DESIGN, CONSTRUCTION AND PERFORMANCE EVALUATION OF A SOLAR KILN FOR WOOD SEASONING
ABSTRACT

Design, construction and performance evaluation of a mixed-mode solar kiln for timber seasoning incorporated with pebble bed in a tropical setting was carried out at Nsukka, Nigeria. The solar kiln consists of a heat storage unit, a solar collector and a drying chamber. The walls of the drying chamber are built with 1.27cm plywood of internal dimension; 76.6cm x 60.2cm x 61.2cm, while the roof is made of transparent glass that allow direct solar radiations into the chamber. The heat storage unit which is an integral part of the solar collector made of galvanized metal sheet and area 0.54m², has black painted pebble bed which also serves as the solar absorber for the system. The performance evaluation of the solar kiln involved periodic testing for moisture content of the wood (Prosopis africana) and measurement of physical parameters like temperature, relative humidity and wind speed. The unloaded kiln, loaded kiln and open air drying (control) were evaluated to ascertain the efficiency of the drying system within diurnal variations. The results of the performance evaluation showed that the solar kiln could attain temperature and mean relative humidity range of 61.7°C and 45.7% while the average ambient conditions are 27.5°C and 69.8% respectively. Further test showed that timbers with initial moisture content of 66.3% were reduced to final moisture content of 12.9% for kiln dried timber while the open air dried timber were reduced to 20.1% in 15 days. It also revealed that initial drying rates for both kiln dried wood and control, were 0.21% per day and 0.56% per day and final drying rate were 0.15% per day and 0.08% per day respectively. The entire processes were repeated to obtain an average result of the timber moisture contents which was subjected to a simple T-test analysis. The effect(s) of the physical parameters (temperature, relative humidity, wind speed and insolation) were shown. The result at 0.05% probability level showed high significant difference between the final moisture content of wood dried using the solar kiln when compared with the final moisture content of open air dried wood.