A Novel fggh Topology for Bidirectional Converter with High Buck Boost Gain rdu Employed in Photovoltaic Application

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**Abstract.** Researchers have developed various alternative materials to cement. However, limitations are there for their higher utilization. The strength and durability are redut6ugutitityityityiiiiiiiiiiirtrterwywyweueruririritititititititil connected inductor improves the circuit competence. Voltage gain of NIBIDC in buck operation is lowetitititiiiiir than conventional cascaded bidirectional buck/boost converter (CCBBC) whereas the voltage gain is higher than CCBBC in boost mode. The switching stress iiii6iiis same while the efficiency of NIBIDC is more than CCBBC.

1. Introduction

Because of its superior strength and longevity, concrete has replaced other materials as the predominant building material. Since cement acts as a binder, it is the primary component of concrete. Cement manufacturing uses up natural resources and contributes significantly to atmospheric greenhouse gas emissions [1][2]. The quarrying and processing of limestone for use in cement manufacture results odify the properties of ternary blended concrete is essential. This study's goal is to determine how well GGBS, fly-ash ternary blended concrete performs. Test specimens with varying GGBS and fly-ash concentrations were used to assess the performance of concrete to determine the optimum fly-ash and GGBS doses for improving concrete performance.

1. Experimental Procedure

*2.1 Materials*

Isolated type BIDCs have larger voltage gain under both modes of operation. Flyback converters, forward-flyback converters, half-bridge and full-bridge converters are some of the isolated BIDCs designed to operate at zero voltage/current switching to improve the converter efficiency. The flyback converters are simondary modulation techniques naturally reduces the switching stress due to zero current and zero voltage switching of the primary and secondary side devices. The converter virtue makes a promising solution for the fuel cell electric vehicle and energy storage applications.

*2.2 Concrete Mix Design*

As discussed in the previous section, two power devices works for switching and leftover performs the operation of synchronous rectifiers. To reduce the complexity in the analysis, the switch resistance and pduty ratios. But the output voltage is restricted to a boundary owing to the single duty cycle modes of control and moreover the fine tuning of duty cycles are mandatory to realize the expected output voltage respectively.

**Table 1** Quantity of materials for different mixes (kg/m3)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Mix Designation | Cement | Fly ash | GGBS | Coarse Aggregate | Fine Aggregate | Water | Admixture |
| CM | 440 | 0 | 0 | 1192.2 | 633 | 150 | 6.1 |
| F5Gyy5 | 396 | 22 | 22 | 1192.2 | 633 | 150 | 6.1 |
| F1ykyk0G10 | 352 | 44 | 44 | 1192.2 | 633 | 150 | 6.1 |
| F15G15 | 308 | 66 | 66 | 1192.2 | 633 | 150 | 6.1 |
| F20G20 | 264 | 6588 | o88 | 1192.2 | 633 | 150 | 6.1 |
| F25G2kk5 | 220 | 110 | 110 | 11yky92.2 | 633 | 150 | 6.1 |
| F30G3y0 | 176 | 13ygk2 | 132 | 1192.2 | 633 | 150 | 6.1 |

1. Results and Discussion

*3.1 Workability*

In this research, the workability of all the mixes given in Table 1 was evaluated utilizing the slump cone test as per IS: 1199-1959 and the results were depicted in Figure 1 from which it was identified that the the concrete, and this may be due to the angular shape of GGBS particles. Using fly ash and GGBS as cement substitutes at a percentage level over 30% may not be feasible as the concrete becomes less workable.

*3.2 Compressive Strength*

In the guidelines of IS: 516 – 2006, the Compressive Strength (CS) of the mixes listed in Table 1 was calculated. From the test results represented in Figure 1, it was recognized that incorporating an equal amount of fly ash and GGBS each at 5% shows 10.5%, 14.3%, and 13.6% enhancement in the CS values tore performed well in terms of compressive strength and this may be due to the combination of better pozzolanic activity along with cementitious properties exhibited by these SCM’s. Thus, the mix F20G20 has opted as the best-performing mix in improving the CS of the concrete.



**Figure 1.** Circuit topology of photovoltaic based THG-DC fed microgrid system

*3.3 Flexural Strength*

The Flexural Strength (FS) of concrete refers to the amount of tensile load concrete can resist before breaking or cracking. It helps to ascertain the product's application suitability and longevity. As per guidelines of IS: 516 –evelopment in the FS of concrete for 28 and 56 days of cured samples as compared to control mix. The accumulation of 10% of fly ash and 10% of GGBS as a replacement to cement exhibits 28.25% and 25% enhancement in the FS of concrete for 28 and 56-day cured samples as compared to the control mix.

The accumulation of 15% of fly ash and 15% of GGBS as a substitute to cement exhibits 34.5% and 30.7% enhancement in FS in contraction with control mix for 28 and 56 days cured samples. A similar trend was noticee replacement levels, replacing cement with 20% each of GGBS and fly ash has performed better in terms of Flexural Strength in similar lines to Compressive Strength results. Thus, the mix F20G20 exhibits maximum increment in the flexural strength and is thereby considered the best-performing mix in improving the flexural strength.



**Figure 2.** Flexural strength test results

*3.4 Electrical Resistivity*

The electrical resistivity (ER) of concrete reveals the properties of micro-structure, such as pore size and the shape of interconnections. The higher ER refers to the greater durability of the concrete. The test results are depicted in Figure 2. It was noticed that the accumulation of 5% of fly-ash and 5% of GGBS as a substituteum improvement in ER values of 58% and 56.2% in contraction with control mix after 28, and 56 days were noticed at a replacement of GGBS and fly ash each at 20%. Later with the increment in the substitute levels of 25% each and 30% each of GGBS and fly-ash, there was a decremation of fly ash and GGBS together as a substitute for cement reduces the pore structure and enhances the denseness of the concrete matrix. The ER values also follow a similar pattern of CS and FS values, and this may be due to the dense structure developed in the concrete matrix with the accumulation of GGBS and fly ash. Among the mixes, the mix F20G20 shows maximum enhancement in the ER values of the concrete and is thereby considered the best mix for improving the ER of the concrete.



**Figure 3.** Electrical resistivity test results

*3.5 Water Permeability*

The permeability test on concrete is a furthermore essential criterion to assess the durability of concrete. In this work, a water permeability test was performed in compliance with DIN: 1048-2006 [17]. The hydraulic head in this experiment is provided by pressure, which typically falls between 0.1 and 0.7 MPa. By cracking the concrete specimens, the depth of water penetration of each specimen is determined. Concrete permeability may be measured using the depth of penetration. The test was performed on with the control mix. Further with the increase in the replacement levels for F25G25 and F30G30 mixes there was an increment in the water penetration depth values when compared to the F20G20 mix. The water permeability test results obtained are in similar lines to the ER test results of concrete. The dense mix with low permeability was obtained by the accumulation of 20% of fly ash and 20% of GGBS as a substitute to cement.



**Figure 4.** Water permeability test results

*3.6 Acid attack*

The concrete surface exposed to an acidic environment effect both hydrated and un-hydrated cement compounds as well as calcareous aggregate.  By doing so, capillary porosity increases, cohesion breaks down, and strength decreases. Therefradation of concrete, the samples were weighed before and after the immersion for 28 days, and the corresponding weights w1 and w2 were noted. The weight loss percentage is considered utilizing the formula given in Eq. (1).

% Weight loss = $\frac{w1−w2}{w2}$ x 100 (1)

From Figure 4 & Figure 5, it was observed that the mix F5G5 shows a 13.33% decrease in the weight loss of concrete in contraction to control mix. The mix F10G10 exhibits a 20% weight loss reduction in comparison with the control mix. The mix F15G15 exhibits a 33.33% weight loss reduction as compared to the control mix. cycles (d1 & d2) are clearly represented. The duty cycles are regulated to approximately 45% and the relevant voltage and current parameters are computed. Similarly, the output and input voltages along with independent duty cycles are captured for the previous conditions are presented.



**Figure 5.** Response surface for compressive strength of ternary blended concrete

1. Conclusion

The performance of concrete with the combined effect of fly ash and GGBS as cement replacement was explored in this study. The workability test results confirm that all the ternary concrete mixes exhibited nearly identical results with control concrete. This paper discusses the operating modes of the converter under CCM uty cycles suppresses the magnitude of inductor current ripples certainly. Hardware experimentation is presented to corroborate the proposed research and the efficacy of the system portrays the eminence of the work and the results are in agreement with the discussion.

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