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POWER QUALITY ANALYSIS IN HYBRID BIOMASS GASIFIER POWER SYSTEM USING NON EDIBLE JATROPHA SEED CAKES

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Abstract:

Power quality is a noteworthy issue in half breeding power framework. The associations of two or more than two vitality framework associated with the matrix are known as crossover power. Amid the mix many issues emerges, such as Synchronization, Power quality and so forth., If there is any deviation from the sinusoidal waves then it could be named as power quality. This examination work concentrates on the power quality investigation of Gasifier – Solar PV framework by utilizing Non Edible Jatropha seed cake fuel as Biomass Gasifier and the yield and with manufactured Portable 2kW Biomass Gasifier. From this examination the Solar PV System goes about as a perfect source and the power quality is repaid by utilizing variable capacitors with the help of MATLAB.

Key Words: CHNS Analysis, Gasifier, Solar PV Framework, Conversion Efficiency, Power Quality, Resistive Burden, Inductive Burden, Jatropha Seed Cakes & Non Palatable Seed Cakes

Presentation:

The power gadgets assume a noteworthy part to relieve the power quality. Yet, the enhancement of power electronic gadgets makes the power quality issues in a power framework. Inappropriate keeping up of power quality it causes the gear harming on the way that it happens the whole generation of the firm will be influenced lastly it makes different financial misfortunes to the worry and the influence suppliers. Subsequently it is important to keep up power usage and transmission frameworks to keep up a strategic distance from the monetary lose.

The accompanying issues are, such as, Active power/Frequency, Reactive power/Voltage control, Fault ride through capacity, planning/determining, glint, swells, droops and voltage asymmetries [1],[2],[3],[4] in a power framework. The adjustment power electronic segments controls the vitality framework and makes impedance to the electrical sign referred to as power quality aggravation, such as, recurrence, Harmonics and so forth., THD of the framework is likewise talked about from the network associated RES by utilizing inverter topologies [5] with various burdens [6] and it diminished [7].

Dynamic Power Filters (APF) is widely used to remunerate the present harmonics, voltage harmonics and load unbalance for network associated sunlight based PV framework. This work was completed utilizing MATLAB/SIMULINK [8], [9], [10], [11]. A Single Phase Single Stage Power Factor Corrected (SSPFC) AC/DC converter that controls variable yield voltage for shut circle framework [12], [13]. Voltage droops; X/R proposition of transmission lines is broke down amid the flaw condition. The yield was checked by PSCAD/EMTDC [14].

The PFC based dynamic channel ways to deal with enhance circuit quality and exchanging misfortune in transformers [15]. An assistant twisting coupled to the transformer of a course dc/dc fly back converter. It enhances the power component and the outcome was confirmed with Resistive burden with the help of MATLAB programming [16].

It exhibits a diagram of matrix reconciliation issues and vitality administration systems of smaller scale frameworks [17]. The effect of static voltage strength and element VAR positions on voltage harmonics of the PV incorporated sub-transmission framework was talked about. What's more, the examination investigation of STATCOM and SVC were talked about. The yield was abridged in utility networks. [18], [19], [20], [21].

A distance procedure was created to figure unique power consider and to find the required limit of capacitor banks in it [22]. The voltage variance and symphonies mutilation was minimized to execute PI controller in wind vitality framework [23]. Shut circle fluffy rationale control framework is used to enhance the present unbalance, load current harmonics and burden receptive power interest for lattice associated RES [24],[25]. STATCOM with two battery vitality stockpiling framework is relieve the power quality issues at the purpose of basic coupling for matrix associated wind vitality framework according to the IEC-61400 standards [26],[27],[28].

The adjustment of different hardware gadgets and controlling gadgets, how it influences the power quality and the various types of issues was talked about, financial misfortunes, gear misfortune etc.,[29] it diminishes the THD in a PV with DG frameworks utilizing fluffy PI controllers [30] and it decreases the voltage glint and influence components lessening [31].

The mix of PV, wind turbine framework, energy components and battery power era framework was utilized to take care of the power demand, along these lines enhancing the power quality [32] the survey work is found with the current PQ changes [33],[34].The difficulties and open doors was examined especially in India and it recommends methodologies for the developments of power generation and [35] to execute the FACTS gadgets will enhance the PQ in miniaturized scale lattices [36].It depicts about the audit of interconnection issues in wind power with electric power frameworks and half and half power framework [37].PI controller based power quality (PQ) ware discussed in sun powered network associated PV framework and wind power issues was talked about [38], [39], [40] The yield was checked with the help of MATLAB/Simulink. These finishes up the majority of the specialists ware engaged power quality change in Wind power-diesel power, Solar power – Wind power, Solar power – Diesel power and so forth.,

This article concentrates on the Power quality examination of Biomass Gasifier – Solar PV System by utilizing Inductive burden as a Non Edible Jatropha Seed Cakes.

Explanation of the Issue:

In India, a large portion of the inside towns can't benefit power office. Certain arrangement of individuals gets electrical vitality effortlessly and appreciates it and in the meantime another arrangement of people groups won't get and the locales are in pieces outs. In view of the various types of regular energizes accessible power era prerequisite could be accomplished. On the off chance that the different mix of power era, the half breed power framework was actualized the power quality issues will decrease. To defeat this and to diminish the piece outs, it is key to produce electrical vitality relying on the regular powers and the power quality examination was required to decrease the square outs and to build the electric vitality buyers. This exploration

article concentrates on the power quality examination of a mixture Biomass Gasifier – Solar PV framework toward the end of Biomass Gasifier for Non-Edible Jatropha Seed cakes with the help of Resistive Loads and Inductive Loads and the power component is repaid by utilizing variable capacitor with the help of MATLAB.

Solar Based PV System:

Figure – 1 demonstrates the proposed technique for the examination work. The potential accessibility of sun based vitality is high and it is accessible at any part of the country. The cost of essential fuel is likewise less. The majority of inquiries are amassing in the errand to get most extreme power from the sun oriented vitality. Subsequently the exploration investigation manages the sun based PV System as a perfect wellspring of vitality.

Proposed Technique:

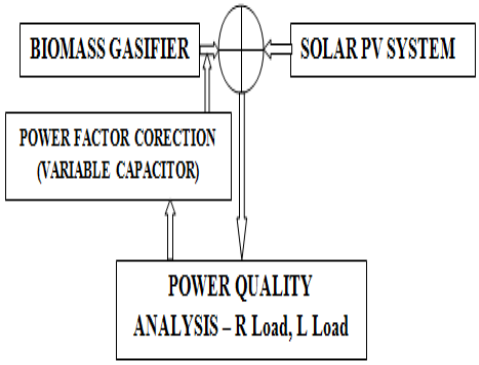


Figure 1: Block outline for Proposed Framework

Biomass Gasifier:

It is not another vitality framework. There are confirmations that it is used amid the Second World War. After the advances of fossil powers it is not utilized further. At present the rotting of fossil powers brought about the need of interchange vitality, the vitality division concentrates on different sorts of renewable vitality source to take care of the vitality demand. Biomass Gasifier is one of the promising strategies to meet this. The fractional ignition of powers creates gas. The maker gas could be used either as a part of warm application or power era. By and large it could be arranged into different sorts, few of them UP draft Gasifier, down draft Gasifier, and so forth; down draft Gasifier is used to check the power quality. Figure – 2 demonstrates that the created convenient 2 kW biomass Gasifier.

Gasification is a procedure that believers natural or fossil fuel based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide. This was accomplished by responding the material at high temperatures (>700 °C), without burning, with a controlled measure of oxygen and/or steam.

It is accomplish by utilizing different ways such as, Drying, Pyrolysis, Oxidation, and Reduction.

Drying: The seed cake is warmed and dried at the highest point of the Gasifier unit. Dampness contained in the seed cake was expelled in this area to a level underneath 20%.

Pyrolysis: The dried seed cake enters the second zone. The vaporous items from de-volatilization is in a part of blazed with the current air. This procedure named as Pyrolysis.

Oxidation: The yield from the Pyrolysis zone responds with the burn without oxygen at the temperature around 800-900oC.

Reduction: From this zone the CO_2 and H_2O respond with the carbon in the scorch which causes these gasses to decrease to CO, H_2 and CH_4 deserting the minerals of the singe as slag. At that point the maker gas exist the reactor ordinarily in the scope of 200 – 300^oC.

Figure 2: Fabricated 2kW Biomass Gasifier

Working Technique:

To do the power quality investigation it includes different ways such as

(I) Fuel Arrangement: The oil extricated Jatropha seed cakes was gathered from the oil plants. The seed cakes are having 10 % to 12 % oil content. This oil substance will make disintegration and consumption issue. Before use it to be dried for common drying procedure or utilizing dryer. To lessen the dampness content it could be used to nourish as a fuel to the Gasifier.

(ii) Gasification: After the drying procedure the seed cakes ware bolstered into the Gasifier for terminating process. All the while exchanged on the blower, the blower sucks the different blends of gasses with fine clean particles.

(iii) Filtering Unit: After the gasification procedure the gasses will enter the separating unit. This unit is used to evacuate the dust particles and the undesirable gasses.

(iv) Analyzer: The producer gas enters in to the analyzer. The analyzer analysis various combination of gases such as CO, CO_2, C_nH_m,

Table 1: CHNS Analysis

Weight: 5.5690 mg

(Instrument: Elementar Vario EL III- Germany)

Si.No	Parameter	Content in %
01	C	42.39
02	H	19.33
03	N	4.311

Conversion Efficiency (n_c):

The following equation is used to determine the conversion efficiency (n_c) of the gasifier.

$$n_c = \frac{\text{Gas flow X GCV of gas}}{\text{Feed rate X HHV of fuel}} \text{ X } 100$$

Where: Gas flow - Nm^3/h

GCV - Kj/kg

Feed rate - Kg/h

HHV - KJ/kg

Calculated conversion efficiency of Jatropha seed cake shown in below table 2.

Table 2: Conversion Efficiency (n_c)

Feed Rate	Gas flow	GCV of gas	HHV	n_c
4	16.4	2454	18200	55.4

5	118.2	2676	18200	53.51
6	20.7	2973	18200	67.22

The above table shows that the feed rate 4 -6 kh/h conversion efficiency of Jatropha seed cake was found 55.4 % to 67.22 % and it concludes that the maximum gas flow rate 20.7 Nm^3/h presents maximum efficiency.

Table 3: Various combination of producer gas produced by biomass gasifier

Note: Depending upon the moisture content the output will be change

Sl.No	Moisture (%)	CO	H_2	Producer Gas	CH_4
01	5	4.29	4.3	10.37	1.74
02	10	10.78	3.34	9.95	1.53
03	15	7.7	6.7	11.94	2.93

Table 4: Various zone Temperatures of producer gas produced by biomass gasifier

Sl.No	Moisture (%)	Temperature at Various Zones in ^0C		
		Oxidation	Oxidation	Oxidation
01	5	615	615	615
02	10	718	718	718
03	15	788	788	788
04	20	963	963	963

(i) Utilization:

Finally the producer gas is entered in to the generator. The generator generates electrical power and it can be utilized in various combinations of loads such as Resistive load, Inductive load, etc.

Experimental Study:

The Non edible Jatropha seed cakes are non-degradable material. It cannot be used to feed animals and it will not dehydrate. This seed cake was used to generate Thermal energy/ Electric energy and output is verified [41].

Figure – 3 Experimental set up for Power quality analysis of Inductive load with biomass gasifier

Load Test (Without Gasifier – R - Load):

Fuel – Petrol = 100%

Table 5 - Various output current/power depending upon the load.

Sl.No	Load =0.25 kW Voltage = 220V		Load =0.5 kW Voltage = 220V		Load =0.75 kW Voltage = 220V	
	I in Amps	Watt meter readings (watts)	I in Amps	Watt meter readings (watts)	I in Amps	Watt meter readings (watts)
1	2.4	110	2.5	225	5.4	335
2	2.3	110	2.5	225	5.4	335
3	2.3	110	2.5	225	5.5	335
4	2.3	110	2.4	225	5.4	335
5	2.3	110	2.4	225	5.4	335

Load Test (With Gasifier):

Fuel - Petrol=70 % Producer Gas = 30%. (Note: The fuel –Petrol consumption is find out with the help of Millage tester/ Fuel tester)

Table 6: Various output Current/Power depending upon the load.

Sl.No	Load = 0.25 kW Voltage = 220 V		Load = 0.5 kW Voltage = 220 V		Load = 0.75 kW Voltage = 220 V	
	I Amps	Watt Meter Reading	I Amps	Watt Meter Reading	I Amps	Watt Meter Reading
1	2.5	110	2.4	225	5.5	335
2	2.3	110	2.5	225	5.4	335
3	2.4	110	2.4	225	5.5	335
4	2.4	110	2.5	225	5.5	335
5	2.4	110	2.4	225	5.4	335

Load Test (Without Gasifier – L - Load):

Table - 7 shows that the various output current/power depending upon the load.

Voltage: 220 V

Sl.No	I in Amps	P in Watts
1	2.4	200
2	2.8	320
3	3.0	480
4	3.2	560
5	3.6	640
6	4.0	800
7	4.3	880

Model Calculation:

Using the general formula required capacity of the KVAR rating can be found.

Phase angle of the present power factor (P_{F1}),

$$P_{F1} = \text{Cos}^{-1} (P_{F1}) = \text{Cos}^{-1}(0.2 / 0.506)$$

$$P_{F1} = 66.72^0$$

Phase angle of the present power factor (PF2),

$$P_{F2} = \text{Cos}^{-1} (P_{F2}) = \text{Cos}^{-1}(0.98) = 11.47°$$

KVAR rating of the required capacitor

$$= P \times (\tan P_{F1} - \tan P_{F2})$$

$$= 0.2 \times ((\tan (66.72°) - \tan (11.47°))$$

$$= 0.424 \text{ KVAR}$$

Table 8: KVAR rating of the required capacitor

Sl.No	Actual Power in kW	PF1 In Degrees	PF2 In Degrees	Required Capacity - KVAR
01	0.2	66.72	11.47	0.424
02	0.32	55.84	11.47	0.406
03	0.48	47.01	11.47	0.417
04	0.56	43.34	11.47	0.414
05	0.64	40.04	11.47	0.407

Load Test (With Gasifier):

Fuel - Petrol=70 % Producer Gas = 30 %. (Note: The fuel –Petrol consumption is find out with the help of Millage tester/ Fuel tester)

Table 9: Various output Current/Power depending upon the load.

Voltage: 220 V

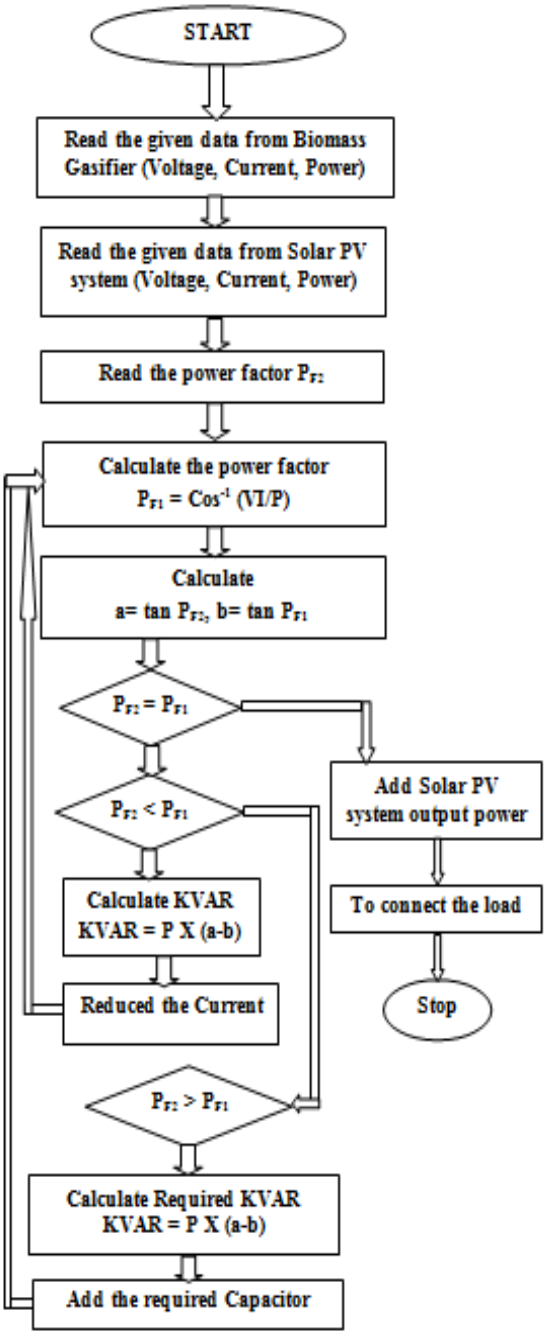
Sl.No	I in Amps	P in Watts
1	2.3	200
2	2.6	320
3	3.2	480

4	3.5	560
5	3.8	640
6	4.0	800
7	4.5	880

Table 10: KVAR rating of the required capacitor

Sl.No	Actual Power in kW	PF1 In Degrees	PF2 In Degrees	Required Capacity - KVAR
01	0.2	67.74	11.47	0.448
02	0.32	58.70	11.47	0.461
03	0.48	43.34	11.47	0.355
04	0.56	37.30	11.47	0.312
05	0.64	36.09	11.47	0.336

Flow Chart:



Algorithm:

- ✓ Read the given data from Biomass gasifier (Voltage (V), Current (I), Power (P)
- ✓ Read the given data from Solar PV system (Voltage (V), Current (I), Power (P)
- ✓ Read the Power factor P_{F2}
- ✓ Calculate the Power factor P_{F1}
- ✓ Calculatea=tan P_{F1}, b=tan P_{F2}
- ✓ if P_{F2}= P_{F1} add solar power and load and stop the program
- ✓ if not go to perform P_{F2}< P_{F1}
- ✓ if the condition is yes then calculate the required KVAR Rating=P X (a – b) and reduce the current(I) value of Biomass gasifier
- ✓ go to step (iv)
- ✓ else goes to P_{F2}> P_{F1} and calculate the required KVAR Rating=P X (a – b) and add the required capacitor after that goes to verify the step (iv)

Conclusion:

Considering the different parameters of Non Edible Jatropha seed cakes, CHNS investigation, Conversion Efficiency and Power quality And it is reasoned that the seed cake could be utilized for power era and the power quality is checked utilizing resistive and inductive burdens. The required remuneration of the capacitor between 0.336 KVAR – 0.448 KVAR toward the end of regular coupling point in biomass gasifier. Also, the power element was repaid with the assistance of variable capacitor by utilizing MATLAB programming. In future the exploration work reaches out to break down different issues in Hybrid framework (Biomass Gasifier – Solar PV power framework) and spotlights on the appropriate answer for enhance the power era of hybridization. The usage of Non Edible Seed Cakes is likewise being expanded.

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