Abstract

This work is aimed at studying and developing laboratory level high frequency power inverter for ohmic heating of liquid food materials. There are large amount of salts or organic acids as electrolyte in liquid food conducting materials like green coconut water, orange juice, sugar cane juice etc. If the electric current passes through these liquid foods, electrical energy will be changed into heating energy by using the electrical conductivity of liquid food conducting materials, which is called ohmic heating. Ohmic heating overcomes the deficiency of traditional heating as it realizes material heating without temperature gradient, and the purpose of uniform heating throughout is achieved directly. It has started with details basic of electronics for operation and development of the inverters with the help of design calculation, operating graphs, data sheets of the component in detail. The design of high frequency power inverters having variable frequency provision has been developed applying the various gate driver: two different types of power inverters, one is half bridge (H-bridge) and another is push-pull inverter using ferrite core. This power supply unit is designed along with the copy of the data sheet style. Driver circuit is also design using microcontroller (ATmega328P, 8-bit AVR) for push-pull inverters which offer significant advantages including higher precision.

It is mainly focused on studying corrosion of electrodes in liquid food after ohmic heating through laboratory experiments. Frequency of inverter and electrode materials has been identified for occurrence of the corrosion. Experiments have been carried out with different frequencies for which suitable inverter have been designed and developed. Electrodes of different materials have been experimented for the same. High frequency such as 20 kHz or more with suitable electrode material have been observed for eliminating the corrosion for some specific liquid materials. Therefore, in the future, this high frequency power inverter will be a promising ohmic heater to sterilize the liquid food conductor at ultra-high temperature in food processing industry. Finally modeling and simulation results and analysis at different frequencies are presented. The result obtained from the simulation model is compared with the experimental results where both the results match with a minor deviation.

This work also deals with the study of electrical conductivity of different liquid samples, including fruit juices. DC conductivity measurement was done using digital conductivity meter at different temperature (20-48°C) for different composition. Nature of the conductivity for all the composition (0.1% KCl, 1% & 2% NaCl solution with distilled water, Coconut water, Orange Juice, Sugar Cane Juice, etc.) looks like similar with respect to temperature. The variation of ac conductivity (σ_{ac}) with respect to frequency is similar in nature, though their values differ. DC conductivity values are also derived from measurements of AC conductivity in the range of 400 Hz–140 kHz frequency. Another way to see the conduction phenomenon is with a complex impedance map, in which the x and y axes stand for the complex impedances Z' and Z", respectively known as Cole-Cole plot.

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