatment similar to that of a disk-type test piece to an hourglass-type fatigue test piece. By applying AIH-FPP treatment under appropriate conditions, it is possible to create an intermetallic compound layer of  $\text{Fe}_2\text{Al}_5$  on the surface of the substrate and at the same time generate a high compressive residual stress.

(2) By applying AIH-FPP treatment to the laminated molding material, the fatigue life is increased compared to the untreated material, and internal fracture is exhibited in the long life range. It is considered that this is because a high compressive residual stress is generated on the surface of the test piece and the generation and growth of cracks are suppressed. In addition, since this compressive residual stress is hardly released even during the fatigue process, it is considered that internal fracture was exhibited by the sustained effect of suppressing the generation and growth of cracks from the surface of the test piece.

(3) Non-metallic inclusions containing titanium oxide as the main component were confirmed near the fracture starting point of the test piece treated with AIH-FPP. In order to further improve the fatigue characteristics of laminated molding materials, it is necessary to seek other methods to detoxify titanium oxide.