

Brain Teaser Challenge

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Answer to the Last Challenge

It seems I am being transformed into a power guy. I hope someone discovers a cure before it is too late. "Your challenge this month, should you choose to accept it, is to explain why most of the harmonic energy you find on the power mains is in the odd harmonics of the fundamental?"

Derek Paice sent me a very nice answer to this BTC, so I am going to give you his response – "Rotating machines are generally symmetrical in the sense that negative half cycles have a similar shape wave to that of the positive half cycles. Mathematically

$$f(\omega t + \pi) = -f(\omega t).$$

In a Fourier analysis of a total waveform like this, expressions for individual harmonics of number n include a multiplier of $\sin(n \times \pi/2)$. If n is an even number this expression becomes zero, hence there are few even harmonics from generators.

Individual loads can draw even harmonics, but IEEE Std 519 guideline discourages use of loads causing even harmonics of current, by limiting their tolerable amount to 25% of the allowable odd harmonics." But I bet you already knew that.

This Month's Challenge

Sorry I missed a month with the BTC. My biggest vice is that I volunteer too much, and my volunteer work has been dominating my time. I guess this column is one of my volunteer jobs, now that I think about it. Anyway, some folks have asked me to mention that one of my big volunteer jobs is as the new international chair of the Humanitarian Technology Challenge, Reliable Electricity Committee. This project is sponsored by the United Nations Foundation and the IEEE. We are a large group of volunteer professionals and academicians who are dedicated to finding better ways to help people in need by the application of technology. These could be disaster victims or people who have never had infrastructure of any kind. Lighting, better food and water, communications, and better medical care are among our objectives.

I was recently asked about consulting on a project to collect deuterium from the ocean. We all know that deuterium is found in much higher concentrations in the sea than in the atmosphere. Perhaps the heavier molecules find it harder to make the transition from liquid to gas phase on the surface, so most of the evaporation is of the lighter isotopes. So the problem today is - how big a container do I need to hold 1 mole of H₂ at STP? Don't light a match.

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(<http://www.shadtechserv.com>) The names of correct respondents may be mentioned in the solution column.