Life Cycle Assessment on Cement Treated Recycling Base Construction

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Abstract : ***LCA is one of the few environmental management techniques that are used to perform a risk assessment, environmentalperformance evaluation, environmental auditing, and environmental impact assessment and must be applied to the construction CTRB. The purpose of this study was to determine the amount of energy consumption is used and determine the amount of emissions (CO2) in the implementation of the Foundation Layer Top (base course) with the former asphalt pavement aggregate blended cement / Recycling Cement Treated Base (CTRB). This study uses: (i) Compilation and data inventory of relevant inputs and outputs of a product system; (ii) Evaluating the potential environmental impacts associated with the data input and output; (iii) Interpret the results of the inventory analysis and impact assessment in relation to the research objectives. The results showed that Energy consumption in the implementation of recycling pavement (CTRB) is 225.46 MJ / km of roads and the resulting GHG emissions 17,43Ton CO2 / km of roads. Previous researchers to calculate the energy consumption of road works on the implementation of conventional (hotmix) is 383.46 MJ / km of roads and the resulting GHG emissions 28.24 Ton CO2 / km of roads. If the calculated difference between a job and Hotmix CTRB and then a comparison is made CTRB energy consumption is 158 MJ / km of road, this happens 70.07% savings and GHG emissions resulting difference is 10.81 tons of CO2 / km of road, resulting in a decrease in 62,02%.***

Keywords- CTRB; CO_2***; energy; LCA, Hotmix CTRB, GHG emissions 17.***

INTRODUCTION

The world community is aware to the importance of environmental conservation since 1962 in conjunction with the publication of *Silent Spring* novel by Rachel Carson telling the effect of pesticides on the incidence of cancer.

This movement was followed by the American society in 1969 by conducting conference in Seattle initiated by Gaylord Nelson and then Earth Day was set for first time by the United States Environmental Protection Agency (USEPA) on April 22, 1970 and on June 5, 1972 by the United Nations in the Stockholm City State conference in Sweden designated as World Environment Day, this brings the impact of environmental conservation movement in developing countries especially Indonesia (Ervianto, 2012).

The growing of global awareness to the environmental protection related to the impact of production and consumption activities generate interest to develop a method to reduce these impacts. One technique that is
developed for this purpose is the Life Cycle Assessment (LCA) in road pavement CTRB construction.

The field of transportation sector affects much to the economic and social environment sectors represents 10% of world gross domestic product. Effect of road and airport construction, including the depletion of natural resources and energy, temperature rise, air pollution, lowering of ground water and drinking water scarcity. Overall in the world, the transportation sector has been absorbing energy 22% of global energy consumption, burning 25% of the burning of fossil fuels and contributing to donate 30% of global air pollution and greenhouse gases.

Ongoing road construction supported by the concept of the three pillars covering of economic growth, environmental protection and social progress is the present transportation demands present without compromising the ability to meet future needs (Resmi, 2011).

1. MATERIAL AND METHODS

a. Compilating and inventory of input and output data which relevants to the product system.

Data collected through. a survey to the construction contractor company CTRB road construction, data obtained includes data on CTRB implementation mechanisms associated with fuel consumption in the company, consisting of data on the use of cement, fuel (diesel), the use of oil, water tank trucks used in conjunction with a recycling machine (CTRB recycler), goat foot roller, the roller (road roller). The data is compiled every 1km on roads done starts from laying cement, scratching pavement (milling), scarifying with a mixture of water, compacting and resurfacing CTRB construction. Thus it can be seen the use of materials and energy each 1km in the CTRB construction.

b. Evaluating the potential environmental impacts associated with the input and output data.

In the second stage, the analysis of environmental impacts is done associated with construction work especially CTRB starting from transportation phase and use of materials, fuel and energy consumption by using the guidelines of the IPCC 2006 are as follows:

GHG emissions (kgCO2/ton) = Energy Consumption (MJ) x Emission Factor (kgCO2 / MJ)/ Total production

c. Interpreting the results of the inventory analysis and assessment impact in relation to the research objectives.

At this third stage, resource inventory analysis and assessment impact of the use of resources and energy expended during the implementation of construction works CTRB are done by using the following formula:

Energy Consumption (MJ / ton) = Fuel consumption (liters) x Colorafic Value (MJ/liter)/ Total production

(2)

2. RESULTS AND DISCUSSION

a. Compilating and inventory of input and output data which relevants to the product system.

The collection of data calculates the estimated energy usage and greenhouse gas emissions of recycling work of

CTRB pavement construction by conducting a survey to several technical institutions that are to the Department of Highways Central Java Province and to the Center of the National Road Implementation in Sidoarjo, East Java Province

Evaluating the potential environmental impacts associated with the input and output data.

CTRB product attached per day with a length of 300 meters and a width of 7 meters wide is 2,100 m2. Thickness is 30 cm, then the volume of CTRB is 630 m3, weight volume average of 2.3 ton/m3, so the CTRB weight = 1,449 tons.

Consumption of diesel per ton CTRB installed: *1.960liter/1.449 ton* = 1, 35 liters per ton.

To calculate the estimated energy requirements and GHG emissions per km used field data that CTRB work for each side of road width is 7 m with a thickness of 30 cm, the number of attached CTRB per km is 1000m x 7m x 0,3 m x 2,3 ton/m3 = 4,830 tons per kilo-meters long.

Consumption of diesel fuel is 1960 liters per day. Diesel emission factor: 2.67 kg CO2/liter; Calorific value of diesel: 35.99 MJ / liter;

The use of cement 7 percent of the weight of the attached CTRB material: *(7/100) x 1.449 ton = 101,43 ton.*

Energy and emissions per day occured on CTRB implementation can be estimated as follows:

Energy requirements (MJ/tonne) = (*1.960 lt x 35,99MJ/liter)/1.449ton = 48.68 MJ / ton*

GHG emissions (kg CO2/ton) = (*1.960 lt x 2,67 kg)/ CO2/liter= 3.61 kg CO2/ton.*

While the energy and emissions per 1 km on CTRB implementation can be estimated as follows:

Energy requirements (MJ / ton) *= 48.68 MJ / ton x 4,830 ton/ km x (1GJ/1000 MJ)= 225, 46 GJ / km*.

GHG emissions (kg CO2/ton) = *3.61 kg CO2/ton x 4,830 ton /km x m x* (*1ton/1000*) *= 17.43 tons of CO2/km.*

The results of calculation of the estimated energy consumption and greenhouse gas emissions in the execution of the CTRB work in this study can contribute as the information to support government policy in an energy efficiency effort and decreasing of greenhouse gas emissions nationally according to PERPRES No. 5 of 2006 and the commitment of the Government of the Republic of Indonesia in international conferences.

3. CONCLUSION

Development of road infrastructure has a very important role to enhance national development, but along with that role, pavement road construction requires energy and produces emissions of greenhouse gases that affects global warming. The construction of road pavement implementation by using recycling processes uses energy more efficiently and produces less greenhouse gas than conventional method (hot mix).

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