

Poly Carbonate Roof Chamber : A fuel saving device in FCV tobacco curing through solar energy harvesting

Complete Details of Technology:

Tobacco, the golden leaf is one among the leading commercial crops in India with a cultivated area of 0.47 million ha, producing 800 million kg annually. Of the total tobacco production, the Flue-cured Virginia (FCV) tobacco is grown in 1.5 lakh hectares and accounts for about 30% (240 m kg) of total tobacco production. Post-harvest drying of FCV tobacco leaves is done through a process of flue curing in a specially constructed structures called 'Barns' under controlled conditions by regulating the temperature and humidity to obtain desired leaf quality. Annually for FCV tobacco curing a total quantity of 1.0 million kg wood is consumed that results in deforestation and also represents a serious environmental issue. Exploiting solar energy use for tobacco curing is one of the options available to reduce dependency on fuel wood. A polycarbonate roof chamber as a solar energy collector was evaluated for three consecutive years (2016-2019) at CTRI Research farm Katheru to evaluate its efficacy in harnessing the solar energy as supplement to wood fuel for curing the FCV tobacco at CTRI Research farm Katheru.

Designed a roof top chamber of 2ft height with polycarbonate sheet (1.2mm thick) mounted on a iron frame over the existing curing barn (24'x16'x10.6') roof (PCRC) with metal sheet over the barn as an solar radiation absorber. A provision for air circulation was made through a duct from the barn top. The tin sheet surface of the barn was painted with black colour for increasing the absorption efficiency of solar radiation. Curing barn with PCRC was compared with traditional curing barn with wood exclusively as a fuel for curing FCV tobacco. Fixing PCRB on the barn resulted in a temperature rise of 86⁰F inside the barn due to trapping the solar radiation through greenhouse effect.

A consistent raise in temperature was recorded in upper tiers inside poly carbonate roof barn compared to conventional barn. The temperatures of Tin sheet on the top of curing barn ranged from 117-125⁰F in the traditional barn and in PCRC barn 134-155⁰F because of which the leaf temperatures maintained inside the PCRB were high (96-131⁰F) during the curing process compared to traditional barn (90-127⁰F) which hastened the curing process there by reduced the wood fuel consumption. Physical and chemical (nicotine, reducing sugars, chlorides) and biochemical (starch, rutin and chlorogenic acid) parameters in cured leaf remained unchanged due to the polycarbonate roof chamber over the barn.

Wood consumption per one kg cured leaf was 3.13-3.99 kg with poly carbonate roof barn against 4.39 - 5.66 kg in traditional barn. About 22-29% wood was saved due to harnessing the solar energy by the polycarbonate roof chamber compared to traditional barn.

Brief Description of Technology Including Salient Features:

Polycarbonate roof chamber as a solar energy collector was evaluated for three consecutive years (2016-2019) at CTRI Research farm Katheru to evaluate its efficacy in harnessing the solar energy as supplement to wood fuel for curing the FCV tobacco at CTRI Research farm Katheru. Designed a roof top chamber of 2ft height with polycarbonate sheet (1.2mm thick) mounted on a iron frame over the existing curing barn (24'x16'x10.6') roof (PCRC) with metal sheet over the barn as an solar radiation absorber.

A provision for air circulation was made through a duct from the barn top. The tin sheet surface of the barn was painted with black colour for increasing the absorption efficiency of solar radiation. Fixing PCRB on the barn resulted in a temperature rise of 60°F inside the barn due to trapping the solar radiation through greenhouse effect. A consistent raise in temperature was recorded in upper tiers inside poly carbonate roof barn compared to conventional barn.

Physical and chemical (nicotine, reducing sugars, chlorides) and biochemical (starch, rutin and chlorogenic acid) parameters in cured leaf remained unchanged due to the polycarbonate roof chamber over the barn. Wood consumption per one kg cured leaf was 3.13-3.99 kg with poly carbonate roof barn against 4.39 - 5.66 kg in traditional barn. About 22-29% wood was saved due to harnessing the solar energy by the polycarbonate roof chamber compared to traditional barn.

Benefits/Utility

About 22-29 % wood fuel can be saved by harnessing the solar energy through polycarbonate roof chamber. Approximately 0.25 million tonnes of wood can be saved annually which reduces the deforestation to that extent. Farmer gets a additional benefit of Rs 4750/- per barn per year.