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INTRODUCTION

We can get fuel from fruit, from that shrub by the roadside, or from apples, weeds, sawdust—almost anything! There is fuel in every bit of vegetable matter that can be fermented. There is enough alcohol in one year's yield of a hectare of potatoes to drive the machinery necessary to cultivate the field for a hundred years. And it remains for someone to find out how this fuel can be produced commercially—better fuel at a cheaper price than we know now.

~ Henry Ford, 1925

Today we all feel the need for 'Going Green'. It is important to protect the environment and sustain its natural resources for the present and future generation by pursuing environmentally friendly and ecologically responsible decisions and lifestyles.

Climate change is one of the challenges facing world sustainable development. Burning fossil fuels is one of the major causes of global warming. According to an Intergovernmental Panel on Climate Change (IPCC) report, 'Most of the observed increase in globally averaged temperature since the mid 20th century is due to greenhouse gas concentrations'.

Another concern is the growing energy consumption, as we progress into the digital age. With exponentially increasing population, world's energy demand also increases, leading to a gap in demand and supply of oil. This has also increased our dependence on other countries for oil. In response to growing alarm over greenhouse gas emissions, soaring oil prices and dwindling crude oil reserves many countries in the world have commenced research into developing alternative ways of fuel from renewable resources. One of the promising green alternatives that can replace fossil fuel is 'biomass' **(Dominik Rutz and Rainer Janssen 2008).**

Biomass is biogenic vegetable mass formed by photosynthesis. Fuels produced from these masses are called biofuels.Two classes of biofuels namely vegetable oils and their derivatives and alcohols and ethers have gained increased public and scientific attention.

The idea of using vegetable oils as fuels is not new. Biodiesel as fuel was first conceptualised by Dr. Rudolf Diesel, the inventor of diesel engine. He used peanut oil as fuel source to run diesel engine. But since vegetable oils possess increased viscosity over conventional diesel fuels, they are unsuitable for use as fuels in classic diesel engines. Hence, the vegetable oils are treated with alcohol in the presence of a catalyst to produce an alcohol ester called 'biodiesel' - transesterification. The biodiesel thus obtained have properties very similar to petrofuels.

Biodiesel readily blends with petroleum diesel at any blend level. Biodiesel is clean burning, renewable, carbon neutral and biodegradable. It produces fewer particulate matter, carbon monoxide and sulphur dioxide emissions. It is also an excellent lubricating additive. With the above environmentally beneficial properties, biodiesels could be the answer to future energy needs.

All countries in the world including those with surplus energy are now banking upon vegetable oil as alternative source of energy. Biofuels are being used globally and biofuel industries are expanding throughout the world. A wide variety of feed stocks are available globally for biofuel production including energy crops, wastes, forestry residues and novel feedstock such as algae.

1.2 Biodiesel Scenario in India

It is Dr. A.P.J.Abdul Kalam, the former President of India who provided the definitive vision for the oil sector. According to him, the oil sector should aim at providing to the nation at least 50% of its annual oil and gas need. India depends on other countries for oil, which increases our burden on oil imports .The large size of the rural economy, seeking self sufficiency in energy and environmental concerns are the driving forces for the biodiesel program in India. It commenced its journey in 2003, with the Indian National Planning Commission launching an ambitious programme 'National Mission on Biodiesel' to foster development of vegetable oil based biofuels.

Since the demand for edible oil exceeds supply, the focus is onto the use of non edible oil feedstock for the production of biodiesel.

India has large areas of waste land which are not being utilised for cultivation. Using these wastelands for cultivation of vegetable oil based plants generates income opportunities for farmers and underemployed labourers in rural areas. Hence plant varieties which are non edible and which can be grown in wastelands such as *Jatropha curcas, Pongamia pinnata, Calophyllum inophyllum,* and *Euphorbia tirucalli* are considered for biodiesel production.

Jatropha and pongamia are considered as the most economically viable and environmentally friendly feedstock option because of their adaptation to harsh climatic and growing conditions. Of the two, Jatropha - the wonder plant of the era is considered as the feedstock of choice due its shorter maturation period and its superior adaptation to arid conditions.

Jatropha as feedstock for biodiesel production has many advantages:

- The oil yield per hectare for jatropha is among the highest for tree-borne oil seeds.
- It can be grown in areas of low rainfall, low fertility, marginally degraded and waste lands.
- It can be grown as hedges and even alkaline soils are appropriate for the crop.
- Jatropha is not browsed by animals.
- Being rich in nitrogen, the seed cake is an excellent source of plant nutrients.

Even though substituting biodiesel for conventional fossil fuel has many societal benefits, there are certain potential problems while using it in vehicles. While integrating biodiesel with existing infrastructure such as pipelines, storage units, fuel tanks and associated equipment the compatibility of materials in biodiesel has to be thoroughly studied.

1.3 Corrosivity of biodiesel

Biodiesel and biodiesel blends cause corrosion and form sediments when in contact with metals like brass, copper, tin, bronze, lead and zinc.Corrosivity of biodiesel and biodiesel-petroleum diesel blends have been studied under wet and dry conditions. Storage materials undergo corrosion in the presence of biodiesel by electrochemical mechanism in the presence of entrained water - wet corrosion **(Kane and Papavinasam 2009)**. In the combustion and automobile operating conditions corrosion due to biodiesel occurs at elevated temperatures, mostly under dry conditions. This type of corrosion is called dry corrosion. A third type of corrosion which is not directly related to the biodiesel, but caused by bacteria that it contains and the condition for their growth is called Microbiologically Influenced Corrosion.

1.4 Microbiologically Influenced Corrosion (MIC).

MIC or biocorrosion may be defined as 'an electrochemical process where the participation of the microorganisms is able to initiate, facilitate or accelerate the corrosion reaction without changing its electrochemical nature' (**Javaherdashti 2008; de Romero *et al.* 2004**). MIC is a type of corrosion that can be harmful to almost all engineering materials. Presence of water is one of the important requirements for the occurrence of MIC. An energy source, a carbon source, an electron donor and an electron acceptor are the other requirements.

Microbes in petrodiesel cause problems like product deterioration, sludge formation and corrosion of tanks and pipes. MIC has been a challenge for sea based petroleum operations for years and is said to cause damage to equipment and infrastructure that support the exploration, production, transportation and storage of oil.

1.5 Susceptibility of biodiesel to microbial contamination:

Biodiesels are fatty acid methyl esters produced from vegetable oils by a process known as **transesterification.** Both petroleum diesel and biodiesel are often contaminated with microorganisms. Water is one of the essential components for microbial growth to occur. It is very hard to remove water from fuel systems especially when blended with biodiesel since biodiesels are more hygroscopic than petroleum diesel. The water condenses and collects at the bottom of the fuel tanks or pipes. Water sitting at the bottom causes microbial growth at or below fuel-water interface. This leads to the formation of sediments, sludge and slime resulting in fuel deterioration and corrosion which normally occurs under the resulting biomass .Since biodiesels are produced from natural products, the likelihood of occurrence of MIC in their presence will be higher than that in conventional fuels. MIC is a serious industrial problem and affects various processes like water injection lines, storage tanks, and residual water treatment system and is widespread in oil production and distribution system.

Various regulations allowing the use of biofuels have not fully considered the potential impact of microbial activity in distribution, storage and end use. These impacts may cause significant implications for fuel quality and stability and also the integrity of distribution and storage infrastructure. At present the data available on this topic is scarce. Hence knowledge about the nature of microbes that survive in biodiesel and the ingredients that help in their growth will help us control MIC.

Based on the above facts, the present work aims to investigate the influence of *Bacilus pumilus* **isolated from the sediments of stored jatropha biodiesel on the corrosivity of jatropha biodiesel (JBD) and its blends with commercial diesel.**

Aluminium and mild steel used as construction materials and copper and brass used in automotive engines have been chosen to test the corrosivity of the JBD in the presence of bacteria with the following research design.