Optimization of Photovoltaic Modules Power intake in Kenya

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ABSTRACT

Research and demonstration of photovoltaic technology for the growing needs in the industry and rural applications are inevitable. Small households are the users of small photovoltaic systems in Kenya. Most installations are solar modules on non-tracking stationary mode. In our equatorial lands the optional installation should be horizontal, but this excludes modules self-cleaning. Several measurements have been made to illuminate the related problems and to optimize the power intake. The modules showed a decrease in the efficiency under hot and dry conditions, and the performance tended to agree with the nominal operating cell temperatures at relatively cooler conditions. Variations of the modules tilt angles produced a decrease in the open circuit voltage and short circuit current of about 2-7% and 4-15% respectively on a given day of data acquisition. Besides, modules registered an output power decrease of less than 12% for 0°, 5°, 10°, 15°, 20° tilt angles while the 25° and 30° had a decrease of 17% and 23% respectively after three months of out-door testing under dusty conditions. Optical measurements of dusty glass samples showed only a small deviation of about 5% for the lower angles of incidence while at higher angles(greater than 20°), the effect of scattering became pronounced. The near-normal hemispherical spectral total transmittance and reflectance for most samples were 89% and 10% respectively while the amount absorbed was roughly 1%. The results obtained from this research therefore, favour the optimum range of tilt angles of 15-20° for regions in Kenya, either facing south or north depending on the installation position relative to the equator. This range allows the modules self-cleaning by rain and wind, while at the same time allowing them to operate at slightly below their rated power output especially during hot seasons.