A STUDY OF SAFETY AND STORAGE OF BIODIESEL

Vinay kumar Gupta[1], Jai Singh[2], Rajendra Prasad Mishra [3]
[1, 3]Department of chemical Engineering, Monad University, Hapur, India
[2]Department of chemical Engineering, C.C.S. University, Meerut, India

ABSTRACT: Biodiesel could also be thought to be flammable because of its flash-point is approximately 150°C. It has somewhat abnormal solvent features and can attack various normal engineering polymers, consisting of natural rubber, polyvinyl, some seal and hose substances and metals, as well as copper, Zn and tin. Unless this can be dependably prevented, then the biodiesel ought to be utilized as quickly as possible after production. It is also reclassified, reserved and handled carefully. Current research paper analyzes the factors that influence the storage of biodiesel, safety strategies and handling difficulties of biodiesel and its solution.

KEYWORDS: *Biodiesel; Safety; Storage Tank; Degradation*

1. INTRODUCTION

Biodiesel, so as to leaves the manufacture plant is in high-feature state. It can become objectionable for the period of sharing lacking correct care as well as concentration *[1]*.Biodiesel can diminish property due to oxidation, get in touch with microbial movement and water. In general, biodiesel will decrease feature extra rapidly than petro-diesel. It has a good quality that if biodiesel leak will bio decrease rapidly and not be reason as a lot of environmental crisis as a fossil oil spill. The more common difficulty is that methyl esters has a propensity to freeze at lower temperatures than petro-diesel *[2]*. Therefore, reservoir space as well as carrying tanks has to be drafted to conformity with preventing these problems. In addition, biodiesel may not be well-matched by various elastomers in general use with petrol. It can be reason of the humiliation of several substances utilized in seals, gaskets, and hoses, *[3]*.

2. SAFETY STRATEGIES OF BIODIESEL FROM SOME FACTORS

2.1. OXIDATION: Oxidation of biodiesel may be reasons of formation of sediments in the fuel. These sediments will change clog up fuel. Biodiesel prepared from vegetable oils (unsaturated fats) have a propensity to oxidize, moreover consequently decrease feature extra speedily than fuel prepared from saturated fats, for example animal fats *[4]*. So storage tanks should be air free closed and preserved under antioxidant compounds.

2.2. CONTACT WITH WATER: Biodiesel can decrease feature because of contact with water. During reservoir and transportation water contacts within the reservoirs along with pipes of the distribution system and it will contaminate the fuel. This free water may be reasons of the engines and reservoir to corrode. It also permits microbes to full-grown within the biodiesel. To stop free water accumulation, certain reservoir tanks ought to be hygienic in addition to dry previous to biodiesel is place into the tank *[5]*. More over if possible keep only a small atmosphere gap on top of the methyl esters tank. If achievable, free water is not used at the bottom of reservoir tanks on any time. The dissolved water in biodiesel will too be reason difficulties when the fuel is reserved for just some months. This water is often reason of acids within the fuel, which might eventually cause a hole within the reservoir tank *[6]*. It is nearly not possible to stay water out of biodiesel since water is often souvenir in reservoir tanks and since biodiesel will absorb water from the atmosphere. The most effective method to stop water from degrading biodiesel is to use the fuel quickly – inside a number of months *[7]*.

2.3. MICROBIAL DEGRADATION: Microbes can grow given the right conditions. They generally want water and nitrogen. Deal with this difficulty by observation, tanks of the biodiesel should not in grips with water. Biocides chemicals that inhibit microbe growth–may also be supplemental to the fuel and these biocides are already unremarkably used with petro-diesel *[8]*.

2.4. PREVENTING BIODIESEL FROM FREEZING: Biodiesel ready from saturated fats have a bent more to gel at heat than biodiesel from unsaturated fats. In general, unpolluted biodiesel ready

from oil will safely be reserved at 45°F to 50°F. During cold climates, underground containers will forestall gelling *[9]*. Above-ground tanks will have chosen warmed otherwise insulated, looking on the placement. Biodiesel merging with petro-diesel have a lower gel point than pure biodiesel. So it is another way to put a stop to biodiesel as of solidifying.

2.5. TRANSPORTING BIODIESEL: When mixtures of methyl esters are transported, the shipping holder has been cleansed this and there's no water inside the tank. The tank may have insulation or warming if the vegetable based methyl ester is being transported in atmospheric situation. Alternatively, the biodiesel are often wet to inside the container. So it should be warmed to remove moisture and microbes. Pure biodiesel is not thought of ignitable, features a flash purpose bigger than 200°F, and might be conveyed with none warning signs. Biodiesel blends need cautioning indications if the flash point of the mixed fuel is below 200°F.

2.6. BIODIESEL CAN DECREASE FEATURE OF OTHER MATERIALS: Another reservoir and transportation matter is that the undeniable fact that pure biodiesel, and its blends. More duration of biodiesel sustains, will decrease feature some hoses, gaskets, and seals of storage tank. Acceptable materials are for containing biodiesel is embrace Teflon, Viton, fluorinated plastics, and nylon *[10]*.

3. HANDLING DIFFICULTIES OF BIODIESEL AND ITS SOLUTION: Vegetable oil based methyl esters hold no unstable natural material that can provide mount to toxic or noxious fumes. On get in touch with eye, methyl esters may be reason of irritation to eye. Protection glasses or face shields ought to be utilized to protect face and eyes. Fire issues are one of hazard problem for biodiesel precaution. Warm fuel possibly will be reason of burn. So during handling, it should be consider that it must keep away from ignite material. Biodiesel should be griped with gloves as biodiesel may be reason of soft skin. Mild impatience on skin can take place *[11]*. Indian Explosive Regulations categorize that biodiesel is as alike to important oils because of its high flash point. There is refusal hazard of blasts from vapours of methyl esters as a consequence of the flash point is more. Large Biodiesel leaks will be harmful. Methyl esters are not completely safe to the larvae and fish and it also effect smaller amount damaging than fossil fuel. Methyl esters have terribly small solubility in water in compared to fossil fuel diesel that hold benzol, toluene, dissolving agent and different additional water soluble, extremely nephrotoxic compounds *[12]*. However, once the Biodiesel is smartly mixed into water, the biodiesel kind a brief emulsion of small droplets that seem to be dangerous to the swimming larvae. The half life for biodegradation of vegetable methyl esters compound is concerning four days at 17ºC and it is about twice as quick as compared to biodegrading of fossil fuel. Within the laboratory tests, rape seed methyl esters organic compound decrease featured by ninety fifth whereas the fuel decrease featured solely four-hundredth at the apex of twenty three days. Any accidental spill of little amounts of Biodiesel ought to contain very little impact on the surroundings compared to fossil fuel diesel that holds additional nephrotoxic and additional soluble aromatics. Still, the methyl esters may still be reason of harm *[13]*. Environmental Protection Agency silent believes leaks of vegetable oils and animal fats as injurious to the surroundings. Spilling methyl esters in moisture and water is prohibited as spilling fossil fuel. Biodiesel have to be compelled to be handled like every different fossil fuels and laws ought to be reviewed to build certain with the intention of biodiesel is roofed within the same category. Once biocides chemicals are employed in the oil reservoir to kill microorganism, appropriate handling precautions like use of gloves and eye protection should be used. One should check that the laws on disposal of fossil oil applicable same to Biodiesel also. Both Fuels should be equally checked that laws for spill interference and hold men action for people who manufacture and reserve biodiesel exists or not. Discharge of animal fats and oil area unit order of magnitude less cyanogenic than fossil oil discharge, don't produce malignant neoplastic disease compounds and, area unit very perishable by microorganism so minimizing physical impact on environment [14]. However, tremendous exonerates of animal fats, vegetable oils and Biodiesel are often reason unenthusiastic crash on water life. Biodiesel spills compare additional favourably to fossil oil spills. Moreover, probability of an oil or Biodiesel oil spill being comparable in magnitude to a fossil oil spill is moreover terribly little as a result of differences in volumes within the two industries *[15]*. There is a desire to differentiate between the vegetable oils and fossil oil through the creation of separate categories

for animal fats and vegetable oils from fossil oils and apply separate standards supported the variations in physical characteristics between the categories. Biodiesel is presently controlled within the similar way like animal fats; crops oils and fossil oil are managed under supervision of oil spill rules and policy. Tanker vessels of transporting biodiesel stay controlled within the identical mode when there would be fossil oil services or tanker vessels transporting fossil oil [16].

4. STORAGE OF BIODIESEL: Biodiesel reservoir ways don't seem to be so much far way from ancient diesel reservoir methods; but, there are a quantity of apprehensions for optimum fuel longevity and purity. Six month is viable reservoir life with correct precautions. The fuel must to be reserved in a very clean, dry, dark environment *[17]*. Biodiesel should reserve in a very humidity-free location, faraway from heat and out of direct daylight. If unable to order out of direct daylight or heat weather; cover tanks with reflective canvass to decrease fuel polymerisation and oxidisation and also reserve in tightly sealed full tanks. All humidness should take away from tanks because water promotes slime and bacterium growth and fuel degradation. If achievable, the storage tank mustn't embrace any copper, brass, lead, tin, zinc, or rubber fittings if possible (practically speaking, brass ball valves are employed by several with no major sick effect).The proposed materials for reservoir tanks are embrace aluminium, steel, polythene, polypropene, and Teflon *[18]*. Zinc metal and copper leech into biodiesel, inflicting impurities, thus do not reserve fuel in tanks holding any quantity of those metals. Underground reservoir is most well-liked in cold climates. Biodiesel will be reserved in open with correct insulation, heating and different instrumentation ought to be put in tank. Additives will be used for small temperature reservoir and pumping *[19]*. The Biodiesel its blends ought to be reserved at temperatures minimum of 15°C on top of the pour point of the fuel. .If reservoir of Biodiesel is already accumulated deposits and slime, might be reason terribly severe filter and pump blockage issue. For long time reservoir stability of Biodiesel and blends adequate knowledge don't seem to be available there. Reservoir conditions should be considered necessary as an example; biodiesel mustn't be reserved or transported in copper, brass, bronze, lead and tin because these metals can hasten degradation. Instead of it, holders should select storage tank of aluminium metal, steel, fluorinated polythene, fluorinated polypropene, Teflon, or covering material. Tanks are designed to order and transport petro-diesel will reserve biodiesel with no issue. Heat, sunlight, and chemical element also will be reason of biodiesel to decrease feature. Thus reservoir ought to minimize exposure to those problems. If biodiesel are going to be reserved for extended than concerning four to 5 months, a stability additive ought to be used, particularly in additional hot climates as a result of exaggerated temperature and humidity[20].

4.1. THE FACTORS THAT INFLUENCE THE STORAGE OF BIODIESEL:

4.1.1. TEMPERATURE: Cool temperature is good in preserving the life of biodiesel. Under high temperature oils form crops leads to their degeneration.

4.1.2. MICROBIAL CONTAMINATION: If biodiesel is polluted by a microbe, the growth of the bacteria will cause to be unfeasible in a few hours. To prevent such reactions, you should always ensure that biodiesel tanks should be atmosphere tight. Biocide should use to kill the microbes, if methyl esters have attacked bacterial contamination.

4.1.3. ATMOSPHERE EXPOSURE: Aerobic injury conjointly spoils biodiesel fuel at a quick rate. The majority persons concerns that however biodiesel is reserved but oxidization could not stop. Oxygen attacks the chemical composition of biodiesel molecules. The aerobic attack is reason of acidic compounds and therefore the fuel becomes acidic and lets out a rancid odour. As oxidization continues, the biodiesel becomes viscous and additional corrosive and even starts to create sediments. A number of the factors that have an effect on however long aerobic injury takes to render your fuel unusable embody. Most biodiesel firms keep their fuel below nitrogen to forestall element damage *[21]*. With no doubt, the common plastic diesel tanks may be non inheritable cheaply will do, if you're storing it for some period.

4.1.4. EXPOSURE TO LIGHT: Oxidation can be facilitated by sunlight. To analysis the results of light on oxidation, take a small ration of oil and put it directly under the sun and in the open atmosphere for a few days. The oil becomes rubbery plastic. This is being reasoned by the formation of polymers during

the oxidation of the fuel *[22]*.In Practice storing biodiesel should be away from straight sunbeams.

4.1.5. CHEMICAL CONTAMINATION: Oxidation may be strong by trace metals chiefly iron, copper and zinc. Biodiesel works corrosively with copper, brass and bronze Therefore, one should ensure that the plumbing, valves and storage of biodiesel is done in containers that are not made of copper, brass or bronze.

4.1.6. THE KIND OF FEEDSTOCK AND ADDITIVES: The kind of feedstock of biodiesel production also determines the nature of biodiesel. Some anti-oxidant additives are also utilized for longer ages of reservoir. Additives used for preservation of methyl esters also effect for storage of biodiesel.

Fig.1. Biodiesel storage tank

4.2.1. STORAGE TANK MATERIAL: Reservoir for a specific biodiesel has been normally chosen in keeping with the characteristics of that substance. The most expected characteristics from fuel reservoir are minor build up prices and greater chemical resistance. Whereas steel and concrete stay one in all the foremost standard selections for tanks but glass-reinforced plastic, thermoplastic and polythene tanks are increasing in quality of storage. They provide lower manufacture prices and bigger chemical resistance.

Table 1. Materials for Storage Tank

Sr.No	Type	Specific Material
1	Metal	Aluminum, Steel (mild/carbon steel), stainless steel
2	polymer	Polypropilene, Polethylene (HDPE), Nylon, Fluorinated Materials
3	Concrete	Concrete
4	Elastomer	Viton, Fluorosilicone, Chemraz, Hifluoer, Fluorocarbon, Teflon

On the basis of physico-chemical analysis, the steel reservoir tank performing arts the minimum changes in fuel properties. It appears safer for storing biodiesel blends, instead of HDPE and glass tank. Steel tank is incontrovertibly solid, strong, and opaque. It will shield fuel from daylight exposure. Glass reservoir tank appears not in fashion for fuel reservoir however some take a look at to guide some new findings. As like alternative polymeric materials, glass is inert to the corrosive environments within and outdoors of the tank. It acts as associate stuff to retard heat transfer to the fuel. It may be properly designed and put in to regulate any contact with wet atmosphere and may be made with a resin with dark surface to guard from lightweight exposure. Glass tank is become enticing for those needs. As known, oxidation is associate irreversible reaction. It's a unidirectional path to the ending of the materials of reservoir. Meanwhile, physical aging of any fuel is reversible. One among in famous materials for forthcoming reservoir is High Density Polyethene (HDPE). HDPE could be a polythene thermoplastic prepared from petroleum. HDPE is understood for its giant strength-to-density magnitude relation. It additionally more tough and additional opaque and may face up to somewhat higher temperatures. HDPE fuel tank will presumably used for fuel reservoir owing to its skilfulness. This material is understood pretty much as good to decrease fuel permeation beside its nice chemical resistance. A recent study conducted by Christensen & L.Mc Cormick, 2014), they reportable that methyl esters blends reserved in polythene storage tanks were unwavering for 380 days once command at 23 °C. However creation of peroxides and acids was detected once the fuel was reserved for 56 days at higher temperature *[23]*. Moreover, the test performing biodiesel blends reservoir in HDPE and other polymeric materials are still limited.

5. CONCLUSION

Two factors are important to regard as for the safety of biodiesel. One thing is it has unusual solvent property and the second thing is it has a tendency to decrease further with time and low temperature. The abnormal solvent properties outcome will rise with warming and growing old. It is too hygroscopic, and can suck up to

1500 ppm water from the air. If even slightly polluted with acid or alkali, biodiesel will be hydrolyzed to fatty acids and methanol. This reaction also arises additional slowly in the absence of water, so material reserved for more than a pair of weeks may show evidence of a different flashpoint than anticipated (which may be significantly lower).Microbes and pollutant can decrease feature. Low temperature makes sure freeze as well as lube oil to the biodiesel. So a moderate temperature should maintain in the tank. Selection of tank for storage of biodiesel like underground tank, over ground tank, steel tank, HPDE tank, depends upon to environment, temperature, climatic change of place, microbial and pollutant attack at reservoir place.

REFERANCES

[1].Tang, Y., Xie, J. S., & Geng, S. (2010). Marginal land-based biomass energy production in China. *Journal of Integrative Plant Biology*, *52*(1), 112-121.

[2].Abioye, O. P., Ijah, U. J. J., & Aransiola, S. A. (2017). Phytoremediation of Soil Contaminants by the Biodiesel Plant Jatropha curcas. In *Phytoremediation Potential of Bioenergy Plants* (pp. 97-137). Springer, Singapore.

[3].Mofijur, M., Masjuki, H. H., Kalam, M. A., Atabani, A. E., Shahabuddin, M., Palash, S. M., & Hazrat, M. A. (2013). Effect of biodiesel from various feedstocks on combustion characteristics, engine durability and materials compatibility: A review. *Renewable and Sustainable Energy Reviews*, *28*, 441-455.

[4].Singh, S. P., & Singh, D. (2010). Biodiesel production through the use of different sources and characterization of oils and their esters as the substitute of diesel: a review. *Renewable and sustainable energy reviews*, *14*(1), 200-216.

[5].Siegert, W. (2009, October). Microbial contamination in diesel fuel–are new problems arising from biodiesel blends. In *Proceedings of the 11th international conference on the stability and handling of liquid fuels* (pp. 18-22).

[6].Tickell, J., & Tickell, K. (2003). *From the fryer to the fuel tank: the complete guide to using vegetable oil as an alternative fuel*. Biodiesel America.

[7].Peterson, A. A., Vogel, F., Lachance, R. P., Fröling, M., Antal Jr, M. J., & Tester, J. W. (2008). Thermochemical biofuel production in hydrothermal media: a review of sub-and supercritical water technologies. *Energy & Environmental Science*, *1*(1), 32-65.

[8].Gerpen, J. V. (2004). *Business management for biodiesel producers* (No. NREL/SR--510-36242). EERE Publication and Product Library.

[9].Leung, D. Y., Wu, X., & Leung, M. K. H. (2010). A review on biodiesel production using catalyzed transesterification. *Applied energy*, *87*(4), 1083-1095.

[10].Mofijur, M., Masjuki, H. H., Kalam, M. A., Atabani, A. E., Shahabuddin, M., Palash, S. M., & Hazrat, M. A. (2013). Effect of biodiesel from various feedstocks on combustion characteristics, engine durability and materials compatibility: A review. *Renewable and Sustainable Energy Reviews*, *28*, 441-455.

[11].Garcia-Perez, M., Lewis, T., & Kruger, C. E. (2010). Methods for producing biochar and advanced biofuels in Washington State. *Washington State University, Pullman, WA*, *137*.

[12].Jhala, K., & Mehta, A. K. (2006, August). Biodiesel–an alternative to reduce water & environmental pollution for marine applications. In *all india seminar on environmental impact assessment* (p. 65).

[13].Bluhm, K., Heger, S., Seiler, T. B., Hallare, A. V., Schäffer, A., & Hollert, H. (2012). Toxicological and ecotoxicological potencies of biofuels used for the transport sector—a literature review. *Energy & Environmental Science*, *5*(6), 7381-7392.

[14].Abdel-Shafy, H. I., & Mansour, M. S. (2016). A review on polycyclic aromatic hydrocarbons: source, environmental impact, effect on human health and remediation. *Egyptian Journal of Petroleum*, *25*(1), 107-123.

[15].Khanmohammadi, M., Garmarudi, A. B., & de la Guardia, M. (2012). Characterization of petroleum-based products by infrared spectroscopy and chemometrics. *TrAC Trends in Analytical Chemistry*, *35*, 135-149.

[16].Singh, S., Jain, S., Venkateswaran, P. S., Tiwari, A. K., Nouni, M. R., Pandey, J. K., & Goel, S. (2015). Hydrogen: a sustainable fuel for future of the transport sector. *Renewable and Sustainable Energy Reviews*, *51*, 623-633
.

[17].Howell, S., & Weber, J. A. (1997). Biodiesel use in underground metal and non-metal mines. *Dieselnet site http://www. dieselnet. com*.

[18].Bennett, E. J. (1981). *Cold Cleaning with Halogenated Solvents: A Manual* (Vol. 403). ASTM International.

[19].Hillman, M., Fawcett, T., & Rajan, S. C. (2008). *How we can save the planet: Preventing global climate catastrophe*. St. Martin's Griffin.

[20]. Lebot, V. (2009). *Tropical root and tuber crops: cassava, sweet potato, yams and aroids* (No. 17). Cabi.

21.Runge, C. F., & Senauer, B. (2007). How biofuels could starve the poor. *Foreign affairs*, 41-53.

[22].Davis, A., & Sims, D. (1983). *Weathering of polymers*. Springer Science & Business Media.

[23]. Christensen, E., & McCormick, R. L. (2014). Long-term storage stability of biodiesel and biodiesel blends. *Fuel Processing Technology*, *128*, 339-348.