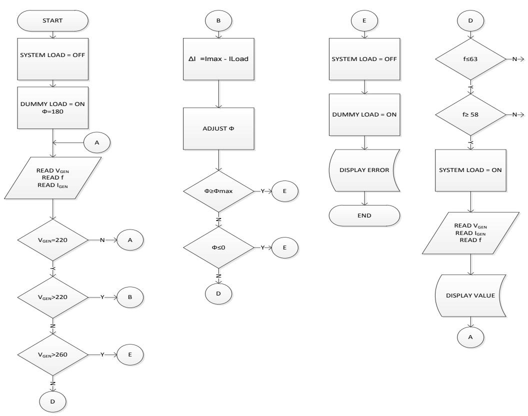
Studies on Design, Construction, and Testing of Microcontroller-Based Electronic Load Controller for Micro-Hydro System and Design and Performance Evaluation of a Jack-Driven Briquetting Machine for Briquette Production

MICROCONTROLLER-BASED ELECTRONIC LOAD CONTROLLER FOR MICRO-HYDRO SYSTEM

The design, construction and testing of micro controller-based Electronic Load Controller for micro-hydro system was undertaken to address the need of the CPU AREC for the installation of new microhydro projects or replacement of the installed analog controller. In addition, this system was developed to address the problem on troubleshooting and maintenance. It specifically aims to design an ELC system for a single phase, 60 Hz, 220V synchronous generator. The study includes the design, construction and testing of sensing and triggering circuits for the ELC. A program was created using Arduino platform which will manage the electronic load controller to function as signal processing, zero crossing detector, analog to digital converter (ADC), and pulse width modulator (PWM). The testing and evaluation for performance of the electronic load controller was based on the following parameters: system voltage, system frequency, system response and the testing of effectiveness for the over voltage, under voltage, over frequency, under frequency and over current protection incorporated in an ELC. For the period of the testing phase it was found out that for the voltage sensing circuit, the highest difference was 0.42 % and the lowest was 0.04 % with a linear response at



the range of 180V to 250V. For the current sensing circuit, it has a non-linear response with an average error of 4.29 %, which is in relatively high, but acceptable for this application. During the final testing, the source voltage was varied from with-in the specified range of 190 to 240 Vac, the normal circuit response. However, when the voltage was outside this value, the controller reacted according to the current conditions; When the voltage was greater than 240 Vac, the controller enabled the dummy load and dump off portion of the load current. When the voltage was below 190 Vac, the load will automatically cut off to protect the load from under voltage. Based on the data of the final testing and evaluation, the performance of the system was acceptable, working normally and meeting the required specifications.

The design and development of a microcontroller-based Electronic Load Controller for micro-hydro systems was successfully completed with the best circuit options used in the system. The design of the system components is for single phase, 60 Hz, 220 Vac ELC for synchronous generator. The design, construction and testing of the sensing and triggering circuits of the ELC was successfully undertaken. The coding and downloading of the microcontroller program was also a success. The system was successfully assembled and the final testing of the circuit and system was done with an error of 4.29% maximum for the voltage ranges from 180 Vac –to – 250 Vac. The system response to the given variations of parameters, reacted according to the specified conditions, meeting the required parameters and ready for use.

For the circuit and systems to become more reliable and not sensitive to external noise from the environment, the circuit boards must be properly shielded and grounding to the earth is necessary. All circuits must be constructed in a single board to avoid excessive connections and wiring. It is recommended that the controller should be installed in a dry and safe area to avoid damage to the component and avoid electric shock. Furthermore, it is also recommended that the controller maintenance should be done at least once a year to ensure reliability of the system. Installation of redundancy in the system is also recommended to compensate for system failure and increase the reliability of the system. Data logging and telemetering options can also be incorporated to the design for remote monitoring. It is recommended also that optimization of this ELC must be done to further improve the control system of the controller. Prior to the actual implementation of the design, a model system for ELC must be created for the development and further improvement of the design.

(Source: Design, Construction, and Testing of Microprocessors -Based Electronic Load Controller for Micro-Hydro System by Caesar Rico S. Acanto and Ramon A. Alguidano, Jr.; completed September 2016)

DESIGN AND PERFORMANCE EVALUATION OF A JACK-DRIVEN BRIQUETTING MACHINE FOR BRIQUETTE PRODUCTION

The machine can produce 200 to 239 pieces of briquettes per hour; however, this indicated a no significant difference (P>0.05) when it was evaluated using the three recommended mixtures. When production rate was analyzed in terms of weight of fuels produced per hour, statistically (P<0.01) more Briquette 3 were produced at 4.56 kg/hr followed by Briquettes 2 and 1 at 3.98 and 3.30 kg/hr, respectively.

The 15-day actual field production test performed by

identified members of UCLA using the same mixtures exhibited an average production rate per day of 105 to 149 briquettes (1.68 to 1.92 kg/hr). The analyzed data in pcs/hr confirmed the results of the laboratory testing where the number of briquettes produced had no significant difference data obtained had no significant difference among the different materials used.

The jack-driven type briquetting machine produced cylindrical briquettes with a hole, the weight of which ranged from 16 to 21 g per briquette. The briquettes produced had an average bulk density of 0.45 g/cc (446

kg/m^3) improving it by 246% when compared to using the previously developed hand-press briquette molder. The heating values of the produced briquettes ranged from 5,800 to 7,100 Btu/lb. The paper and sawdust combination obtained the highest value (7,153 Btu/lb) while briquettes mixed with CRH had the lowest heating value at 5,872 Btu/lb.

Results of the proximate analysis in terms of ash yield revealed that briquettes mixed with rice husk (in carbonized form) contained higher ash at 31% and, thus, have much ash-forming elements than most of forestry biomass like sawdust. The use of a hydraulic jack in compressing briquettes and the presence of many holes on the side of the molders resulted in briquettes with lower moisture at 5.6 to 7.1%.

Ultimate analysis in terms of H content in the three briquettes produced ranged from 4.8 to 5.9% with Briquette 2 having the highest. All three types of briquettes produced N of less than 0.1% of its dry matter weight. The value obtained for S ranged from 0.028 to 0.036% of the dry matter weight.

Briquettes 1 and 2 boiled 2 li of water significantly the fastest ($P<0.01$) at 12.5 min followed by Briquette 3 and Charcoal at 16 min and 19 min, respectively. In cooking 750 g of rice, Briquette 1 exhibited significantly ($P<0.01$) the fastest cooking time at 19 min followed both by Briquettes 2 and 3 at 23 min and Charcoal at 25 min.

The development and fabrication of the jack-driven briquetting machine and the production of briquettes have high positive response (93.1%) as to its usefulness as substitute fuel for cooking when it was surveyed for product acceptance by the waste reclaimers found at the Calajunan Disposal Facility.

The results of the survey also indicated that 81% of the respondents are willing to buy them as cooking fuel in their respective households. Briquette 1 generated the highest operating cost per hour at Php25.46 due to the additional expense on longer pulping operations for paper. Briquettes 2 and 3 incurred the same expense at Php23.91 per hour of operation. More earnings may be earned per day from Briquette 3 at Php355.92 followed by Briquettes 2 at Php286.32 and Briquette 1 at Php192.32.

(Source: Technical and Economic Evaluation of the Designed Jack-Driven Briquetting Machine by Aries Roda D. Romallosa; completed October 2014)

University Research Center
Central Philippine University
5000 Jaro, Iloilo City
Philippines
http://www.cpu.edu.ph
E-Mail: urc@cpu.edu.ph

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