



A battery-powered electric hydraulic excavator developed by Kobelco

Improving Efficiency of Equipment Testing of Battery-Powered Electric Hydraulic Excavator

Kobelco Construction Machinery Co., Ltd. (Kobelco), a manufacturer of hydraulic excavators and crawler cranes, has been working on the development of a battery-powered electric hydraulic excavator that emits no CO₂. In the process, it introduced Vector's CANape and CSM measurement modules to test attachments (booms, arms and buckets) and achieved significant improvements in the efficiency of measuring and analyzing temperatures, voltages and the CAN bus.

Development of CO₂ Emission Free, Battery-Powered Electric Hydraulic Excavator

Kobelco is a global construction machinery manufacturer that excels at making hydraulic excavators, crawler cranes and demolition machines. In product development, it has been pursuing user friendliness at worksites, fuel efficiency and low noise through its "user hands-on approach" based on the needs of users in the field.

Furthermore, Kobelco is proceeding with the initiatives to realize carbon neutral. One of them is the development of a battery-powered electric hydraulic excavator and the company has been developing the technology and identifying issues.

The battery-powered electric hydraulic excavator emits no CO₂ and NO_x and is also free from vibrations and noises that always come with the diesel engine, bringing

advantages of reducing burden on the driver and considering surroundings.

Several Data Loggers Used to Verify Operations of Attachments

In the verification of the attachments' operations, data are logged such as hydraulic pump output, control valve operating status, hydraulic pressure of systems, oil temperatures and CAN bus traffic to check the consistency with the specifications. If any anomaly is observed, it is necessary to analyze the information and find the cause.

However, Mr. Ryoichi Taniguchi of Zero Emission Engineering Department, Product Development Engineering Division, who is responsible for the development of the battery-powered electric hydraulic excavator at Kobelco, explained it had taken considerable time for data logging and analysis.

Data to be logged	Previous environment	Current environment
Temperatures such as oil temperatures	Company A's logger	CANape + CSM measurement modules
Voltages (Control signal, hydraulic, revolutions per minutes, etc.)	Company B's logger	
CAN bus	Company B's logger (later on, CANalyzer)	

Table 1. Logging environments for battery-powered electric hydraulic excavator attachments

"When I was put in charge in 2021, several loggers had been implemented under various circumstances, and more specifically, Company A's logger was used for temperature logging, Company B's logger for voltage logging and Company B's logger for CAN bus logging," he said. "It was a challenge, but partly due to a short development span, there was no timing to review the overall test environment." Previously, certain steps were required such as exporting a CSV file from a logger, importing the CSV file into spreadsheet software, and performing calculations if necessary, making a timeline chart, and then determining pass or fail, according to Mr. Taniguchi.

Logging Unified with CANape and CSM Measurement Modules

To improve testing efficiency, Mr. Taniguchi's team started introducing Vector solutions.

"First, in 2022, we implemented Vector's [CANalyzer](#) for CAN bus logging," he said. "It was implemented because my boss at that time gave me the advice. We found it easier to use than Company B's logger, and it enhanced the efficiency of CAN bus traffic analysis."

While the introduction of CANalyzer improved the efficiency of CAN bus traffic analysis, the number of logging systems in use increased to three – Company A's logger for temperature logging and Company B's logger for voltage logging with the addition of CANalyzer for CAN bus traffic logging – and unifying these three became a new challenge.

"Partly because CANalyzer was quite easy to use, we wondered if we could unify the loggers into Vector solutions and consulted with Vector Japan and were suggested a combination of [CANape](#) and CSM measurement modules for temperature and voltage logging," Mr. Taniguchi said. "After watching demonstrations in the summer of 2024, we implemented them officially in the fall of 2024."

CANape is a tool developed for reprogramming ECU parameters and exporting RAM values. It has developed into an all-purpose measurement tool including logging and analysis of camera images and GPS. As is the case



Figure 1. For calculations of necessary data, CANape's function is used to calculate data obtained with CSM modules. It is realized by combining several subfunctions.

with Kobelco, CANape is used for logging and analysis of various types of information such as voltage and temperature as well as development of driver assistance systems and automated driving systems.

[CSM measurement modules](#) are hardware that convert outputs from sensors such as analog voltage, pulse, PWM signal, thermocouple output (temperature), bridge circuit voltage (strain gauge) and electric current into CAN bus or XCP on Ethernet and sends it out. A notable feature is that they are extremely robust and also suited for actual vehicle testing.

Kobelco has implemented a thermocouple module (THMM) for measuring temperatures and a voltage module (AD) for measuring voltages converted from hydraulic pressure, etc. As a result, it is possible to analyze all data including CAN bus, temperatures and voltages in an integrated manner with CANape.

Data Sorting Work Efficiency Improved with the Use of CANape

Kobelco chose CANape and CSM for the bench test environment of the battery-powered electric hydraulic excavator. The test environment components include a storage battery, a hydraulic pump that generates hydraulic pressure, and a control valve that keeps the pressure from exceeding a certain level.

Test scenarios are designed for short-time testing to check individual behavior and long-time testing to check the rise of temperatures by operating several hours to put a load on a hydraulic pump or battery on purpose.

"Because there is no need to import data into spreadsheet software via CSV file and also data processing and making a chart can be done immediately after importing data from CSM in CANape, the time required for data sorting and failure analysis has been shortened considerably," said Mr. Taniguchi in explaining the advantages (Table 1).

The following efforts are also being made in the use. To make it easier for exchanging other tools' data, CANape data are stored in the industry-standard MDF (MF4) format for sharing within the department.

Another effort is the use of CANape's functions, which allow the user to perform calculations in CANape of data that require calculations and show the results in CANape without the use of spreadsheet software (Figure 1). "We've defined about 10 kinds of functions and find them very convenient," said Mr. Taniguchi.

Aiming for Commercialization to Reduce CO₂ Emissions

The basic development of the battery-powered electric hydraulic excavator has already been completed, and it has been confirmed that the battery-powered electric hydraulic excavator has the same levels of output and operating speed as those of a conventional diesel engine excavator.

In addition to the battery-powered electric hydraulic excavator, Kobelco is proceeding with the development of a fuel cell-powered electric excavator at the same time and plans to continue the development with the aim of commercializing it around 2030.

Sources:

Cover page, Figure1: Kobelco Construction Machinery Co., Ltd.

Table1: Vector Japan Co., Ltd.

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