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Performance Analysis of Electrolytic and Film Type Capacitor

Bavithra R, Abarna B
SMVEC, Madagadipet, Puducherry

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***Abstract*—This paper deals with the performance analysis of electrolytic and film capacitor in three phase inverter with focus of frequency aspect in ripple current. High capacitance density but low ripple current is produced in electrolytic capacitor alone in DC link of three phase inverter, which degrades the performance of life span of electrolytic capacitor. In order to overcome this problem, Hybrid connection type of capacitor bank is used in order to increase the life span of electrolytic capacitor. A film capacitor is connected parallel with electrolytic capacitor. Film capacitor has, low capacitance density, high ripple current and very reliable. From this combination, electrolytic capacitor has slow absorption of energy whereas film capacitor has absorption of high frequency harmonic. This combination makes longer life span for electrolytic capacitor. In meantime, it reduces the capacitance losses, heating and hotspot temperature rise in electrolytic capacitor. In this paper, analysis of film and electrolytic capacitor is done in MATLAB software and its results are compared.**

Keywords—Film Capacitor, Total Harmonic Display, Dc Link Capacitor, Ripple Current, MATLAB Electrolytic Capacitor

I. INTRODUCTION

More electronic equipment's are used in automobiles and wind mills .The inverter is used to convert the dc to ac. The inverter used for analysis here is pulse width modulation inverter. The voltage source inverter is a common element of power electronics for both wind and solar energy application. Inverter requires DC link capacitor [1], relay, NOT gate, IGBT and DC sourced link capacitor is connected between the IGBT and DC source. The inverter without capacitor will give the output with high frequency which is so degrade. The two capacitor namely film and electrolytic capacitor which offer the dramatically change in the output and increase the lifetime. The analysis of film and Electrolytic capacitor separately and together connected with inverter then the variation of frequency is discussed below.

II. FILM CAPACITOR

Power film capacitors are electrical capacitors with an insulating plastic film as dielectrics, sometimes combined with paper as carrier of the electrodes. Film capacitors [2] with very high power ratings are used for applications in power system and electrical installations. Here film capacitors [2] inserted between the IGBT's and electrolytic bank. Film capacitor has high ripple current and low capacitance.

The advantages of the film capacitor are

- Polypropylene film capacitors can qualify for class 1 application.
- High rated voltages up to the range of KV possible.
- Much higher ripple current, compared with electrolytic capacitors.
- High and very high surge current pulse possible.

III. ELECTROLYTIC CAPACITOR

An electrolytic capacitor is a capacitor that uses an electrolyte as one of its plates to achieve a larger capacitance per unit volume than other types. An electrolytic capacitor will generally have higher leakage current than a comparable capacitor, may have significant limitations in its operating temperature range, parasitic resistance, inductance and the stability and accuracy of its capacitance value. Electrolytic capacitor has low ripple current and high capacitance. Two types of electrolytic capacitors are: aluminum and tantalum.

IV. DESCRIPTION

A. *Circuit analysis*

Using the matlab, the circuit model was developed with capacitor and without capacitor, and then the frequency is analyzed.

B. *Without capacitor*

Voltage source inverter is not connected with capacitor (see fig 1).The analysis of the frequency is done. DC voltage source is connected between insulated gate bipolar transistor and voltage, current measurement.

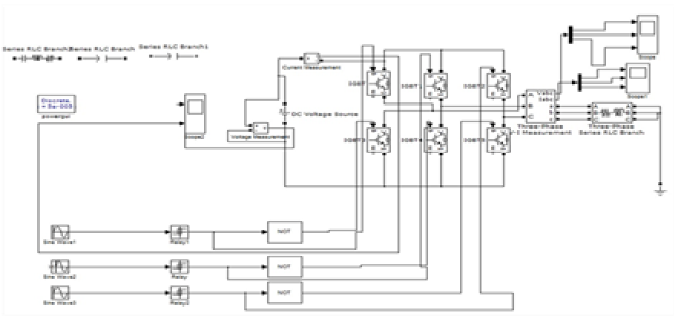

Fig.1. Inverter topology without capacitor

Then the output of the inverter which is not connected with capacitor is very high frequency (see fig 2). Consider 5 cycles, the total harmonic display in output of without capacitor is 2561.23% which is very high.

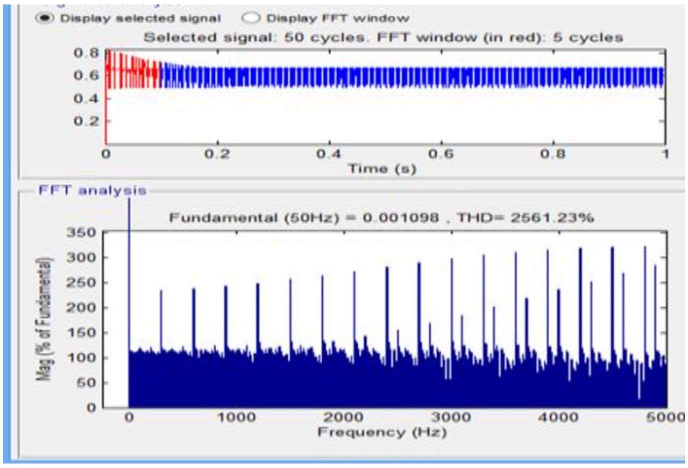

Fig 2. Frequency output of without capacitor

C. *With electrolytic capacitor*

Fig 3: Hybrid DC link capacitor bank

The voltage source inverter is connected with the electrolytic capacitor. The ripple current ratings for electrolytic capacitor [9] are typically defined at 120 Hz. The output of electrolytic capacitor (see.fig.4) so, that ripple current offer the high frequency spectrum. When frequency is increases then life time of electronics which is used is decreases frequency spectrum.

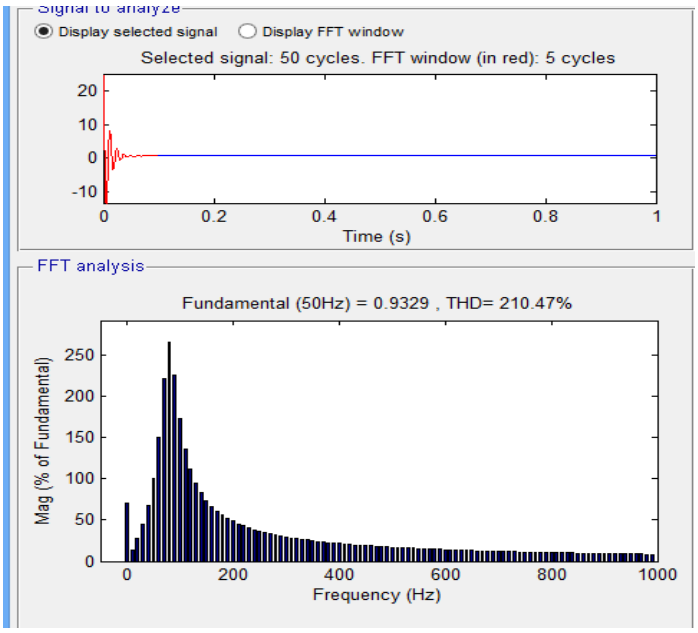

Fig 4: Output frequency of electrolytic capacitor

D. *With both electrolytic and film capacitor:*

In order to optimize the problem, the hybrid capacitor [8] (i.e.) combination of the film and electrolytic capacitor) is used. The detailed matlab model was developed (see fig.7) using microcap [5].

The output was shown below (see fig.6) with reduction in ripple current and reduction in the frequency. The total harmonic display is reduced to 194.24% which is very low when compared to the both.

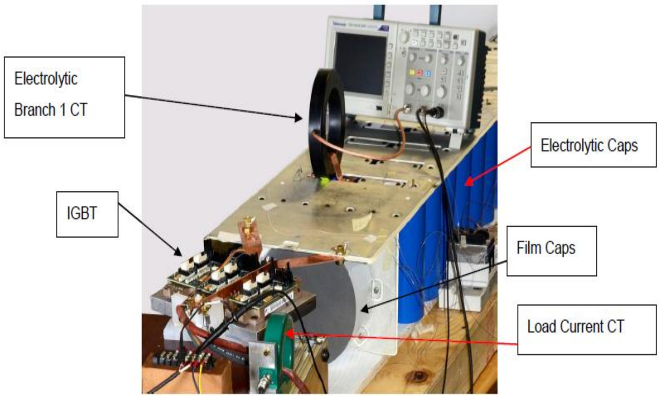

Fig 5: Hybrid DC link capacitor prototype bench testing configuration.

Fig.5 shows Hybrid DC link capacitor prototype bench testing. It is performed to determine the current pull from the electrolytic capacitor.

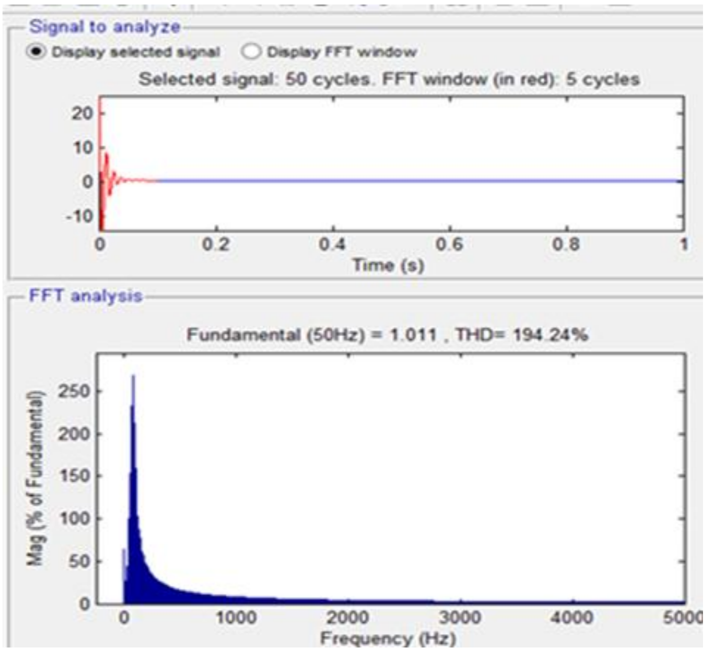

Fig 6: The output frequency of with electrolytic and film capacitor

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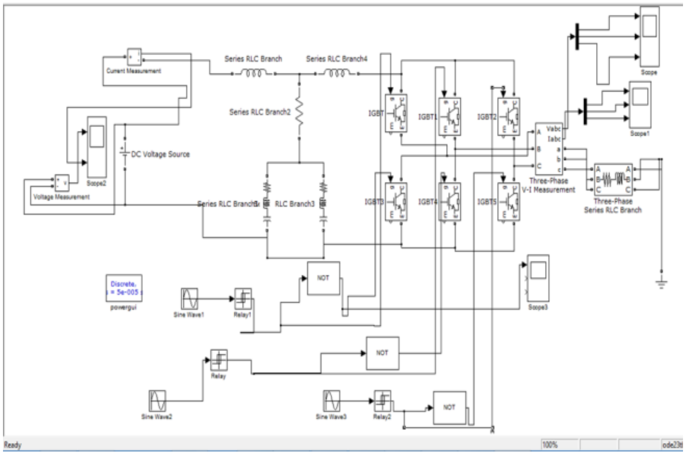

Fig 7: Inverter topology with electrolytic and film capacitor

V. RESULT

The addition of 2mF film capacitor to a 39.9mF electrolytic bank has a significant effect.

Power dissipated in the electrolytic bank is reduced

VI. CONCLUSION

The output of electrolytic capacitor frequency is high when compared the output of the hybrid film/electrolytic capacitor. A hybrid capacitor can reduce the harmonic frequency of the electrolytic banks in wind and solar inverter application.

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