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Performance And Emission Characteristics Of Ci-Di Vcr Engine Using Honne Oil Methyl Ester

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Abstract : *The major means of transportation is through CI engine which is run by fossil diesel. In recent years Bio diesel is been extensively researched using various oils for obtaining desired performance and emissions similar to that of diesel. Basically Bio diesel being Biodegradable, environment friendly in nature is best suitable alternative types of source, to meet the future fossil energy crises. The biodiesel derived from Honne oil is considered as one of the promising alternative fuel derived from non-edible sources. The aim of this paper is to evaluate the utilization of this fuel in diesel engine in maximum possible effective way. To find this, an experiment analysis of performance parameter (such as brake power, break specific fuel consumption, brake thermal efficiency and Exhaust Gas temperature) and emission characteristics (NOx, HC, CO. etc.) is obtained for various bio diesel and diesel blends and compared with ordinary diesel at various loads on a modified variable compression ratio CI engine. The results of the investigation shows that the performance and emission characteristics of the engine fuelled with Honne oil methyl ester – diesel blends is comparable to the ordinary diesel.*

Keywords *-Bio diesel, honne oil, Honne oil methyl ester, performance, emissions*

I. INTRODUCTION

The concept using vegetable oil as a fuel was introduced by Dr. Rudolf Diesel who developed the first diesel engine to run on peanut oil. But later due to problems like high viscosity, injection problems and atomization factor the use of vegetable reached to near extinct. Current crises for search for possible alternative to diesel is on due and to the spot light bio diesel come in picture. Biodiesel is a natural and biodegradable fuel defined as mixture of fatty acid alcohol esters derived from usually edible or non-edible oils which is used in diesel engines. This fuel could be considered as mineral diesel substitute that is having a positive point like reduction of greenhouse gases because it is renewable resource1. In India, biodiesel is prepared from oils from non-edible sources like Jatropha etc. [14]. In other parts of world the bio diesel which is prepared from oil which is selected on the basis of weather and soil conditions. This extracted oil could not be useddirectly in diesel because of its various factors; it has to be convertedinto readily usable form. The use of chemically altered vegetable oil which is called biodieseldoes not require any engine modification. Biodiesel can be produced from various oils from a chemical reaction named transesterification. The transesterification basically describes reaction between oil and alcohol (short chain like methanol, ethanol) usually in the presence of base catalysts.Using edible oils like palm oil, sunflower oil, soybean oil in biodiesel production has raised a question for fuel versus food debate. The Calophyllum seed oil (honne) is greenish black in colour. It is used as a hair oiland also has various medicinal advantages to its non-edible nature. In Karnataka, India, it is known as "hoone" whereas undi oil in Maharashtra. Seeds contains 75% of oil. The tree grows along coastal areas and adjacent lowland forests, although it occasionally occurs inland at higher elevations. It is native to east africa, india, southeast asia, australia, and the south pacific. It has been widely planted throughout the tropics and is naturalized in the main Hawaiian Islands [1].Calophyllum oil contains 19.58% free fatty acids[2]

II. OBJECTIVES

1.To produce bio diesel first we must extract oil from the seeds of honne oil. 2. Later the conversion of honne oil to biodiesel from a reaction named transesterification. Transesterification basically involves reacting oil with an alcohol (methanol or ethanol) in presence of a base catalyst (NaOH or KOH). In this present work the Honne oil is treated with a solution of sodium methoxide and then allowed for endothermic reaction for a temperature range of 60-65^{O}C at constant stirring for a reaction time of 2 hours. Later this solution is poured into a separating funnel where the mixture of ester and glycerol separates and Honne oil methyl ester (HnOME) called Biodiesel is removed from the separating funnel. 3. This biodiesel is blended in various proportions like B

20 (20% of Biodiesel and 80% diesel fuel by volume).4. Various thermo-physical properties are determined. The Properties of Diesel, Honne Oil and Honne Oil Methyl ester are mentioned in the below Table No.1. Performance evaluation and emission parameters were found for diesel and blends of Honne oil methyl ester-diesel like B20, B40, B60, B80 and B 100.

III. EXPERIMENTAL SETUP AND PROCEDURE

The Performance and emissions tests were conducted on four stroke single cylinder direct injection water cooled Diesel Engine. Load is varied with Eddy current type dynamometer. The specifications of test rig are mentioned in Table No.2. The engine used was a modified Variable compression ratio engine. The operating compression ratio used is 18.

Figure 1: Calophyllum oil

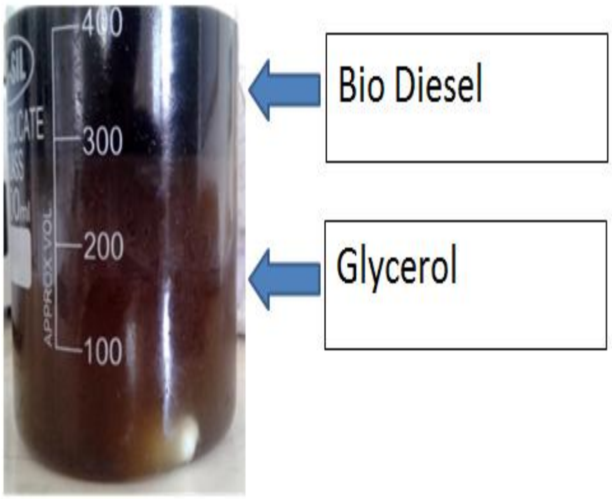


Figure 2: Transerterified mixture

Table 1: Properties of tested biodiesel and its blends with Diesel

Table 1: Properties of tested biodiesel and its blends

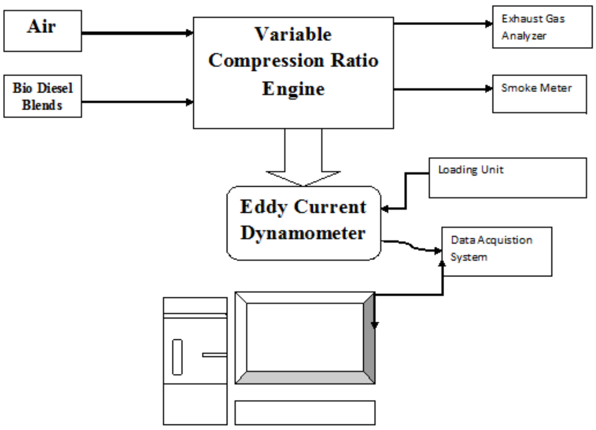
Properties	Diesel	B100 (HnOME)	B80	B60	B40	B20
Density (kg/m^3)	830	889	872	860	852	840
Viscosity at 40^{o}C (cSt)	2.9	5.2	4.6	4.4	4.1	3.6
Cetane Number	51	52.03	51.8	51.4	51.4	51.3
Calorific value (MJ/kg)	42.5	38.55	40.1	41	41.18	41.3
Ash Content (%)	0.10	0.51	-	-	-	-
Flashpoint (^{o}C)	65	170	146	130	108	76
Fire Point (^{o}C)	78	182	176	158	142	101
Cloud point (^{o}C)	-	4	-	-	-	-

Table 2: Specification of engine

Make and Model	Kirloskar Oil Engine TV1
Type	4-stroke single cylinder, water Cooled,
Bore and stroke	80mm and 110mm
Compression ratio	17.5:1; adjustable range from 12-18
Maximum Speed	2000rpm
Exhaust Gas Analyzer Make	Indus Scientific Pvt Ltd

Software	Enginesoft LV‖ Engine performance analysis software
Measureable Gases	CO, CO2, NOx, SOx and HC

The performance parameters and Engine emissions were obtained by varying the load (0kg, 3kg, 6kg, 9kg, and 12 kg) and Blend Percentage of Honne oil methyl ester by volume. The various blends of HnOME and diesel are used like B20, B40, B60, B80 and pure biodiesel are used. Top Dead Centre (bTDC). The gas analyser used was 5-way in nature that can measure NO_x, SO_x, HC, CO and CO_2.



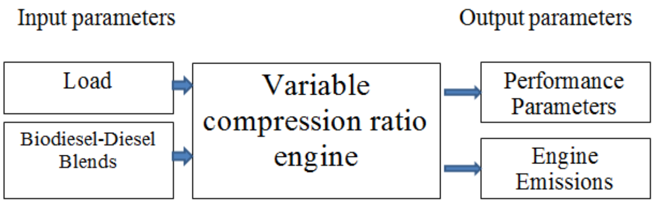


Figure 4: Block diagram of Experimental Procedure

Figure 3: Experimental Setup

IV. RESULTS AND DISCUSSIONS

1. Brake Mean Effective Pressure

The Fig.5 signifies Load applied and Brake mean effective pressure (BMEP). It is observed that as the load increases the brake mean effective pressure also increases. The Pressure found for fossil diesel is quite lower. Also as the percentage of Honne Oil Methyl ester increases, the Brake mean effective pressure also increases. The Brake mean Effective pressure of Honne oil methyl ester is found maximum for all other the blends of Honne oil methyl ester-diesel. The brake mean effective pressure is a factor of turbulence generated caused by effective combustion leading to Higher BMEP. The BMEP of Diesel has increased by 53% on average with diesel fuel.

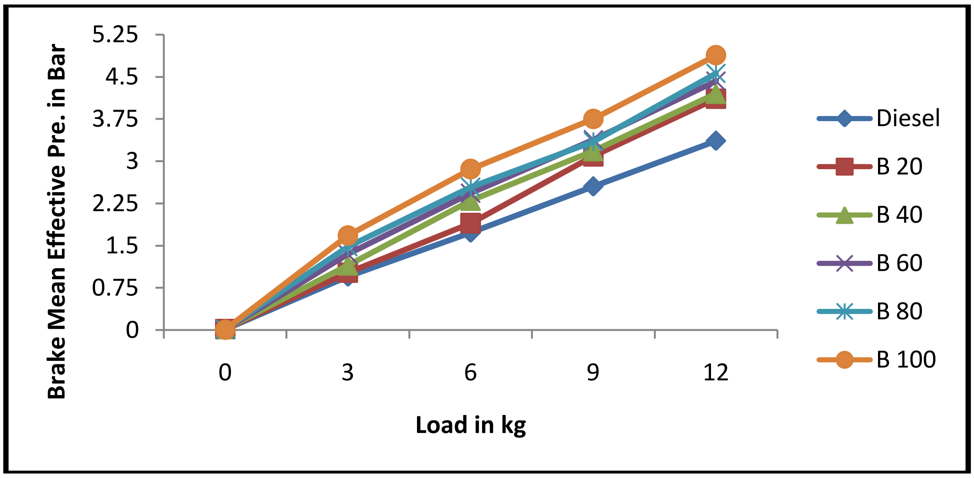


Figure 5 : Effect of Load on BMEP

2. Brake Specific Fuel Consumption

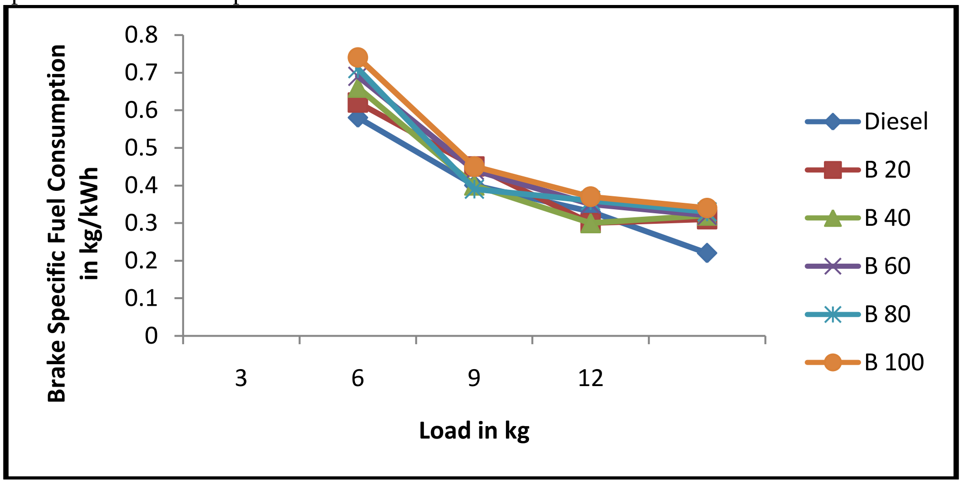


Figure 6 : Effect of Load on BSFC

The Fig.6 is useful to get an idea of amount of fuel consumed for getting 1kW of brake power. The graph describes the fact that Mineral diesel is found to give a specific energy output with less quantity of fuel. Also the Honne Oil Methyl ester-Diesel Blends tend to be on the higher side as the calorific value or heating value are lesser when compared to fossil diesel. It is also found that as the load increases the Brake specific fuel consumption (BSFC) decreases for the fuels and blends used in the engine. The BSFC of B20 blends tends to match up with diesel and for B100 the bsfc is found to be maximum. At no load condition the bsfc is found to be as the Brake Power is also Zero. The brake specific fuel consumption of B 100 is increased 24% to that of diesel fuel.

3. Brake Thermal Efficiency

Brake thermal efficiency (bthe) is the amount of available power to heat input. In the Fig.7 the brake thermal efficiency of diesel is higher than all other blends of Hoone oil methyl ester- diesel. The brake thermal efficiency of all fuels used in the engine are found to increase as the load increases. The heat input provided is given by mass of fuel consumed and calorific value of fuel. The bthe of B20 is almost sme at lower laods but as the load increases, the average reduction is 3% when compared with diesel. In the case of B 100 the bthe reduces on a average load of 11%. The brake thermal efficiency of B 100 is lowest and fossil diesel is highest.

4. Exhaust Gas Temperature

The exhaust gas temperature is the remaining heat carried by the exhaust which is left out to the atmosphere.Fig.8 shows that as the load applied on the shaft the exhaust gas temperature also increases. It is found the Heat released is proportional to amount of exhaust gas temperature and heat release is a function of complete combustion. The amount of heat carried away by exhaust gas is almost same and when B20 is compared, an increase of 2% was found during the trial and for B100 the exhaust gas temperature was found to increase on a average of 5%.

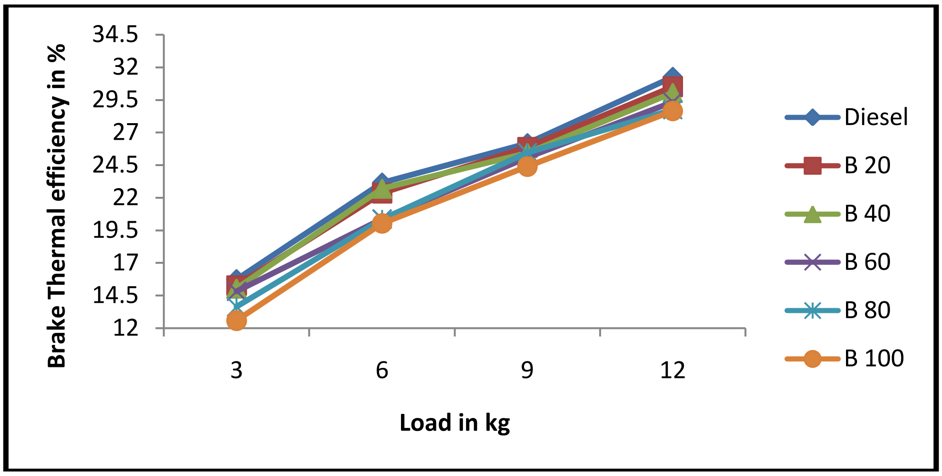


Figure 7 : Effect of Load on Brake thermal efficiecy

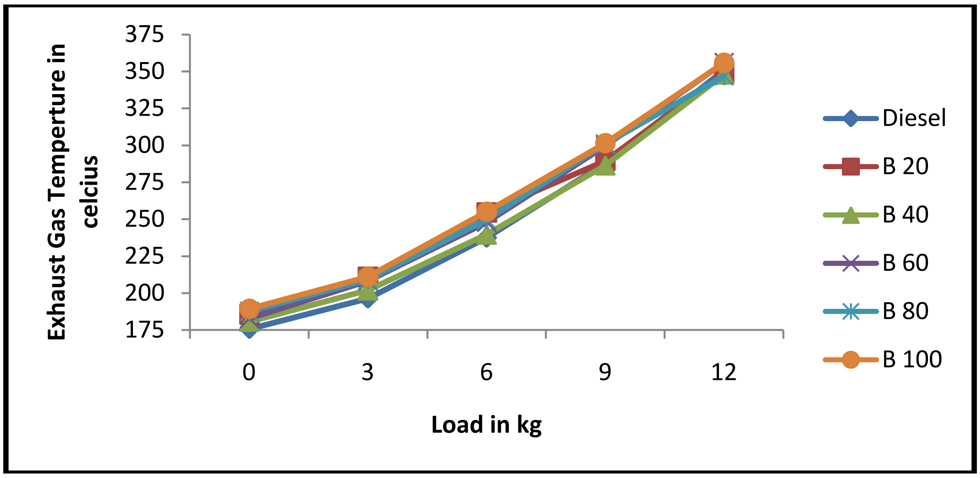


Figure 8 : Effect of Load on Exhaust gas temperature

5. Carbon dioxide emission

The amount of carbon dioxide released is a factor of cleaner combustion [3]. The Fig.9 signnifies that as the percentage of honne oil methyl ester in bio diesel. As the load increases the fuel consumption increases for constant speed, the carbon dioxide emmision also increases in a approximate linear manner. The carbon dioxide emission is higher B100 and the lowest is found for diesel fuel. The increase in carbondioxide emissions for B 100 and B 20 is 14% and 3% respectively with respect to mineral diesel. More the emission of carbon dioxide and lesser the carbon monoxide emission gives a idea that better and greener is the combustion (cleaner).

6. Carbon Monoxide Emission

The carbon monoxide (CO) emissions signify that the combustion taking place inside the cylinder is not complete and the basic two reasons are either the oxygen is lesser than theoretical or time available for combustion is lesser. The fig.10shows the fact that biodiesel blends have much lesser CO emissions than the blends of Honne oil methyl ester-diesel. The B100 blends yields a reduction of 54% lesser than diesel and B20 gives carbon monoxide emission reduction of 10% on average of all loads. It is also found for that as the load increase for a constant speed the fuel consumption also increases and also the CO emission increases.

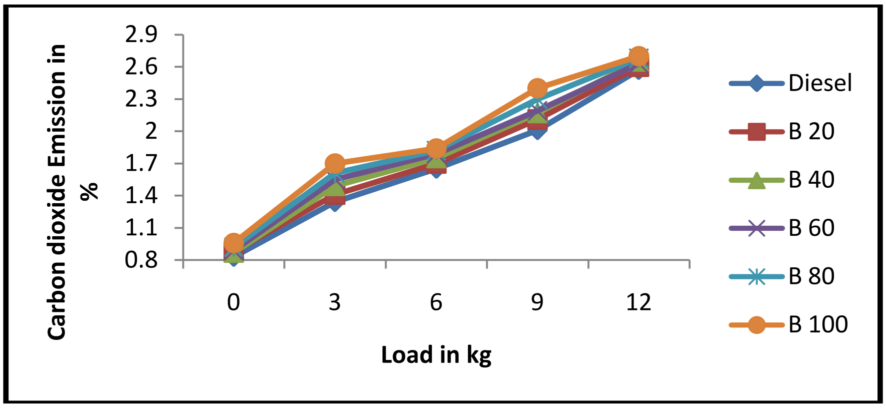


Figure 9 : Effect of Load on Carbon dioxide emission

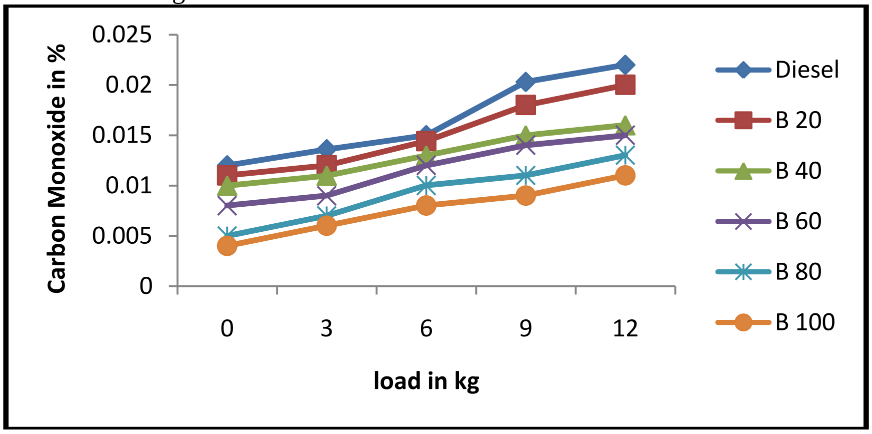


Figure 10 : Effect of Load on Carbon monoxide emission

7. Hydrocarbon Emission

The hydrocarbon emission (HC) is resultant of incomplete combustion and other factors [6]. Graph shows a act that as the load increases the HC emission also increases. The hydrocarbon emission of diesel is found highest. As the percentage of methyl ester increases the hydrocarbon emission decreases. B 20 exhibits a reduction of HC emission by 14% and B 100 shows highest reduction of HC by 51%. At no load condition the HC emission tops up and as the Load is applied it drops down and gradually increases as load increases.

8. Nitrous Oxide emission

The nitrous oxides (NOx) emission is a function of combustion temperature and the combustion chamber [18]. The relationship of load and nitrous Oxides emission is linearly increasing in manner as shown in Fig.12. The Nitrous oxides emission of B 100 is found is highest and lowest is diesel. NOx emission of B100 increased by 36%. B 20 by 13% when compared with mineral diesel.

V. CONCLUSION

The experimental analysis has proved that Hoone Oil methyl ester has peaked up the human hazardous factor of Lower emissions mainly HC, CO. But the NOx emissions were quiet high when compared with fossil diesel. For a slight compensation of BSFC the brake thermal efficiency was found to be better than diesel. Also the Brake mean effective pressure recorded for Honne Biodiesel more than Diesel by 53%.

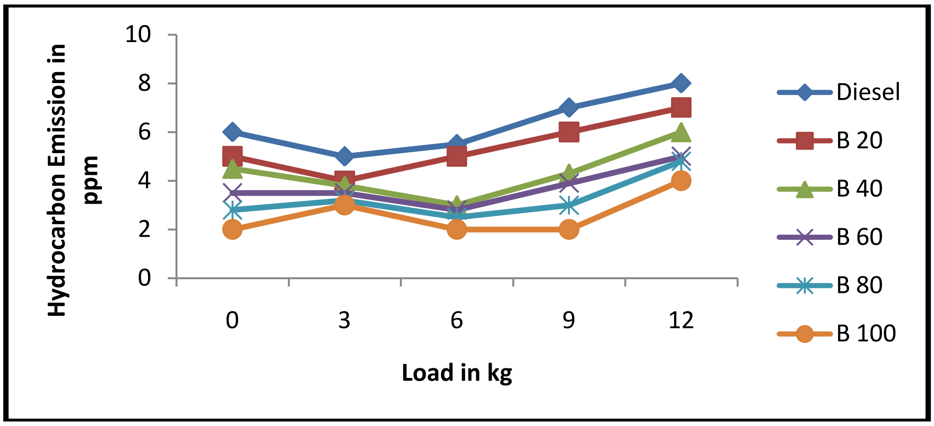


Figure 11 : Effect of Load on Hydrocarbon Emission

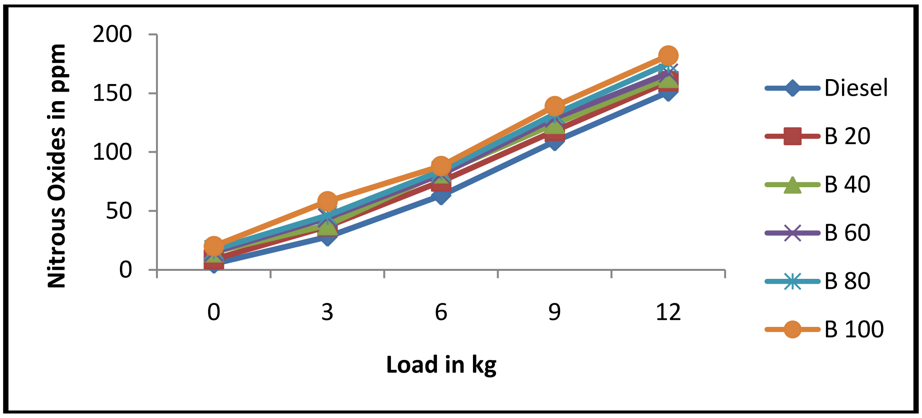


Figure 12 : Effect of Load on Nitrogen Oxide Emission

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