

Development and Assessment of Various Models of Solar Dryer for Drying of Coffee Cherries

S. MULATO

Indonesian Coffee and Cocoa Research Institute
Jl.PB.Sudirman No 90, JEMBER, EAST JAVA

SUMMARY

Despite remarkable increase of the domestic coffee production, several problems related to the coffee bean quality remain unsolved. Recently Indonesia produces approximately 600.000 tons and smallholders dominate 90% of this. Referring to the defect-based quality system, the quality of smallholders' coffee beans is considered very poor. Some survey reported that the drying was the key operation in the smallholders' coffee processing practice and was assumed as the major factor affecting the final coffee quality. Various models of solar dryer had therefore been developed and tested for the drying of coffee at the farmers' field using both solar and furnace as heating sources. The model varied from a small scale drying capacity of 500 kg coffee cherries till a large-scale solar dryer up to 5000 kg one. The small scale dryer essentially consisted of a flat plate air heating collector, a tunnel-like drying chamber and a small fan of 0.125 kW to provide the required airflow over the coffee cherries layer. Both the solar collector and the drying chamber were covered with a UV stabilized transparent plastic sheet. The average time required for drying fresh coffee cherries to the final moisture content of 12% was 76 to 80 hours, whilst at the same time, the moisture content of comparable samples dried in the traditional sun drying were only 35% (wb). The average daily solar radiation during the tests was about 2.50-3 kWh per m² resulting an average drying chamber temperature of 38-40°C. Firewood consumption for the additional heating during nighttime was 0.5 kg per kg-dried coffee. The medium scale dryer utilized a solar greenhouse model. A UV stabilized plastic sheet was used to cover the roof and sidewalls. The height of the house was 2.80 m. The available floor under the greenhouse was 6 m long and 3 m wide. A flat bed type dryer of 3 m x 2 m x 1 m was installed in the middle part of the floor. The dryer was equipped with a 0.4 kW exhaust blower. Test results with several depths of coffee bed had indicated that the highest drying efficiency was attained at 57% when the drying chamber was loaded with 1100 kg. This amount was equal to a 0.30 m deep bed of wet coffee cherries. The specific energy was 5.20 MJ per kg water evaporated. The average daily solar radiation was 3.50 kWh per m² producing an average drying chamber temperature of 38-40°C, and rH of 45%. The total drying time was 72 hours when the final moisture reached 11.20%. The large scale of solar coffee dryer was provided with a 144 m² solar collector incorporated on the roof of the drying building. A flat bed type dryer of 6 m x 3 m x 1 m was installed under the roof and the capacity was approximately 5000 kg of coffee cherries. The airflow of the hot air through the collector was 150-250 m³ per min and was generated by a 1.25 kW multiple-operated axial fans. The collector was able to heat the drying air up to 60°C and rH of 24% when the average solar radiation was 3.50 kWh per m². Burning of 55 kg wood per hr in the furnace during nighttime could maintain the drying air at a relatively stable temperature of 55-60°C and rH 25-30%. The total drying time was 48 hours when the final moisture reached 12% at a 0.30 m deep bed. The heat output of the furnace ranged from 55 to 70 kW at the combustion efficiency of 50 to 60%. The entire trials showed that the models of solar dryer performed sufficiently even during cloudy and rainy days. The mean quality of the coffee dried in the solar dryer was physically better than that of the sun drying samples. The

improvement of drying rate was able to lower the moisture content of the coffee cherries at the right time. As a result, the risk of spoilage and microbial infestation to the dried coffee beans could be reduced. The proper protection of the coffee cherries during the entire drying process could also avoid the contamination of the product against soil, insects and other undesirable materials. These combined factors contributed a significant improvement of the coffee bean quality as well as its uniformity and consistency.