UTILISATION OF BIODIESEL FUEL FOR ASSESSING ROADWORTHINESS: A STUDY FOCUSED ON HONG KONG.

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ABSTRACT

Automobile is a major source of pollutants and air pollution in densely populated areas like Hong Kong, making the switch to environmentally friendly fuels an urgent matter. With a focus on the function that automobile servicing processes play, this study examines the usage of biodiesel energy as an important consideration in determining an automobile's roadworthiness. The study took a quantitative tack by surveying transportation experts, automobile drivers, and automotive owners with pre-designed questionnaires. The relationship between biodiesel usage, servicing procedures and adherence to Hong Kong's roadworthiness norms was examined through ANOVA. Biodiesel has obvious positive effects on the ecosystem, according to the results, including fewer exhaust release, less particulate matter (PM), and better air quality. Nevertheless, proper vehicle upkeep is crucial to its efficacy. Upholding efficiency and guaranteeing obedience to stringent inspections rules requires frequent repairs, prompt component substitution, and obedience to supplier recommendations. There is a significant relationship between vehicle maintenance practices and roadworthiness in Hong Kong. On the contrary, biodiesel's benefits can be nullified by variable fuel economy and possible roadworthiness breakdowns caused by lack of management. Adopting biodiesel and instituting periodic vehicle upkeep are critical for accomplishing ecological and security objectives, according to the findings of the study. More study into the effects of biodiesel on performance of engines over a longer period is required, as are tax breaks, stricter testing procedures, and increased driver knowledge. Hong Kong can advance towards more environmentally friendly, securer, and more ecological transport by combining biodiesel consumption with efficient management.

Keywords: Biodiesel; Utilisation of Biodiesel fuel; Roadworthiness; Hong Kong; Vehicle maintenance practices.

INTRODUCTION

Biofuel is one possible solution to transportation-related issues. Biofuel, which is produced from biomass, represents a single option for transitioning vehicle oils off gasoline. Since the total CO_2 emissions of biofuels are typically lower than those of petroleum-based fuels, they contribute to a decrease in emissions caused by transportation. To some, biodiesel is an environmentally preferable and safer replacement to petroleum diesel. Research on the

characteristics and harmful effects of biodiesel particulate matter (PM) has been inconsistent and has relied on laboratory-produced PM from the engine combustion of passenger automobiles. Diesel fuel, biodiesel, and heavy-duty diesel (HDD) automobiles operating in real-world environments need to be studied (Jerome & Udayakumar, 2021). The way biodiesel impacts roadworthiness is a matter of much debate. While this could reduce petrol and particulate matter generation, it could also increase fuel consumption, lead to filtration blockage due to wedge growth, and so on. It is not enough to rely solely on studies conducted in laboratories when evaluating the biodiesel roadworthiness of an automotive product. Real-life operational utilisation monitoring is required to analyse the fuel productivity, dependability, and contaminants under genuine driving circumstances. To get ready for the upcoming rollout of new emissions standards, the automotive industry is working tirelessly to develop more stringent electrical controls and pollution-reducing pollutants (Karimu & Dramani, 2021). The impending implementation of the restrictions is the driving force behind this situation. To reduce the number of harmful substances discharged into the air by cars, the government of the "Hong Kong Special Administrative Region (HKSAR)" has launched a variety of programs. Under the laws that were put into effect were monetary benefits for the installation of exhaust after-treatment systems, stronger air quality standards for cars, and tax benefits for the use of sustainable power suppliers. Many people are in favour of these rules, and early efforts that have used green methods have been successful thus far. Still, most of these vehicles have failed to improve the way they perform or reduce their fuel usage. Pretty much every single time, they do whatever it takes to make Hong Kong's air cleaner or to make petrol cheaper.

BACKGROUND OF THE STUDY

Automobile accounts for a disproportionately large share of both energy consumption and carbon dioxide (CO_2) emissions. The automotive industry was responsible for more than half of the worldwide petroleum consumption in 2017, reported to the International Energy Agency (IEA). Approximately 23% of the total CO_2 emissions in 2013 came from transporting goods. The Chinese automobile industry is a prime illustration of a rising economy due to its meteoric rise over the last several generations. Throughout 2000 and 2014, purchasing around 2.1 million to 23.5 million units of personal cars in China was an annual growth rate around 19%. The number of vehicles in China's stockpile reached 154 million at the completion of year 2014 (Li et al., 2023). Because of this, CO2 emissions, blackouts of electricity, and air pollution in China's urban centres have collectively worsened. Take China's biggest towns as an example; in the last several years, haze has grown increasingly widespread, and one reason for this is the pollution from vehicles. Vehicles accounted for roughly 5% of China's total release of greenhouse gases in 2014, compared with the commercial carriage industry contributing nearly 8%. China and other countries are implementing strong preventative measures to address these issues. In Hong Kong, researchers looked at how biodiesel affected the roadworthiness of cars. Biodiesel significantly reduces smoke emissions and vehicle vibrations, according to the data; nonetheless, it may have varying effects on petrol consumption and vehicle efficiency. In Hong Kong, the "Environmental Protection Department (EPD)" is responsible for reporting this data.

Numerous concerns about the effectiveness and long-term dependability of parts for engines using higher amounts of biodiesel were raised in the research investigation. Regardless, B5 (containing 5% biodiesel) is now the blend recommended by the nation's authority for applications in outdoor as well as indoor automobiles. This is mostly since reused culinary oils is a basic resource utilised in this region (Yan et al., 2021). The piano, as a popular and all-ages musical instrument, is particularly important in the future development of art teaching in colleges and universities. The introduction of multimedia technology into piano teaching in colleges and universities is important means to meet the needs of art teaching in the current era. The piano, as a popular and all-ages musical instrument, is particularly important in the future development of art teaching in colleges and universities. The introduction of multimedia technology into piano teaching in colleges and universities is important means to meet the needs of art teaching in the current era.

PURPOSE OF THE RESEARCH

The purpose of this research is to examine, within the context of Hong Kong, the potential for conducting roadworthiness studies utilising biodiesel fuel. Considering growing international worries about environmental degradation, urban pollution, and dependence on petroleum-derived energy sources, biodiesel has emerged as a potentially environmentally friendly alternative that could reduce contaminants and promote cleaner forms of conveyance. Few studies have examined its practical effects on vehicle efficiency, maintenance, and compliance with roadworthiness standards in densely populated areas like Hong Kong. A significant indicator of a car's roadworthiness is its dependability over time, and this study intends to learn how using biodiesel affects motor ignition, pollutant control, and longevity. The final goal of this investigation is to give lawmakers, transport authorities, and automotive owners solid recommendations about the ecological footprint, environmental impact, and practicality of biodiesel as a gasoline substitute. Despite sacrificing roadworthiness, this will assist Hong Kong accomplish its electrical capacity and sustainability aspirations.

LITERATURE REVIEW

Compared to traditional fuels derived from fossil fuels, biodiesel has shown to be eco-friendlier and more sustainable. It is a biofuel that regenerates itself using renewable, organically decomposing ingredients. An earlier study has provided a life cycle evaluation of the emissions of greenhouse gases of modern automobiles powered by a mix of electric and renewable energy sources. The findings are examined through the lens of the fleet-wide production possibility of fuels produced from renewable sources. Research suggests that hybrids with plugs, rather than battery-powered vehicles, would help the car industry achieve its loftiest environmental objectives (Andersson & Börjesson, 2021). Additionally, the comparison between output evaluated using present measures of policy and those resulting from the life cycle of outputs of greenhouse gases is evaluated. The disparities highlight the inadequacy of existing climate policy tools in reducing the carbon footprint of the automobile industry, and they propose

solutions. Property usage, resource pricing, and international commerce have all been altered by the increasing quantity of biofuels and biofuel laws in many nations throughout the past decade or so, as demonstrated in a separate article. Prospective need for petrol, diesel and biofuel is expected to be reduced due to increased fuel effectiveness and automation of the automobile inventory. A global drop of 0.3 per cent in agricultural land and a decline of 1.9 per cent to 6.6 per cent in commodities costs are the outcomes. The general reduction in farmland has led to a decrease in the worldwide emission of greenhouse gases (Dumortier et al., 2021). Since vehicles often remain in service for ten years or longer, the fleet's average expenditure on petrol and diesel does not fluctuate quickly but rather over a lengthy period. Numerous emerging and industrialised nations are seeking environmentally friendly and cleaner options due to the fragile global stability and the volatile costs of fossil fuels, as shown in previous study (Tao et al., 2023). In addition, the paper examines the relevant regulations, drawing attention to the difficulties linked to the unpredictability of renewable resources, materials of origin, and manufacturing control supplies. Lastly, the potential outcomes for fluid biofuels in future generations were discussed. Presenting predictions for potential advances, this thorough analysis covers the manufacturing and utilisation of vaporised biofuels from many viewpoints and seeks to present an organised overview of these fuels.

RESEARCH QUESTIONS

How do of vehicle maintenance practices influence roadworthiness in Hong Kong?

RESEARCH METHODOLOGY

Research Design: Utilising a quantitative research approach, this study investigated the effects of biodiesel petrol usage on the roadworthiness of automobiles in Hong Kong. To find the consistency and magnitude of quantitative relationships, data was analysed using SPSS edition 25, which includes odds ratios and 95% confidence intervals. Results were regarded as statistically noteworthy if the p-value was 0.05 or below. Findings from structured questionnaire procedures were verified and confirmed by descriptive investigations, and the key elements of the data gathering were described using descriptive statistics.

Sampling: To ensure that the diverse transit system in Hong Kong was adequately reflected, the stratified sampling technique was employed. They used the Rao-soft software to determine that 472 was the minimum acceptable sample size. To make up for people's incapacity to reply, investigators distributed 600 surveys evenly across the strata. Roughly 560 responses were returned by the respondents. Following removing 25 contributions containing contradictory or erroneous information, the research project's aggregate sample size was 535.

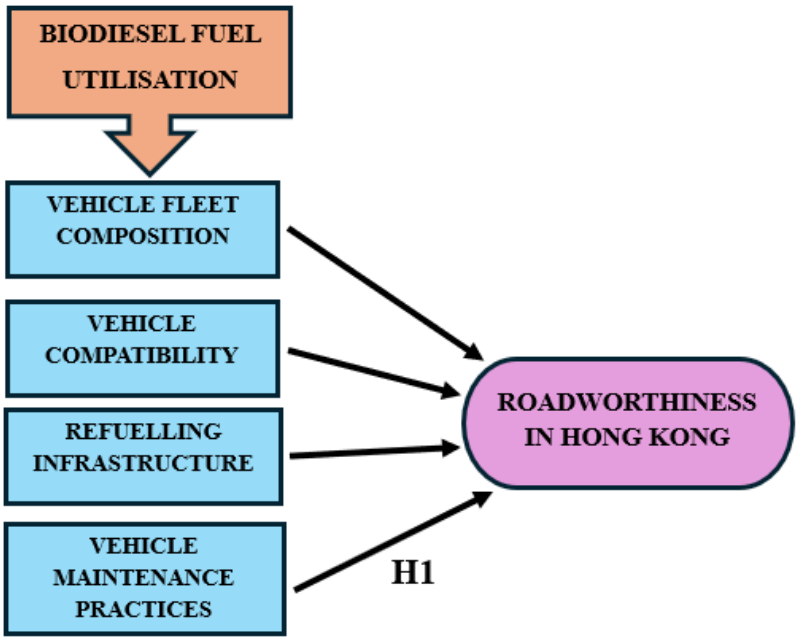
Data and Measurement: The primary method of data collection was the distribution of a structured questionnaires to transit specialists, travellers, and car owners. There were two sections to the instrument. In the first section, researchers included a few important demographic information and car specifications. The second section used a 5-point Likert

scale, with choices ranging from "absolutely disagree" to "absolutely agree," to gauge individual views on biodiesel in relation to its availability, dependability, cost, impact on vehicle performance, and compliance with roadworthiness standards. Investigations on biodiesel usage in Hong Kong conducted by academics, as well as articles from the public transit administration and authorised government records, were used as secondary data sources that supported the findings.

Statistical Software: While Microsoft Excel was utilised for preliminary dataset preparation, SPSS edition 25 was utilised for statistical computations, assessment, and interpretations.

Statistical Tools: Researchers used descriptive statistics to show changes in population and automobile attributes, and factor analysis (FA) to validate the survey's reliability and correctness. To explore for variations in vehicle types, usage rates, and ownership types, investigators employed analysis of variance (ANOVA). Furthermore, statistical analysis and correlation studies were carried out to examine significant developments and connections concerning biodiesel fuel usage and its contribution to maintaining Hong Kong's roadworthiness standards.

CONCEPTUAL FRAMEWORK



RESULT

Factor Analysis (FA): Factor Analysis (FA) seeks to unearth hidden characteristics in readily available datasets. It is common practice to use coefficients of regression in evaluations when there are no clear visible or biological signs. Finding obvious weaknesses, infractions and possible links is the purpose of simulations. The Kaiser-Meyer-Olkin (KMO) analysis is used to assess the data collected from multiple regression trials. Correct estimations have been derived from the mathematical framework and its sample components. There might be replicas,

according to the data. The information is presented more clearly when proportions are reduced. From KMO, the investigator gets a number between 0 and 1. A sufficiently large sample is indicated by a KMO value between 0.8 and 1. Kaiser claims the following values to be the correct intervals of measurement: Kaiser has developed the following credentialing guidelines:

An appalling 0.050 to 0.059; well below the usual range of 0.60 to 0.69; The typical range for middle grades is between 0.70 and 0.79. A quality point score between 0.80 and 0.89. The interval from 0.90 to 1.00 astounds them. According to the Kaiser-Meyer-Olkin scale: 0.836**.** The results of Bartlett's test of Sphericity are as follows: 4533.638; 190 is degrees of freedom (df); sig =.000 is the approximate chi-square value.

Table 1. Examination of KMO and Bartlett's Sampling Adequacy.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.836
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4533.638
	df	190
	Sig.	0.000

In most cases, this facilitates the application of the criteria for choosing. Investigators used Bartlett's Assessment of Sphericity to find out if the correlation matrices were statistically significant. A set of data is considered adequately comprehensive if its Kaiser-Meyer-Olkin score is 0.836. Researchers can see that the p-value is 0.00 from Bartlett's Sphericity test. The correlation array does not possess distinctive characteristics as evidenced by its favourable outcome of Bartlett's Sphericity test.

INDEPENDENT VARIABLE

Biodiesel fuel utilisation: In the transportation and manufacturing industries, biodiesel fuel utilisation has become an attractive substitute to traditional petroleum-derived energies. Biodiesel has many positive effects on both the natural environment and the economy because it is made from sustainable resources, including animal-derived fats, leftover culinary oils, and plant-based oils. By utilising it, the reliance on petroleum and coal is diminished, and the outputs of atmospheric greenhouse gases and airborne pollutants such as PM, petroleum-based products, and carbon monoxide are reduced. Biodiesel promotes regional manufacturing, is environmentally friendly and helps with securing electricity. It is also renewable. Biodiesel has multiple functions in everyday life, including as standalone fuel (B100) or in mixtures with petroleum-based diesel (B5, B10, or B20) in different quantities (Rashid et al., 2025). It is an easy transitional fuel because it can be used with typical diesel-powered engines with little to no alteration. The superior lubrication characteristics of biodiesel

compared to regular diesel also contribute to its ability to prolong machine longevity. But there are also crucial factors to think about, including increased manufacturing expenditures, problems with cold flow in cold weather, and competitiveness with supplies of food for intake (Nagaraja et al., 2020). In general, biodiesel fuel utilisation is a greener, more ecological power option that contributes to global sustainability. Reduced ecological effects, improved power endurance, and the promotion of a sustainable economy via the effective utilisation of discarded materials can all be achieved by the extensive utilisation of discarded materials.

FACTOR

Vehicle maintenance practices: To ensure highway security, effectiveness, and sustainable development, vehicle maintenance practices are crucial. The longevity of cars, the frequency of engine failures, and the expense of replacements can all be enhanced with periodic upkeep. Fuel and sensor replacements, hydraulic maintenance, tyre replacement, misalignment testing and fluid level management (including gearbox, brake system and radiator) are prevalent operations (Gallega, 2025). Important components including the engine, gearbox, and brakes must function consistently, which is why these precautions are taken. Automobiles must undergo periodic checks to guarantee they are roadworthy in numerous places, particularly heavily populated ones. Reduced hazardous emissions, enhanced efficiency, and reduced consumption of fuel are all benefits of regular maintenance that help keep our air clean. For the sake of convenience and legality, commercial vehicles frequently implement methodical maintenance procedures that make use of logbooks or electronic surveillance systems. Ignoring the supplier's suggested maintenance schedules can cause deterioration along with safety issues, thus operators and proprietors should observe them (Guzalov et al., 2023). Along with structural maintenance, the importance of activities like disinfecting, cell care, and inspecting technological components is growing with the emergence of contemporary, technologically advanced automobiles. Automotive upkeep procedures offer multiple benefits, including reducing running costs, protecting the natural world, and ensuring the safeguarding of drivers and riders.

DEPENDENT VARIABLE

Roadworthiness in Hong Kong: In Hong Kong, the term "roadworthiness" describes a vehicle's ability to travel on public roadways while remaining secure, dependable, and in compliance with all applicable laws. By conducting regular checks, enforcing registration regulations, and evaluating exhaust, the Transportation Division ensures that vehicles are roadworthy according to rules. Every year, drivers must take their cars in for roadworthiness inspections to make assured the lights, controls, handling, tires, and suspensions are all in good working order. There will be fewer incidents due to technological breakdowns thanks to this approach, which assists in keeping security levels acceptable. As component of its regulations for vehicles to be roadworthy, Hong Kong also has stringent pollution limits (Rao et al., 2024). By enforcing ecological requirements on automobiles, these initiatives seek to tackle the region's air purity

concerns. These examinations have a higher probability to find problems with vintage and badly managed automobiles, so it is important for proprietors to take upkeep seriously or get up-to-date versions. Alternative energy sources, like biodiesel and electrical power, are also encouraged by the administration of Hong Kong to improve roadworthiness and environmental sustainability. Improving highway security, decreasing traffic from accidents, and promoting ecological sustainability are all made more important by Hong Kong's crowded neighbourhoods and high traffic volumes, which is why stringent roadworthiness requirements must be maintained (Zhang et al., 2022). The metropolis's transportation network benefits greatly from roadworthiness in terms of effectiveness and reliability.

Relationship between vehicle maintenance practices and roadworthiness in Hong Kong: The crowded roadways, restricted roadways, and rigorous transportation restrictions in Hong Kong make the relationship between vehicle maintenance practices and roadworthiness particularly crucial. A car is considered roadworthy if it can properly carry out its functions without endangering anyone on highways or its surroundings. By keeping cars up to the requirements specified by the Transportation Division, successful upkeep techniques have immediate effects on that state. Important components including braking, driving, illumination, and emissions management can be kept in good working order with frequent maintenance, prompt replacements, and following manufacturing specifications (Mikulić et al., 2020). Industrial fleets, cabs and transportation automobiles, in specific, are required to undertake regular roadworthiness tests in Hong Kong. By keeping up with scheduled upkeep, people can avoid fines, licence revocations and costly breakdowns caused by failing to comply with these assessments. Especially important in Hong Kong's heavily populated and heavily utilised road system, it lessens the likelihood of accidents brought on by technological breakdowns. Additionally, cars that are well-kept help lower citywide pollutants levels, which is becoming an increasingly serious issue (Solah et al., 2021). The conservation of the environment is influenced directly by repair procedures such as checking the exhaust technology and evaluating fuel economy. Public welfare, compliance with rules, and conservation of the environment all depend on regular automobile upkeep, which is why it's everyone's duty to do so in Hong Kong. Considering what has been discussed so far, the researchers in this study set out to test the following hypothesis regarding the relationship between Vehicle maintenance practices and Roadworthiness in Hong Kong:

"H_{01}: There is no significant relationship between vehicle maintenance practices and roadworthiness in Hong Kong."

"H_1: There is a significant relationship between vehicle maintenance practices and roadworthiness in Hong Kong."

Table 2. H1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	76,387.100	210	3656.891	992.395	0.000
Within Groups	430.895	324	7.286		
Total	76,817.995	534			

The findings of this inquiry are substantial. With an F-value of 992.395 and a p-value of 0.000, it can be concluded that the significance level is under the 0.05 alpha threshold, suggesting analytical importance. The results determines that the "*H_1: There is a significant relationship between vehicle maintenance practices and roadworthiness in Hong Kong"* has been accepted, and the null hypothesis has been rejected.

DISCUSSION

Considering the framework of Hong Kong's heavily inhabited and strictly controlled public transit system, the results of this study emphasise the substantial impact of vehicle maintenance practices on roadworthiness. The findings point to the fact that less ecological influence, regulatory adherence, and automotive security have a direct association with regular and organised scheduled maintenance. Technological dependability and safety for society are both improved by servicing, which guarantees the correct operation of vital components like lights, steering, accelerators, and emission regulation. To maintain the advantages of biodiesel usage, the research also highlights the significance of preservation. The effectiveness of biodiesel in reducing exhaust and damaging emissions is highly dependent on the level of vehicle upkeep, even though it offers significant ecological benefits. Worst case scenario: adherence fails in roadworthiness checks and fuel use unpredictability gets worse due to lack of servicing. In contrast, biodiesel automobiles may maximise performance and comply with Hong Kong's stringent security and ecological requirements with routine inspections, prompt substitution of damaged parts, and use of the manufacturer's suggestions. The larger implication for policy is a further important finding. It is now more important than ever for the procedures for maintenance to be backed by tax breaks, examinations, and business training to help Hong Kong minimise its carbon footprints. The research proves that responsible driving and the use of alternate resources are two sides of the same coin when it comes to making roads more environmentally friendly. In sum, the results confirm that regular car repairs are essential for safe driving in Hong Kong. They can help achieve both ecological and transit protection objectives when combined with biodiesel usage.

CONCLUSION

In Hong Kong, especially in the setting of biodiesel fuel usage, this study finds that automobile servicing procedures are crucial for assessing roadworthiness. Although with the use of renewable fuels like biodiesel, automobiles may be kept reliable, ecologically acceptable, and productive with regular upkeep. While using biodiesel has several advantages, such as improved comfort and less pollutants, the results show that automobiles, air filters and combustion engines need regular maintenance to stay working properly. These advantages can be diminished if servicing is neglected, resulting in difficulties with performance and failing required examinations. Various suggestions for the future arise. The initial objective for lawmakers is to ensure that all corporate and personal automobiles follow the most effective procedures for upkeep by instituting more stringent requirements for inspection and providing rewards for adherence. Second, to properly handle biodiesel-fuelled engines, vehicle drivers and technicians ought to be educated through educational programs and public education initiatives. Third, to improve connectivity and guarantee an accessible source of knowledge, governmental organisations, fuel producers, and repair providers should work together more closely. Lastly, more study into the effects of biodiesel on engine efficiency over the long term is needed so that specific maintenance recommendations may be made. Biodiesel usage and rigorous maintenance procedures can help Hong Kong achieve its ecological objectives without sacrificing vehicle security or dependability.

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