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Review Article

Taguchi Approach to Evaluate Performance Parameters tor Diesel & Petrol Engine

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Abstract

In this review paper the taguchi methods implement to evaluate performances parameters for compression and spark ignition engines are presented .

Keywords: *Taguchi, compression ignition and spark engine etc.*

Introduction

Gopinath.S**,** Nadanakumar.V , Kannan.M presented in their technical paper injection parameters plays major role in engine performance and combustion characteristics. Injection parameters include injection pressure and Number of holes was optimized with L9 orthogonal array with suitable biodiesel blends.

In the present work, the injection pressure and number of holes are varied at three levels with the fuels diesel, waste cooking oil and rape seed oil. Optimization technique was made by Taguchi method and suitable orthogonal array L9 was selected for a design of experiments. Injection pressure and Number of holes includes 190,200,210bar and 1, 3,4holes respectively. Hence, the experiments were conducted to analyse the performance characteristics to improve brake *thermal efficiency.*

Karthikeyan.R Nallusamy.N Alagumoorthi.N Ilangovan.V presented in their technical paper used Turpentine; a volatile fraction of pinus resin as an alternate fuel for diesel fuel. Generally, turpentine possesses moderate cetane number which is not sufficient to operate existing diesel engine. However, this could be admissible along with diesel fuel in the form of blends. Keeping this in mind experiments have been conducted using blends of turpentine and diesel fuel to study its replaceability, performance and emission behaviour. As the investigation involves three parameters such as blend proportion, injection timing and injection pressure, a simultaneous optimisation method called Taguchi was used in the work. This method requires fewer numbers of trials for fixing optimum levels. This is the primary advantage of this method. As per this method nine trials were experimented and its results were used for optimisation.

In addition, an ANOVA was also performed for the parameters to evaluate its percentage contribution over the desired output. The results of the taguchi experiment showed that the 40T blend (40% turpentine and 60% diesel) performed better at 29°BTDC injection timing and at 180 bar injection pressure than other blends and had a capacity to cold start the engine. Using the optimum levels, a full range experiment was also conducted using 40T blend to compare its performance and emission behaviour with standard diesel operation. The results of the full range experiment showed that the 40T blend offered approximately 2.5% higher brake thermal efficiency than diesel baseline operation without much worsening the exhaust emission.

Senlin Xiao,Wanchen Sun, Jiakun Du, and Guoliang Li presented in their technical paper research results have shown that EGR (exhaust gas recirculation) rate, pilot fuel quantity, and main injection timing closely associated with engine emissions and fuel consumption. In order to understand the combined effect of EGR rate, pilot fuel quantity, and main injection timing on the NOx (oxides of nitrogen), soot, and ISFC (indicated specific fuel consumption), in this study, CFD (computational fluid dynamics) simulation together with the Taguchi method and the ANOVA (analysis of variance) technique was applied as an effective research tool. At first, simulation model on combustion and emissions of a light duty diesel engine at original baseline condition was developed and the model was validated by test. At last, a

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confirmation experiment with the best combination of factors and levels was implemented. The study results indicated that EGR is the most influencing factor on NOx. In case of soot emission and ISFC, the greatest influence parameter is main injection timing. For all objectives, pilot fuel quantity is an insignificant factor.

Furthermore, the engine with optimized combination reduces by at least 70% for NOx, 20% in soot formation, and 1% for ISFC, in contrast to original baseline engine. Adnan Parlak Hülya Karabaş İbrahim Özsert, Vezir Ayhan and İdris Cesur presented in their technical paper different kinds of vegetable oils and their methyl/ethyl esters have been tested in diesel engines. However, studies reporting the effects of tobacco seed oil and Tobacco Seed Oil Methyl Ester (TSOME) on emissions of diesel engines are limited. One of the most important issues is to investigate parameters that affect the yield of biodiesel and their interactions on emissions of a diesel engine. The Taguchi method is a useful tool for this purpose. Two different catalysts (KOH and NaOH), four different blends (B10, B20, B50 and B100) and four engine speeds were used during full-load tests. Optimal catalyst type, engine speed and TSOME blends on exhaust emissions were determined using Taguchi's technique.The Taguchi design method revealed that choosing right catalyst and the blend rate are important two factors in view of minimisation of pollutant emissions.

Rahul D.Gorle, Diwesh B.Meshram, Pratik L.Naik, Vivek S.Narnaware presented in their technical paper experiments are carried out by biodiesel blends and compared it's with diesel fuel characteristics. In this study, the optimization of experimental parameters, such as catalyst type, catalyst concentration, molar ratio of alcohol to oil and reaction temperature, on the transesterification for the production of Jatropha methyl ester was performed. Alkali catalyzed method has been used for biodiesel production process by using catalysts such as KOH, NaOH, NaOCH3. The Taguchi method helped to understand the effect of control parameter and to optimize the experimental conditions from a limited number of experiments and contribution of each noise factor calculated by ANOVA. Finally the yield of Jatropha methyl ester could be improved using control parameter which was obtained by Taguchi method. This paper investigated the performance and emission characteristics of various blends of Jatropha biodiesel with diesel on a Single cylinder four stroke diesel engine. The acquired data were analyzed for various parameters such as brake thermal efficiency (BTE), brake mean effective pressure (BMEP), brake specific fuel consumption (BSFC), exhaust gas temperature (EGT).The blends of BJ-10 and BJ-20have superior emission characteristics than other blends and closer to diesel value.

Maulik A Modi, Tushar M Patel , Gaurav P Rathod presented in their technical paper an experimental study has been carried out for palm seed oil blended with diesel used in a single cylinder diesel engine. Palm seed oil is obtained from the seeds of palm tree. In this study, the effects of parameters` i.e. load, compression ratio and injection pressure are taken as variable for optimization. As the experiment required simultaneously optimization of three parameters with three levels, Taguchi method of optimization is used in this experiment. The results of the Taguchi experiment identify that 16 compression ratio, injection pressure 180 bar and engine load 10kg are optimum parameter setting for highest brake thermal efficiency. Engine performance is mostly influenced by engine load and is least influenced by compression ratio. Confirmation experiment was done using an optimum combination showed that the brake thermal efficiency was found by experiment is closer to the predicted value.

K. Sivaramakrishnan and P. Ravikumar presented in their technical paper to optimize the direct injection (DI) single cylinder diesel engine with respect to brake power, fuel economy and emissions through experimental investigations and DOE methods. A single cylinder 5.2kW diesel engine was selected for test. Five parameters, Power (P), Static injection pressure (IP), Injection timing (IT),Fuel fraction (B) and Compression ratio (CR) was varied at four levels and the responses brake power, fuel economy andemissions were investigated. The optimum n values of the response could be predicted using Signal - Noise ratio(S/N ratio)and optimum combination of control parameters were specified. Results of confirmation tests showed good agreement withpredicted quantities. Thus the relationship between the diesel engine parameter, brake power, b.s.f.c and Emissions couldbe understood using design of experiments. The best results for brake specific fuel consumption (BSFC), brake thermal efficiency (BTHE) were observed at increased CR, IP, and IT. The emissions CO, HC were reduced while NOx emissionsincrease. The results of the study revealed that the combination of a blend of 30% karanja biodiesel (B30), a compression ratio of 17.9, a nozzle opening pressure of 230 bar, injection timing of 27° bTDC and at 70% load produces maximum multiple performance of diesel engine with minimum emissions from the engine.

Subramani Saravanan1, Govindan Nagarajan, Santhanam Sampath presented in their technical paper attempt was made to minimize the NOx emission of a crude rice bran oil methyl ester (CRBME) blend with less sacrifice on smoke density and brake thermal efficiency. Three factors namely fuel injection timing, percent-age EGR and fuel injection pressure were chosen as the influencing factors for the set objective. Experiments were de-signed by employing design of experiments method and Taguchi's L9 orthogonal array was used to

test the engine. MRSN ratio was calculated for the response variables and the optimum combination level of factors was obtained si-multaneously using Taguchi's parametric design. ANOVA was employed to analyze the variance of MRSN and the most influencing factor for the set objective was taken from the ANOVA table. Obtained combination was confirmed experimentally and significant improvement was observed in the response variables.

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