The Effect of Transitional Temperature and Temperature Change on Nitinol Force

This experiment tested the effects of three changes in temperature (Δ20°C, Δ30°C, and Δ40°C) and three transitional temperatures based on the alloy composition of Nickel and Titanium in Nitinol (25°C, 35°C, and 45°C) on the contractional force of uniform Nitinol springs. The contractional force, in newtons, was calculated by recording the minimum and maximum forces of the springs before and after the temperature difference was applied to them.

In order to analyze the data, four two-factor DOE's were conducted. The results showed no statistically significant effects due to the large variability in the research; however, trends in the data showed that the temperature and transitional temperature differences affected the data, but were not considered significant due to the large range of standards. The largest effect value was 0.0751 newtons, for the high transition temperature and the high change in temperature, on the contractional force because of the amount energy transferred from the water to the Nitinol springs. This greatly accelerated the transformation process from its crystalline martensitic form to its crystalline austenitic form by allowing the Nitinol alloy to reach its most stable form faster. The properties of Nitinol as a shape-memory alloy allow it to revert back to a previously memorized shape based on the dynamic molecular bonds formed between Nickel and Titanium when energy is applied.

The research is important because Nitinol, as a form of harnessing waste heat energy, can be used in future renewable energy processes, such as powering generators in dams between large bodies of different temperature water.

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