Development of ultra-lightweight construction machines

Project title

Development and field verification of ultra-light attachment and boom and stick

Institutions：TAGUCHi Industrial Co., Ltd. and Tokyo University of Agriculture and Technology

Project outline

Objective

Currently there is a wide variety of construction machinery on Earth, with high demand for improvements in mobility, safety, weight reduction, and fuel efficiency.
Furthermore, machinery used to construct the lunar bases will be transported from Earth, so high versatility and light weights are sought from the perspective of transportation costs. We at first, selected the hydraulic excavator with high versatility for this weight reduction.
The hydraulic excavator can perform various operations by affixing or changing its “attachments,” such as devices that possess different functionalities according to the type of work and application.
Our goals for this study are weight reduction and practical future application. We intend to meet these objectives by designing, prototyping, and performing evaluation tests using unconventional materials for work equipment , such as the boom and stick and attachments for the hydraulic excavator.

Contents

①To design, prototype, and perform evaluation tests on work equipment, such as stick and boom, by using a lightweight metal to reduce the overall weight of the hydraulic excavator.
②To design, prototype, and perform evaluation tests on work equipment by using CFRP to reduce the overall weight of the hydraulic excavator.
③To design, prototype, and perform evaluation tests on attachments of hydraulic excavator by using lightweight metal and CFRP to reduce the attachment weights.
④To enhance the functionality of the attachments by using the technology of improving abrasion resistance and the structural health monitoring of CFRP.

Lightweight metal Stick・Carbon fiber（CFRP）Stick

We designed, prototyped, and performed evaluation tests on the sticks of hydraulic excavator, made by a lightweight metal stick and CFRP.
The weights of two stick were as follows: the lightweight metal stick was approximately 1/2 and the CFRP stick was approximately 1/3 of the original metal stick.

The evaluation test showed that the prototyped sticks can be used in the same way as the original, and were observed some improvements of performance in the hydraulic excavator.

This shows a good effectiveness by reducing the weight of stick.

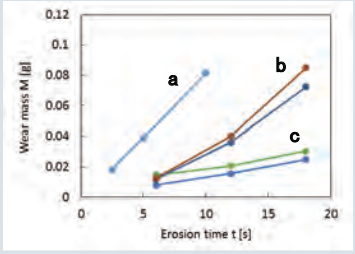
Lightweight metal stick installed in a hydraulic excavator(actual)

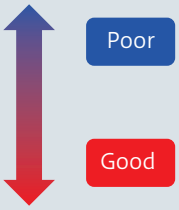
Carbon fiber（CFRP）stick installed in a hydraulic excavator（actual）

Abrasion-resistant coating applied to the CFRP by using the plasma spray process

Applied the abrasion-resistant coating to the surface of CFRF and conducted the sand erosion test.

Verified superior erosion resistance.





a: CFRP base material　b: Coating A　c: Coating B