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Study of LCA (Life Cycle Assessment) Method on the Reduction of CO2 Emissions in Aggregate Production

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Extended Abstract

Global warming is a serious problem for human beings in the 21century. There are several greenhouse gases that cause the global warming, among them carbon dioxide is the most significant. The amount of carbon dioxide released from aggregate product industry is unpredictable. Currently, efforts to prevent further global warming have become a worldwide issue, but CO_2 emissions reductions effort in the aggregate product industry is insufficient (Web-2). Emissions of CO_2 from crushed stone production are a result of rock excavation, transportation of excavated rock mass, the crushing process, and the product transportation process. The most significant, product transportation, produces approximately 35% of the total CO_2 emission, and the demand of aggregate has increased significantly for reconstruction from the Great East Japan Earthquake, causing greater CO_2 emissions. There are variety of heavy machines used in the process of deforestation, stripping, drilling, loading, and transportation in open-pit mining. It's necessary to comprehend the CO_2 emission amount from each heavy machine running in the quarries. Using the Engine Exhaust Gas Analyzer (Auto4.1), we measured the CO_2 emissions during operation of each heavy machine, and calculated the CO_2 emissions in different processes of the operation to find the total CO_2 emission amount. To reduce CO_2 emissions of several heavy machineries running in quarry, it is important to consider optimizing the entire process to minimize the operating times of the heavy machinery. Since, information technology (IT) can help mining organizations by building in efficiencies to improve productivity and reduce costs (Web-1). The position of operating and cycle time of each machine can be visualized by GPS.

The purpose of this study was to optimize the excavation of the rock mass in the quarry in order to reduce CO_2 emissions. Optimization of excavation is considered to be very effective for the reduction of CO_2 emissions and this can be done by shortening the machine transportation routes. A system that can manage the operation of dump trucks in real time has been built within the GPS devices. We optimize the preferential routes for the drivers of the dump trucks hauling the excavated rock by monitoring and studying their transportation routes. As a result energy saving and reduction of CO_2 emissions can be achieved. It is considered that information technology (IT) will be effective for the improvement of work efficiency and reduction of CO_2 emissions.

By establishing the LCA (Life Cycle Assessment) method on reducing CO_2 emissions on open-pit mining and aggregate production, it is now considered to be an important contribution to the progress of low-carbon society.

The results obtained in this study are as follows:

(1) The full system can evaluate the running routes and position of dump trucks in real-time by linking the digital transceiver and its map application on the office PC. By the use of this system set-up, it

is able to accurately read the up-to-date position of the heavy machinery and direct the dump truck accordingly. In addition, this will subsequently lead to the reduction of CO_2 emissions while saving energy and increasing efficiency.

(2) It has become possible to display the position of a dump truck in real-time through a semi-transparent overlaid terrain map on the PC windows.

(3) It has become possible to calculate the amount of the CO_2 emissions in real-time using the calculation sheet.

Web sites:

Web-1: http://www.infosys.com/industries/resources/white-papers/Documents/plug-value-leakage.pdf, consulted 20 Mar. 2015.

Web-2: http://solar-center.stanford.edu/sun-on-earth/glob-warm.html, consulted 24 Mar. 2015.