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Sustainability of biodiesel production as vehicular fuel in Indian perspective

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ABSTRACT

Biodiesel production offers promising opportunities to create additional alternate sources of energy. Since India is deficient in edible oils, the non-edible oil like jatropha, neem, karanja, mahua, simarouba etc., could be the desirable source for India for production of bio-diesel. This brief presents the current status, discusses the future prospects and examines the critical constraints and impediments in India to the path of development of biodiesel program. It also offers suggestions and alternative policy options so as to enable the program to achieve its objectives. The effects of biodiesel on engine performances i.e. brake power, brake thermal efficiency, specific fuel consumption and substantial reduction in particulate matter (PM), hydrocarbons (HC), carbon monoxide (CO) and oxide of nitrogen (NO_x) were also reviewed.

Contents

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1. Introduction

Biofuels are globally considered sustainable and eco-friendly source of energy to enhance national energy security and decrease dependence on imported fossil fuels. Main user of diesel fuel in India is the agriculture sector next to transport sector. The demand for diesel fuel exceeds its availability resulting in its scarcity and is projected to increase at an annual rate of 5.8% [1]. Biodiesel demand and over-capacity in Europe, US and Asia are driving investment in the global trade of alternative feedstocks (Fig. 1).

1.1. Energy scenario of India

With the growing population of petroleum fuel, India is the fifth largest primary energy consumer (per international energy annual) and the fourth largest petroleum consumer in the world [2]. India produced around 1073 million litres of ethanol in 2009 (USDA 2010) of which around 100 million litres was blended with petrol to be used in automobiles as fuel. Now the country becomes world's 7th largest ethanol producer, with an annual production of 200 million litres of ethanol [3,4]. The per capita energy consumption of India was 439 KGOE in 2003, which was much lower than in developed countries (i.e. 1090 in China, 7835 in USA) but also than the global average of 1,688 KGOE [5]. In 2008–09 with the limited reserves, India's indigenous production was around 33.51 million tons and consumption was around 161.7 million tonnes. India does not have the ability to meet the country's growing demand for energy from indigenous sources even in the short term. As a result, the country is increasingly becoming dependent on imported crude oil. In the past few years India has been a net importer of liquid fuels and the volume and value of these imports have risen (Fig. 2). The import of crude oil has risen from 57.8 million tonnes. ($9.21 billion) in 1999–2000 to approximately 140.4 million tonnes. ($75.6 billion) in 2009–10, accounting for about 81% of total oil consumption in the country [6]. With the country entering a more energy intensive phase of its development, demand for transportation and consequently liquid fuels will dramatically rise in the future. Nowadays, all the tractors and other heavy duty vehicles are powered by compression ignition (CI) engines using diesel fuel. The vehicular pollution is contributing about 70% to the total air pollution and estimated to have increased eight times over the last two decades. India's total carbon emissions are increasing at an estimated 3.2% per annum, against 3.9% in China and 1.3% in the United States [3,5].

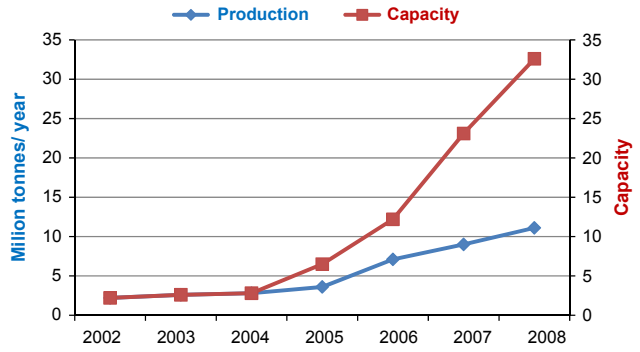

Fig. 1. World biodiesel production and capacity.

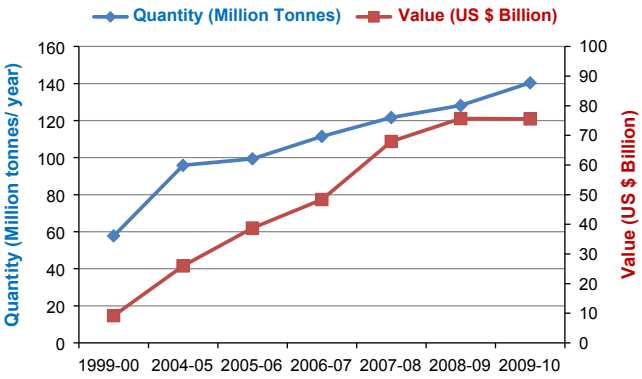

Fig. 2. Crude Oil Imports by India, 1999–2009.

Out of various possible new alternative sources of energy, biodiesel has potential as an alternative energy source. However, biodiesel alone will not solve our dependence on foreign oil within any practical time frame. Biodiesel is a viable substitute for petroleum-based diesel fuel. Biodiesel operates in compression ignition (diesel) engine, which essentially requires very little or no engine modifications because biodiesel has properties similar to petroleum diesel fuels. Moreover, a renewable fuel will help reduce India's carbon dioxide emissions.

1.2. National policies on biofuels

The biofuels industry in India is basically controlled by the government agencies to encourage investment in this field. In the recent decade, the Government has formulated certain policies and promoted the production and consumption of biofuel. In 2003, the Government of India launched National Biofuel Mission with a view to explore the potential of biofuels as a cleaner source of energy and to partially offset the growing burden of crude oil import bills. Under the Ethanol Blended Petrol Programme (EBPP) the Government made it mandatory to blend petrol with 5% of ethanol across the country except Jammu and Kashmir, north-eastern states and Island territories [7]. However, this figure is quite low as compared to those of other countries such as Brazil, USA, China and Indonesia. This policy envisages a target of complete blending 10% by 2016–17 and then gradually raise it to 20% after 2017 [8,9]. In 2009 the 'National Policy on Biofuels' by the Ministry of New and Renewable Energy (MNRE) launched to mainstream the biofuels, particularly in the transportation and energy sectors. This stimulates rural development and generates employment opportunities, as well as aspires to reap environmental and economic benefits arising out of their large-