THE GLOBAL ENVIRONMENTAL IMPACTS OF PALM OIL BIODIESEL PRODUCTION ON GLOBAL WARMING (A REVIEW)

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Abstract— This paper reviews the trends on the impacts of palm oil biodiesel production to the environment, its constructive carbon balance and the continuity than fossil diesel. The increase in the cultivation in the tropical countries like Malaysia, Indonesia and many other parts of the world had as well produced environmental problems of global warming from greenhouse gas emissions (mainly carbon dioxide, methane and water vapour). Many researchesabout the utilisation of empty fruits bunches, fresh fruit bunches and palm oil mill effluents were carried all to reduce the greenhouse gas emissions causing the global warming. Palm oil biodiesel is a first generation biodiesel (reducing land and food scarcity). The processing and usage of palm oil residues many researches to reduce the emissions of greenhouse gases. The palm oil biodiesel releases only 38% of greenhouse gases, can be degraded easily and its low-temperature behaviour can be enhanced by blending with petrol diesel e.g. B100, B20 etc. use to reduce the emission of nitrogen oxide as it produces excess of it. Palm oil biodiesel significantly reduces carbon dioxide, carbon monoxide, toxic and other emissions when burned as a fuel and so far the biggest biofuel and represents 82% of the biofuel production. Biodiesel, been renewable reduces the emissions of carbon dioxide by 80%.

Keywords— Greenhouse Gases, Pollution, Biofuel, Global Warming.

I. INTRODUCTION

Worldwide petroleum consumption has steadily increased as energy becomes vital in all the human endeavours from the integration of living standards, more transportation, plastics and other petrochemicals.So what next is towards sustainable environment, thus produces a fuel which emits less greenhouse gases and air pollutants, so biofuel (Bunnel, 2007). The petroleum is a limited resource for fuel and at the end of 2008 (Demirbas, 2009) and by the annual statistical review of British Petroleum's World Energy, the world known oil reserves were estimated at 1.7 x 10^{11} tons with a reserve-to production ratio of 42 years, therefore biofuel in essence (British Petroleum, 2009). Energy depends on petroleum-derived fuels, and transportation alone contributes about one-fifth of universal carbon dioxide emissions and 60% of global oil consumption (International Energy Agency, 2008) and averagely there are about 806 million cars and light trucks on the road in 2007 (Plunkett, 2008). The values are predicted to reached1.3 billion by 2030 and to over 2 billion vehicles by 2050 (World Business Council for Sustainable Development, 2004). The increasing greenhouse emission can cause multiple problems to the ecosystems and universal climate together with the world oil deposits (Balat and Balat, 2009). Biofuel is a liquid or gaseous fuels used in transportation mainly produced from biomass e.g. Bioethanol, methanol and biodiesel. Biodiesel is newly developed to replace the fossil diesel from living origins like animal and plant oils; it has great environmental value (Demirbas, 2008). The idea of biofuels began when the diesel engine was invented by Rudolf Diesel in 1900 by then used peanut oil as the fuel and the abundance of petroleum diesel makes the idea to be dormant, but as necessity to sustainability brings back the idea (Yusuf *et al.*, 2011).

The biodiesel burns with less greenhouse gases and particulate matters than the petrol diesel. A standard were developed to measure its performance, the biodiesel standards are mostly ASTM D6751 (American Society for Testing and Materials) and the European standard (EN14214). A biodiesel is identified by its observed behaviours in viscosity, density, cloud point, pure point etc. (Balat and Balat, 2010).

Biodiesel can be mixed with petrol diesel e.g. B2 (2% biodiesel and 98% petroleum diesel), B5 (5% biodiesel and 95% petroleum diesel), B20 (20% biodiesel and 80% petroleum diesel) and B100, to reduce nitrogen oxide emission. The advantages of biodiesel over petrol diesel are availability and renewability, Lower emissions, Biodegradability and Higher lubricity (Balat and Balat, 2010).

The emergence of biodiesel had added input to the production as the palm oil system generates more biodiesel per hectare than the other systems and can produce an outstanding 4000 litres of oil per hectare, thus highest feedstock to yield biodiesel (Thamsiriroj and Murphy, 2009). Palm oil contains mainly palmitic and oleic acids, the two common fatty acids, and about 50% saturated fatty acids, while Palm kernel oil contains mainly lauric acid and more than 80% saturated fatty acids (Yusuf *et al.*,2011).

The materials for the biodiesel production grouped biodiesel into first, second and third generation. First-generation biodiesel is directly related to a biomass (oily plants and seeds) that is more edible e.g. palm oil, rape seed, sunflower (Balat and Balat, 2010). Trans esterification is the process of converting palm oil into biodiesel and is achieve by

breaking the bonds linking the long chain fatty acids to glycerol, replacing it with alcohol using sodium or potassium hydroxide as catalyst (Lee and Lavoie, 2013).

The biodiesel is a clear amber-yellow liquid with low viscosity, non-flammable, non-explosive, biodegradable, non-toxic, and it significantly reduces toxic and other emissions when burned as a fuel and so far the biggest biofuel and represents 82% of the biofuel production.

II. CURRENT TRENDS ON THE ENVIRONMENTAL IMPACTS OF PALM OIL BIODIESEL PRODUCTION

The cultivation of palm oil trees had produced excess emission of greenhouse gases and air pollutants, from clearing of forests, use of machines during cultivation, transportation and processing of the palm oil and its effluents, palm oil mill effluent processing produces about $10m^3$of methane per tonne(Hojjat, 2009). The research of Reijnders and Huijbregts (2008) on FFB found that the greenhouse gas milling emissions is approximately 7–54g/MJPME. Thamsiriroj and Murphy (2009) in their research use the life-cycle analysis of the biodiesel production of two biodiesel feed stocks; palm oil and rape seed. The study found the percentage of GHG emission of 55.1% (35.21 g CO_2 eq/MJ biodiesel) from the PME and 28.8% (58.35 g CO_2 eq/MJ biodiesel) for the rape seed. Table two below shows the different stages of emissions during the life cycle analysis of the palm oil and rape seed and it shows the suitability of palm oil.

Table 1: Showing the life cycle assessment summary of greenhouse gas emission of the two biodiesel feedstock

(kg CO_2/GJ)	Rape seed	Palm oil
Process emissions	58.35	35.21
Direct emissions	72.42	71.76
Short-term carbon emissions	−68.61	−67.77
Net emissions	62.16	39.2
% greenhouse-gas reduction @ total emissions of conv. diesel 87.3 kg CO_2/GJ	28.8%	55.1%

Source: Thamsiriroj and Murphy (2009)

Chiew and Shimada (2013) conducted a research on the reduction of the environmental impacts of palm oil biodiesel production of global warming, acidification, and ozone layer depletion. The research uses recycled technology and empty fruit bunches (EFB) of the palm oil to obtain the values of environmental performance of the seven recycling technologies; Medium density fibreboard (MDF) production, ethanol production, briquette production, composting, methane recovery, pulp and paper production, biofuel for combined heat and power (CHP) plants. The results showed that composting has the least impact on the environment with the global warming value of 22.2kg CO2 equivalent and acidification and ozone layer depletion value of 0.07kg SO2 equivalent, thus composting is the best recycling technique to reduce the environmental impacts.

However Shafawati and Siddiquee (2013) use the composting of oil palm fibres, empty fruits bunch to reduce the environmental impacts of global warming and eutrophication. This research employs the use of fungus; Trichoderma sp. as the biological control agents in the composting activities to help as an activator to the reaction process. This reduces amount of methane gas release which decreases the global warming potential.

Similarly Wicke (2008) research synthesises palm fatty acid distillate (PFAD) from the palm oil which has high energy content and less greenhouse gas emissions.

III. DISCUSSION

Palm oil biodiesel production effects the environment, since numerous trees are destroyed which are constantly removing CO2from the atmosphere, enhancing the global warming but reduced compares to fossil fuels and also greatly affects the biodiversity. But, Palm oil biodiesel is very chief, contains small amount of carbon dioxide and it is waste can be harness to give biomass again. However, it is associated with major environmental impacts of biodiversity, depletion of resources, climate change, but remain a feasible method for environmental sustainability, because of some advantages mentioned (César *et al.,* 2013).However estimated annual world biodiesel requirement by 2050 could be 277 million tons, twice current total vegetable oil production and seven times total palm oil production (British Petroleum, 2009).

There is vast greenhouse gas emissions with forest preparation, dehydration of peat soils and use of petrol fuels for planting crops, palm oil processing, products and transport. The carbon emissions from petrol fuels take many years to balance the emissions discharge when forests or peat lands are convertedto palm oil plantation, carbon cycle exists in the process of palm oil production as; palm oil tree takes in carbon dioxide while growing and produces the fruits then processed to extract the oil and produces the palm oil biodiesel that burns giving same amount of carbon dioxide inhaled, thus environmental impact is reduced(Reijnders and Huijbregts, 2008).

In the production and treatment of palm oil greenhouse gases emissions always happens. Yet the waste from palm oil production is full of organic matters that also contribute to the emission of greenhouse gases, typical example is the wastewater which gives out methane into the atmosphere (World agro forestry centre, 2012). The processing of fresh fruit bunches and empty fruits bunches releases huge

amounts of greenhouse gases (methane and carbon dioxide mostly) which influences climate change. The palm oil mill effluents have been found to be a good source of greenhouse(Stichnothe and Schuchardt, 2010).

However, Lam and Lee (2011) found that palm oil mill effluents were known as a possible ways to create renewable bioenergies like biohydrogen and biomethane via anaerobic digestion. Thus the treatment of wastewater and renewable bioenergies making gives another benefit to the palm oil industry. Energy is a grim anxiety globally (Lee and Lavoie, 2013).The global energy matrix is still built on non-renewable and highly polluting fossil fuels but biodiesel is out to help the issues (Yusuf *et al.,* 2011). In essence it upgrades the global environment by reducing the greenhouse gas emission but palm oil biodiesel production encourages biodiversity loss except when manage sustainably (Torres *et al.,* 2013). Researchers had been developed to cuts the extent of the environmental problems of the palm oil biodiesel manufacturing. Shafawati and Siddiquee (2013) uses the composting technology to find the one which produces less greenhouse gas while Chiew and Shimada (2013) develop a technique of using Trichoderma species to reduce the emission of methane from empty fruit bunches. The widespread use of integrated pest management and leguminous cover crops reduces the use of insecticides and herbicides; and oil palm requires less fertiliser per unit of output than other oil crops (Fitzherber*tet al.*, 2008).

CONCLUSION

Palm oil is a good raw material for palm oil biodiesel, thus it has least eutrophication potential, emits 38% of greenhouse gases, can be blended with petrol dieselto reduce the emission of nitrogen oxide and contains small amount of carbon. Palm oil biodiesel significantly reduces carbon dioxide, carbon monoxide, toxic and other emissions when burned as a fuel and so far the biggest biofuel and represents 82% of the biofuel production. Biodiesel, been renewable reduces the emissions of carbon dioxide by 80%. In essence palm oil biodiesel is a path way to reduce the emission of greenhouse gases and other air pollutants but in lesser quantities than fossil fuels, thus environmentally friendly and helps towards acquiring a sustainable environment in the future.

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